INTERACTION OF NON-MEAT INGREDIENTS ON SENSORY CHARACTERISTICS AND CHEMICAL CHARACTERISTICS OF PORK LOIN CHOPS DURING VACUUM-PACKAGED REFRIGERATED STORAGE

A Thesis

by

TARA KATHRYN FORD

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2004

Major Subject: Food Science and Technology

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ABSTRACT

Interaction of Non-meat Ingredients on Sensory Characteristics and Chemical Characteristics of Pork Loin Chops during Vacuum-Packaged Refrigerated Storage. (August 2004)

Tara Kathryn Ford, B.S., Texas A&M University

Chair of Advisory Committee: Dr. Rhonda K. Miller

Fresh, boneless, vacuum-packaged pork loins were obtained from a commercial pork processor and used in a five-part study to examine the effects of sodium chloride (0, .125, .375, .75, 1.50%), sodium phosphates (0, .1, .2, .3 and .4%), sodium lactate (0, 1, 2, 3 and 4%), potassium lactate (0, 1, 2, 3 and 4%) and sodium diacetate (0, .05, .10, .15 and .20%) on the color, sensory characteristics, package purge, water holding capacity, and pH of pork chops stored in vacuum-packaging for 0, 7, 14, 21 and 28 days. The first experiment examined the effects of sodium chloride and sodium phosphates (Brifisol® 512, polyphosphate blend) in the aforemented attributes. The second experiment was designed like the first experiment except a different sodium phosphate (Brifisol® 85, polyphosphate and pyrophosphate blend) was used. In the third experiment, sodium chloride was standardized at .75% and sodium phosphate and sodium lactate differed. In the fourth experiment, sodium chloride was standardized at .75% and sodium phosphate and potassium lactate differed. In the fifth experiment, sodium chloride and potassium lactate were standardized at .75% and 2%, respectively, and sodium phosphate and sodium diacetate differed. Results from Experiments 1 and 2 indicated that pork chops should contain .2% NaP + .75% NaCl to improve flavor, texture, and water holding capacity over storage time. Based on results from Experiments 3 and 4, it is recommended that pork chops contain approximately 2% NaL or KL + .2% NaP to maintain positive sensory flavor, texture, color and minimize processed meat-like bite, package purge, and cook loss over time. The combination of approximately .1% NaDi + .2% NaP maximized desirable characteristics like pork lean/brothy, juiciness, tenderness, and color; and minimized processed meat-like bite when compared to the control chops in Experiment 5.

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I am dedicating this thesis to Luke Etheredge, my husband and confidant. It has been his patience, understanding, and advice that has helped me see this thesis come to fruition. Thank you for your prayers and thank God for answering them. I will be forever grateful.

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Finally, I would like to express my appreciation to my parents, Erin and Geneva Ford, for their love, encouragement, and financial support during the long road of my graduate career (which it has indeed become).

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CHAPTER I

INTRODUCTION

Hundreds of value-added convenience foods are marketed for the fast pace consumers of today. Enhanced pork loin chops, roasts, and ribs are now available that contain a 7-13% brine solution that may include combinations of water, sodium lactate (NaL), sodium phosphates (NaP), potassium lactate (KL), and/or sodium diacetate (NaDi). The addition of these ingredients help to enhance juiciness, tenderness, flavor, and shelf-life of these products. Research on enhanced products has been primarily directed toward determining the effect of non-meat ingredients on microbial growth and flavor enhancement in meat products. There is limited information regarding color, pH, and textural changes that occur during the storage of vacuumed-packaged fresh pork loins injected with varying combinations of these non-meat ingredients. Weber (1997) found that the addition of NaL and/or NaP to beef roasts caused the texture to become denser when compared to non-injected control roasts. With the addition of NaL and/or NaP, springiness, cohesiveness, and hardness of beef roasts increased over time. Anwar (2000) found that the texture of beef-steaks injected with KL and/or NaDi changed from a steak-like bite to a soft/rubbery, processed meat-like texture during refrigerated storage over a 42 day period. Maca and

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others (1997b) found that springiness and hardness increased with NaL and/or NaP addition in cooked beef top rounds. In other research, the addition of non-meat ingredients has been associated with increased juiciness, flavor, tenderness, and microbial shelf-life (Papadopoulas and others 1991a, 1991b, 1991c; Pagach 1992; Miller and Acuff 1994; Maca and others 1997a, 1997b, 1999; Anwar, 2000).

By understanding the combined effect of water, sodium chloride, sodium lactate, sodium phosphate, sodium diacetate, and potassium lactate on palatability, texture, color, pH, and water-holding capacity during vacuum-packaged, refrigerated storage the pork industry can provide a more consistent enhanced product to consumers. Therefore, the objectives of this research was to understand the relationship between the addition of water, sodium chloride, sodium phosphate, sodium lactate, potassium lactate, and/or sodium diacetate combinations and pork muscle pH, color, and water holding capacity during storage at 4°C for 0 to 28 days; and to examine the effect of addition of these ingredients on trained meat descriptive attribute sensory flavor aromatics, mouthfeels, basic tastes, aftertastes, and especially meat texture characteristics

CHAPTER II

LITERATURE REVIEW

Use of Non-Meat Ingredients in Meat Products

Non-meat ingredients, such as sodium chloride, sodium phosphate, sodium lactate, potassium lactate, and sodium diacetate, are used in the meat industry to maintain end product consistency and quality. The majority of fresh pork products available at the retail meat case and in food service industry are enhanced. The pork industry utilizes non-meat ingredients to increase juiciness, tenderness, flavor, and improve and stabilize color, increase shelf-life, and increase water holding capacity in pork loin chops, roasts, and ribs. Enhancement is not a method to improve low quality pork, but an opportunity to improve the overall quality of fresh pork and reduce the amount of variation in pork quality (Miller 2001).

Sodium Phosphate: Alkaline phosphates have been shown to increase pH, improve color and stability, decrease purge, reduce oxidative rancidity, and enhance meat palatability by increasing meat tenderness, juiciness, and flavor. Phosphates function by changing the ionic strength, pH, and stability of actomyosin. Phosphates increase the pH of the meat by increasing the ionic strength of the meat proteins moving the pH away from the protein’s isoelectric point. With an increase in ionic strength, there is an increase in protein swelling or solubilization. With protein swelling, actomyosin partially dissociates, and creates space in the protein network. In addition, some negatively charged sites on the protein are exposed allowing water to bind (Hedrick and others 1989).

The United States Department of Agriculture (USDA), Food Safety Inspection Service (FSIS) regulations state that phosphates cannot be greater than .5% in meat products. Phosphates are purchased as a dry powder and are usually combinations of several phosphates, such as polyphosphates and tripolyphosphates, hexametaphosphates, and pyrophosphates. Phosphates are added to meats after being solubilized in water. Phosphates are thought to be only active in the diphosphate (pyrophosphates) form where they are primarily responsible for increasing water-holding capacity (WHC) of the muscle proteins (Offer and Knight 1988). Tripolyphosphates and hexametaphosphates are less soluble, thus dissolve more slowly in water and must be hydrolyzed completely to become active with the protein network. The optimal temperature for hydrolyzation is 32°C. This temperature prevents rapid hydrolyzation of the phosphates to the monophosphate form, that is inactive the muscle tissue. In addition, this temperature increases microbial growth and spoilage. Phosphates are blended together to maximize functionality within a product.

Sodium tripolyphosphate addition to meat has been shown to improve and stabilize color. When sodium tripolyphosphate was added to ground beef patties and then frozen, Hunter a* color space values, a measure of redness, was higher than the control (Molins and others 1987). In addition, pork loin chops containing sodium tripolyphophates had higher red color values than water containing controls (Mendonca and others 1989). The darker, redder appearance of meat treated with sodium tripolyphosphate has been attributed to the subsequent increase in meat pH. The higher pH allows more water to bind to available negatively charged side chains of meat proteins and results in less free water to reflect light.

The pump yield and WHC of meat are also improved with the addition of sodium tripolyphosphate. A decrease in purge and an increase in pump yield were found in pork loins injected with sodium tripolyphosphate (Sutton and others 1997). Fresh pork loin chops injected with .5% sodium tripolyphosphate had higher WHC compared to non-injected control chops, chops treated with citric acid or chops containing sodium acid phosphate (Cannon and others 1993).

High levels of sodium phosphate in meat are also associated with improved meat tenderness. Meat has been characterized as more tender, however, some research has found a softer, rubbery, and more processed meat-like texture when sodium phosphate is found at high levels. Keeton (1983) examined the effect of sodium chloride/tripolyphosphate levels on the sensory and texture properties of pork patties using trained sensory panelists and texture profile analysis. When increasing levels of sodium chloride/phosphate combinations (0/0, 1/0, 1/0.25, 2/.5%) were blended into pork patties, they found the tenderness sensory scores for the pork patties increased when compared to the controls. Results from the texture profile analysis indicated that as sodium chloride/phosphate combinations increased, there was a slight increase in energy required to compress the meat sample in the 1st and 2nd compression. Cannon and others (1993) also reported increased tenderness scores in marinated pork loins containing sodium tripolyphosphate when compared to the non-injected controls. Pork loins stored for 21 days at 4°C did not change in tenderness. It was determined that fresh cooked pork roasts injected with sodium tripolyphosphate were more tender than the non-injected controls ($P < 0.05$) (Smith and others 1984). Two theories have been proposed by Offer and Trinick (1983) to understand how sodium tripolyphosphate increases meat tenderness. The first states that sodium tripolyphosphate promotes the depolymerization of myosin filaments. The second states that sodium tripolyphosphate weakens the binding of the myosin head to actin. Actin is dissociated and by dissociation, actin limits the expansion of the filament lattices.

Increased juiciness is another benefit found in meat treated with sodium tripolyphosphate. Juiciness scores were higher for beef and pork roasts injected with sodium tripolyphosphate when compared to non-injected control roasts (Smith and others 1984). Sensory panelists also rated reheated pork and beef roasts the same for juiciness as fresh, cook control roasts. Pork patties (Keeton 1983) and marinated pork loins (Cannon and others 1993) containing tripolyphosphates have been rated higher in juiciness by sensory panelists. In addition, Jones and others (1987) found that after 0 to 28 days of refrigerated storage, pork flavor intensity decreased in pork roasts injected with tripolyphosphate when compared to non-injected control roasts.

Phosphate addition has been shown to improve flavor retention in injected pork. Smith and others (1984) determined that flavor intensity scores for beef roasts injected with sodium tripolyphosphate did not decrease as in the control roasts. However, sensory panelists found metallic or soapy flavors in sodium tripolyphosphate injected roasts. With a pH of about 11, tetrasodium pyrophosphate is very caustic and it reacts with meat fat to produce a soap. This soap is thought to be responsible for the soapy flavor found in products containing phosphates mixes (Pearson and Gillett 1998). However, soapy off-flavors were not detected by sensory panelists in beef strip loins containing sodium tripolyphosphates, sodium chloride (NaCl), and sodium lactate (NaL) combinations. This was most likely due to sodium chloride and sodium lactate's ability to mask the soapy off-flavor attribute (Vote and others 2000).

Phosphates are also chelating agents that assist in decreasing the rate of lipid oxidation. Phosphate has been shown to bind trace metal ions such as calcium and iron. These metals are prooxidants and have been shown to assist in initiating autooxidation. The major cause off-flavor deterioration and the subsequent development of off-flavors in meats has been attributed to oxidative rancidity or autooxidation. Tims and Watts (1958) first coined the phrase "warmed-over flavor" or WOF. They described the off- flavor attribute as "stale", "old" or "rancid" and this flavor is predominantly found in precooked meats, especially after reheating. The characteristic flavor and aroma of oxidized fat is due to the oxidation and decomposition of phospholipids and fatty acid molecules forming low molecular weight aldehydes, acids, and ketones. "Cardboardy", "painty", and/or "fishy" are other attributes used by trained sensory panelist to describe the flavors associated with oxidative rancidity (Johnsen and Civelle 1987). When sodium tripolyphosphate was added to pork patties, the amount of lipid oxidation was minimized (Keeton 1983). The WOF sensory attributes were lower ($P < 0.05$) for sodium tripolyphosphate injected pork roasts when compared to non-injected control roasts (Smith and others 1984). Similarly, Jones and others (1987) found no significant difference in WOF scores of precooked pork roasts among treatments during 0 to 28 days refrigerated storage.

In summary, phosphates' role in meat products is to improve and stabilize color by increasing muscle pH, reducing oxidative rancidity, and enhancing meat palatability by increasing meat tenderness, juiciness, and flavor.

Sodium Lactate: Sodium lactate, the salt of an lactic acid, is used primarily in pork to prevent spoilage and increase shelf-life; however, research has shown that its use also can maintain desirable sensory characteristics. Sodium lactate is listed as GRAS (generally recognized as safe) by the Food and Drug Administration (FDA). USDA, FSIS regulates the addition of sodium lactate at a maximum usage level of 2.9% in the final product, which equates to 4.8% since it is sold in a 60% solution. For antimicrobial effects, sodium lactate can be found at levels up to 4%. USDA, FSIS has approved sodium lactate for use as a flavor and antimicrobial agent (USDA 2004).

The pH of meat products increases with the addition of sodium lactate. In cooked beef top rounds treated with increasing levels sodium lactate, pH increased (Pagach 1992). Similarly, Evans (1992) found that treating beef top rounds with sodium lactate increased the pH, but with increasing storage days, the pH decreased.

The color of meat products has been shown to improve and/or stabilize with the addition of sodium lactate to meat products. Lamkey and others (1991) and Brewer and others (1991) determined that the addition of sodium lactate to fresh pork sausage prevented discoloration. Similarly, according to trained sensory panelists and Hunter color space measurements, beef top rounds treated with sodium lactate, were darker and redder in color and the color was stabilized over storage days (Maca and others 1999). As mentioned in the previous discussion of sodium phosphates, an increase in meat pH improves and stabilizes meat color. Therefore, with the addition of sodium lactate, which has been shown to increase meat pH, this improvement in color is most likely due to the increase in pH.

Sodium lactate also is a humectant, which has been associated with increasing cook yield in meat products. In roast beef, the addition of 3% sodium lactate increased cook yield by 12% (Papadopoulas and others 1991b). Similarly, cook yield increased as the sodium lactate level increased in meat

(Papadopoulas and others 1991b; Evans 1992). In beef top rounds treated with sodium lactate, cook yields increased when compared to non-injected controls (Weber 1997). However, Eckert (1997) found that cook yields did not differ among ground beef patties treated with sodium lactate and the control.

Sodium lactate has been shown to affect the palatability, tenderness, juiciness, and flavor of meat. Papadopoulas and others (1991b) determined that with the addition of increasing levels up to 3% sodium lactate in roast beef, muscle fiber tenderness, overall tenderness, and juiciness trained sensory panel scores increased. In addition, Warner Bratzler shear force values decreased in roast beef samples as the sodium lactate level increased. However, Sutton and others (1997) found that Warner-Bratzler shear force was not affected by the addition of 2% sodium lactate to pumped pork loins.

It has been noted that sodium lactate has humectant properties that improve juiciness (Papadopoulas and others 1991b; Eckert and others 1997; Maca and others 1997a). The addition of 1 to 4% sodium lactate to beef roast improved the juiciness at 0 d and there was no apparent change throughout storage indicating that sodium lactate acted to stabilize juiciness (Papadopoulas and others 1991b). Eckert and others (1997) also reported that the addition of sodium lactate increased perceived juiciness in hamburger patties. Similarly, Maca and others (1997a) determined that the addition of sodium lactate and/or sodium phosphate increased juiciness scores.

In addition to improving texture and juiciness, sodium lactate has been found to improve flavor. Positive flavor notes were associated with roast beef injected with 3% sodium lactate and consumer overall-like was high and trained panelists rated roast beef flavor, overall flavor, saltiness, and sourness high when compared to other treatments (Papadopoulas and others 1991c). Lamkey and others (1991) concluded that sodium lactate increased flavor intensity and saltiness in beef chuck muscles, due to the sodium ion. Sutton and others (1997) also observed an increase in pork flavor, salt basic taste intensity, and pH with the addition of sodium lactate to pork loins.

In addition to improving flavor, sodium lactate has been shown to decrease WOF. Papadopoulas and others (1991a) reported that off-flavors attributed to WOF in beef roast were decreased with the addition of 1% sodium lactate when compared to the control. However, in pork sausage containing 1% sodium lactate stored at 4 °C for up to 21 days, off-flavor intensity increased (Brewer and others 1991). However, at 2 or 3% sodium lactate, microbial growth would have been inhibited, extending shelf-life, and delaying the onset of sour and off-flavors in fresh pork sausage. High levels of sodium lactate have been associated with throat-burning mouthfeel and higher levels of chemical aromatic flavor. Papadopoulas and others (1991b) found that panelist experienced minor throat irritation while evaluating beef roast treated with 4% sodium lactate.

The addition of sodium lactate to meat products is beneficial in increasing shelf-life and reduction of microorganisms. Sodium lactate lowers the water activity of the meat and the lactate and sodium ions have antimicrobial properties thereby reducing the proliferation of microorganisms. Sodium lactates bacteriostatic effect has been documented in many studies and on many products such as, cooked beef (Papadopoulas and others 1991a, 1991b, 1991c; Pagach 1992; Miller and Acuff 1994; Maca and others 1997a, 1997b, 1997c, 1999), fresh pork sausage (Brewer and others 1991; Lamkey and others 1991), ground beef (Eckert and others 1997), and cooked turkey breasts (Weber 1997). Maas and others (1989) was the first to patent the use of sodium lactate in cook-in bag turkey products to reduce risk of C.*botullinum* toxin formation. When compared to the control, *Salmonella typhimurium, Listeria monocytogenes and Escherichia coli* 0157:H7 growth was inhibited with the addition of sodium lactate to cooked beef top rounds and stored for up to 28 days at 10°C (Miller and Acuff 1994). Brewer (1991) found that pork sausage treated with 2 or 3% sodium lactate had less microbial growth and a longer shelf-life from 7 to 10 d at 4°C. Lamkey and others (1991) determined that the lag phase of the microbial growth was longer with the addition of 3% sodium lactate to fresh pork sausage. Papadopoulas and others (1991a) found that beef top rounds treated 3 or 4% sodium lactate, vacuum-packaged and stored at 4°C had lower APC when compared to the control at 84 days of storage.

It can be concluded that sodium lactate's role in the meat system is to primarily prevent spoilage and increase shelf-life, but it can also maintain desirable sensory characteristics.

Potassium lactate: Research began on potassium lactate when interest focused on adding a non-meat ingredient that did not increase the sodium content in the final product or have any off-flavors associated with its use. Like sodium lactate, potassium lactate is the salt of lactic acid and is listed as GRAS by FDA. Potassium lactate is beneficial in increasing pH, meat color, and cook yield, and has a bacteriostatic effect, however, it has little affect on flavor and texture.

Higher pH values were found in cooked beef top rounds containing potassium lactate (Pagach 1992). Similarly, an increase in pH was found in strip loin streaks with increasing levels of potassium lactate in the final product (Anwar 2000).

Due to the increase in the pH, meat products treated with potassium lactate, appeared darker in color. A darker purple color was found in strip loin steaks containing 2.5% potassium lactate as indicated by lower L* a* b* color space values when compared to the controls (Anwar 2000). Anwar (2000) also found higher cook yields and lower purge in strip loins steaks injected with potassium lactate.

Potassium lactate contributes little to meat flavor. Cooked beefy/brothy aromatics and WOF were not significantly different for cooked beef top rounds with 4% potassium lactate and the controls (Pagach 1992). When potassium lactate was used in the place of sodium lactate, the salty flavor was reduced in cook beef (Pagach 1992). Similarly, Anwar found that trained sensory panelist scores were not different for overall flavor intensity, beefy/brothy, cooked beef fat, serum/bloody, burnt/browned, cardboardy, liver, sour tastes and, metallic mouthfeel for beef strip loin steaks treat with potassium lactate. However, with an increase of potassium lactate from 1.5 to 2% the salt and bitter flavors increased in the beef strip loin steaks (Anwar 2000).

In addition to some flavor benefits, the texture of beef strip loin steaks treated with 1.5 to 2% potassium lactate was improved as indicated by higher trained panel scores for muscle fiber tenderness and lower scores for connective tissue amount when compared to that of the controls (Anwar 2000). Shear force values were also lower for strip loin steaks treated with potassium lactate (Anwar 2002).

Potassium lactate was demonstrated to be a bacteriostatic agent was researched by Pagach (1992). Beef roasts treated with 2.4 to 4% potassium lactate did not significantly differ in APC values than those roasts injected with 4% sodium lactate. When Harris and others (1990) standardized the lactate ion concentration in beef at 0% (control), 2%, or 4% sodium and/ or potassium lactate, the APC values were lower for beef treated with either sodium and/or potassium lactate when compared to the control. Similarly, APC values decreased for beef strip loin steaks treated with increasing levels potassium lactate for up to 49 days of storage (Anwar 2000).

In conclusion, potassium lactate increases muscle pH, improves meat color, has some bacteriostatic effects, however, it is level dependent on the flavor and texture of the meat system.

Sodium Diacetate: Another non-meat ingredient commonly found in pork products is sodium diacetate is classified as GRAS by the Food and Drug Administration. Sodium diacetate is approved as an antimicrobial agent; however, it is not usually found above .2% in meat products. Other ingredients such as, sodium lactate or potassium lactate, are commonly used in combination with sodium diacetate.

Because sodium diacetate is added at such low levels, it is not surprising that research has shown that sodium diacetate has minimal effect on meat color (Anwar 2000; Grones 2000). Treated strip loin streaks containing .1% NaDi did not have any significant treatment effects for sensory color, or CIE L*, a*, b* color space values.

Sodium diacetate has been shown to have limited effect on juiciness in ground beef patties (Grones 2000) and brine injected bee strip loin steaks (Anwar 2000). Sensory panelists did not find any significant differences among ground beef patties containing .15% sodium diacetate and 3% sodium lactate when compared to the control. Again, because sodium diacetate was added at such low levels a significant difference in juiciness was not detectable.

Similarly, meat texture is not affected by the addition of sodium diacetate. Trained sensory panelists reported finding no significant textural differences among treatments when evaluating ground beef patties (Grones 2000) or brine injected beef strip loin steaks (Anwar 2000).

Sour flavors are commonly found with the addition of sodium diacetate due to the dissociation of its two acetate ions. Ground beef patties containing either .15% NaDi + 3% NaL or .15% NaDi + 2% NaL had slightly higher soured flavors than other treatments according to trained sensory panelists (Grones 2000). The intensity of other flavor attributes were not affected by sodium diacetate (Grones 2000). Similar results were found by Weber (1997) in roast beef and turkey breast roasts. Again, because sodium diacetate is added at such low levels the flavors of the meat products are not significantly affected.

Because sodium diacetate has little affect on color, juiciness, or texture, it is very effective as an acceptable antimicrobial agent. The chemical composition of sodium diacetate consists of two acetate ions that dissociated into acetic acid and sodium acetate. By dissociating into acetic acid and sodium acetate, the initial concentration of acetic acid is increased, which lowers the pH and results in decreased microbial growth. Microbial growth in refrigerated poultry was decreased with the addition of sodium diacetate to the surface of the product (Moye and Chambers 1991). Similarly, Anwar (2000) found that with increased storage beef strip loin steaks containing sodium diacetate had lower APCs when compared to either the control steaks or steaks containing potassium lactate. The combination of sodium diacetate and potassium lactate produced the lowest APCs in the beef strip loin steaks (Anwar 2000). In addition to lowering APC counts, sodium diacetate can act to inhibit or slow the growth of meat pathogens, such as, *Listeria monocytongenes, E. coli* 0157:H7*, Salmonella enterditis, hyersinia, Entercolotica;* gram negative bacteria *and Lactobacillus fermentis* (Schlyter and others 1993). Schlyter and others (1993) determined that sodium diacetate (.3%) slowed the growth of *Listeria monocytogenes.* In ground beef and beef slurries containing .28% sodium diacetate and stored at 4°C total aerobic plate counts were low when compared to the control. *Salmonella ssp.* growth was lowered with the application of sodium diacetate to the surface of poultry and subsequently by stored at 4°C (Moye and Chambers 1991).

In summary, previous research has shown that sodium diacetate has had little effect on the color, juiciness, or texture of a meat system; however, it is very effective as an antimicrobial agent.

CHAPTER III

MATERIALS AND METHODS

Five experiments were conducted to examine the effect of non-meat ingredients on sensory characteristics, color, and chemical characteristics of pork (Table 1). Each experiment focused on the addition of different ingredients. Experiment 1 examined the use of sodium chloride (Culinox® 999, Morton sodium chloride, 123 N. Wacker Dr., Chicago, IL, 60606-1745) and sodium phosphate (Brifisol® 512, BK Giulini, Park Plaza III, 3695 Alamo St., Suite 203, Simi Valley, CA, 93063). Brifisol® 512 is a blend of polyphosphates designed to be water soluble at low processing temperatures and in the presence of sodium chloride and has a pH (1% solution) of 9.0 ± 0.3. Experiment 2 examined the use of sodium chloride and a different sodium phosphate (Brifisol® 85, BK Giulini, Park Plaza III, 3695 Alamo St., Suite 203, Simi Valley, CA, 93063). Brifisol® 85 is more commonly used in the pork industry. Brifisol® 85 is a blend of poly- and pyrophosphates. It has a pH (1% solution) 8.5 ± 0.3 and is designed to extract and activate myosin protein to optimize water-holding capacity and reduce package purge due to the incorporation of the pyrophosphate. The results of experiments 1 and 2 were used to identify the standard sodium chloride solutions for use in subsequent

Table 1- The percentage of non-meat ingredients in the final pork loin chop within experimental treatments.

Treatments	NaCl[a]	NaP512[a]	NaP85[a]	NaL[a]	KL[a]	NaDi[a]
Experiment 1						
1	0.375	0.1	0	0	0	0
2	0.375	0.3	0	0	0	0
3	1.125	0.1	0	0	0	0
4	1.125	0.3	0	0	0	0
5	0.75	0	0	0	0	0
6	0.75	0.4	0	0	0	0
7	0	0.2	0	0	0	0
8	1.5	0.2	0	0	0	0
9	0.75	0.2	0	0	0	0
10	0	0	0	0	0	0
Experiment 2						
1	0.375	0	0.1	0	0	0
2	0.375	0	0.3	0	0	0
3	1.125	0	0.1	0	0	0
4	1.125	0	0.3	0	0	0
5	0.75	0	0	0	0	0
6	0.75	0	0.4	0	0	0
7	0	0	0.2	0	0	0
8	1.5	0	0.2	0	0	0
9	0.75	0	0.2	0	0	0
10	0	0	0	0	0	0
Experiment 3						
1	0.75	0	0.1	1.0	0	0
2	0.75	0	0.1	3.0	0	0
3	0.75	0	0.3	1.0	0	0
4	0.75	0	0.3	3.0	0	0
5	0.75	0	0.2	0.0	0	0
6	0.75	0	0.2	4.0	0	0
7	0.75	0	0	2.0	0	0
8	0.75	0	0.4	2.0	0	0
9	0.75	0	0.2	2.0	0	0
10	0	0	0	0	0	0

Table 1- Continued.

Treatments	NaCl[a]	NaP512[a]	NaP85[a]	NaL[a]	KL[a]	NaDi[a]
***Experiment* 4**						
1	0.75	0	0.1	0	1.0	0
2	0.75	0	0.1	0	3.0	0
3	0.75	0	0.3	0	1.0	0
4	0.75	0	0.3	0	3.0	0
5	0.75	0	0.2	0	0.0	0
6	0.75	0	0.2	0	4.0	0
7	0.75	0	0	0	2.0	0
8	0.75	0	0.4	0	2.0	0
9	0.75	0	0.2	0	2.0	0
10	0	0	0	0	0	0
Experiment 5						
1	0.75	0	0.1	0	2.0	0.05
2	0.75	0	0.1	0	2.0	0.15
3	0.75	0	0.3	0	2.0	0.05
4	0.75	0	0.3	0	2.0	0.15
5	0.75	0	0.2	0	2.0	0
6	0.75	0	0.2	0	2.0	0.2
7	0.75	0	0	0	2.0	0.1
8	0.75	0	0.4	0	2.0	0.1
9	0.75	0	0.2	0	2.0	0.1
10	0	0	0	0	0	0.0

[a] Na = sodium chloride, NaP512 = Brifisol® 512 sodium phosphate, NaP85 = Brifisol® 85 sodium phosphate, NaL = Purasal® sodium lactate, KL = Purasal® potassium lactate, NaDi = sodium diacetate

experiments. Experiment 3 examined the use of sodium lactate (Purasal® SP Hi Pure 60, Purac, 111 Barcley Blv., Lincolnshire, IL, 60069) and sodium phosphate (Brifisol® 85 BK Guilini, Park Plaza III, 3695 Alamo St., Suite 203, Simi Valley, CA, 93063) with sodium chloride standardized at .75%. Experiment 4 examined the use of potassium lactate (Purasal® PhiPure60, Purac, 111 Barcley Blv., Lincolnshire, IL, 60069) and sodium phosphate (Brifisol® 85 BK Giulini, Park Plaza III, 3695 Alamo St., Suite 203, Simi Valley, CA, 93063) with sodium chloride standardized at .75% in the final product. Experiment 5 examined the use of sodium diacetate (Purac, 111 Barcley Blv., Lincolnshire, IL, 60069) and sodium phosphate (Brifisol® 85 BK Giulini, Park Plaza III, 3695 Alamo St., Suite 203, Simi Valley, CA, 93063) with potassium lactate (Purac, 111 Barcley Blv., Lincolnshire, IL, 60069) standardized at 2% and sodium chloride standardized at .75%.

Experiment 1

Fresh, chilled (< 4 °C), vacuum-packaged, boneless pork loins were obtained from a commercial pork processor for injection. The pork loins were purchased on three different production days and the loins (< 4 °C) were processed within 24 to 36 hours post-fabrication in a refrigerated processing room. Production day was defined as a replicate. One pork loin was used for each treatment on each processing day. Prior to injection, fresh pork loins were removed from the vacuum-package and weighed. Duplicate pH readings were obtained using a penetrating probe (IQ150, IQ Scientific Instruments, Inc., San Diego, CA) in the anterior and posterior ends of the *Longissimus lumburium* muscles of each loin and the average pH calculated. Each day, prior to evaluation, the pH meter was calibrated using pH 4 and 7 buffer solutions. Instrumental color was measured using the Minolta colorimeter (CR-200, Minolta Co., Ramsey, NJ) to determine CIE L*, a*, and b* color space values. The Minolta colorimeter light source was D56 and standardized with a white tile (L* 97.32, a* .14, b* 1.94) at the beginning of each days usage. Instrumental color evaluation was taken at three random locations on the raw pork loin *Longissiumus lumburium* lean external surface 10 min after removal from the vacuum-package (AMSA 1993).

Ten brine formulations were defined for experiment 1 to provide varying combinations of sodium chloride and sodium phosphate (Brifisol® 512, BK Giulini, Park Plaza III, 3695 Alamo St., Suite 203, Simi Valley, CA, 93063) (Table 1). The pre-weighed ingredients were mixed with chilled double distilled, deionized water and the pH of each brine solution was taken in duplicate using a penetrating probe (IQ150, IQ Scientific Instruments, Inc., Sand Diego, CA). The standardized injection level was set at 10% of the fresh weight of the pre-injected loin. To ensure that a 10% injection in the final product was reached, each loin was weighed prior to injection, and then re-weighed after injection and pickup percentage was calculated as:

$$\% \text{ pickup} = ((\text{injected weight} - \text{pre-injection weight}) / \text{pre-injection weight}) * 100$$

If the percentage pickup was lower than 10% then the loin was injected again. If the percentage pickup was over 10% then the brine was removed by physical application of pressure to the loin and the pickup percentage was recalculated. If 10% injection in the final product could not be reached, then a new loin was selected and the pH and instrumental color was taken as previously described. The new loin was assigned to a treatment and was weighed prior to injection and after injection to ensure that 10% injection was achieved in the final product. After injection, the pork loins were individually vacuumed-packaged in oxygen barrier film (B540 bags Cryovac Division, WR Grace & CO., Duncan, SC., U.S.A.) held 24 h and stored at 4 °C. The vacuum bags used in this study were .32 mil Suran®-coated polyvinyl chloride having an OTR of 3-6 cc $O_2/m^2/24h$, atm. at 4.44°C and 0% relative humidity (RH) and a moisture vapor transmission rate of 0.5-0.6 g/2.54 $m^2/24h$ at 37.78°C and 100% RH.

After a 24 h equilibrium period, each loin was segmented into 10, 2.54 cm thick pork loin chops. Pork loin chop pairs, where consecutive chops were treated as an experimental unit, were randomly assigned to storage days (0, 7, 14, 21, and 28) within a loin. Each pork loin chop was bagged separately, vacuumed-packaged (B540 bags, Cryovac Division, WR Grace & CO., Duncan, SC., U.S.A.), and stored at 4°C for the assigned storage period.

Within an experimental unit pair, the first anterior chop was used to measure package purge and trained descriptive sensory attribute evaluation while the second anterior pork chop was used for instrumental color evaluation, pH, trained panel objective color evaluation and water-holding capacity.

To determine percentage purge, a clean vacuum-package was weighed to identify package weight. The vacuumed-packaged pork loin chop was weighed and then opened. The pork loin chop was removed from the package and weighed. Percentage purge was determined using the following formulas:

Purge weight = Unopened package weight – (Raw pork chop weight + Package weight)

Percent purge = (Purge weight/ (Unopened package weight –Package weight)) * 100

The chop for sensory evaluation was weighed (g) and a type T wire mini-thermocouple (Omega Engineering, Inc., Stamford, CT) was inserted in the geometric center of each pork chop. The internal temperature was monitored by an Omega RD4031 Hybrid Recorder (Omega Engineering Inc., Stamford, CT., U.S.A.). The pork chops were cooked on a Farberware Open-Hearth Electric Broiler (Mod. FSR200, Housewares, Inc., Mt Prospect, IL.,) to an internal temperature of 35 °C, then the pork chops were turned and cooked until an internal temperature of 70 °C was obtained (AMSA 1995). Cooked weight and cooking time were recorded. Cook loss percentage was determined using the following formula:

Cook loss, % = ((Raw pork chop weight – cooked pork chop weight)/ Raw pork chop weight)) * 100

Pork loin chops were held in an Alto Shaam, storage oven (750-TH-11, Alto-Shaam, Inc. Milwaukee, WI., U.S.A.) at 55 °C prior to serving and for no longer then 10 min. Serving preparation included removing ~.64 cm of the exterior edge of the pork loin chops and cutting the remainder of the chop into ~1.27 cm cubes. Up to four sessions were held each day; five samples were evaluated per session. To minimize positional bias and halo effects, the order of sample presentation were randomized within each sensory day (Larmond 1977). Testing took place in climate controlled, partitioned booths separated from the sample preparation area so that panelists were not disturbed during evaluation. Three ~1.27 cm cubes were placed in approved odor-free plastic weigh boats and served to panelist through bread-box style stainless steel domes that separated the food preparation area from the sensory testing area. The separation was necessary to prevent odors and reduce the noise in the evaluation booths. Cool incandescent lights with red gel filters were used to disguise visual differences among the samples. To prevent taste fatigue, expectorant cups were provided and panelists were instructed not to swallow the samples. To ensure that all panelists rated each attribute similarly, a warm-up sample was given at the beginning of each sampling session. Additionally, appropriate rest periods of approximately 2 min between samples and of 10 min between sessions were provided. Double-distilled, deionized water; unsalted soda crackers; and whole ricotta cheese were used to clean the panelist’s palate between samples.

Up to 10 sensory panelists were selected and trained according to Cross and others (1978) and AMSA (1995). Sensory evaluation ballot development sessions during preliminary studies were used to determine the flavor aromatics, basic tastes, aftertastes, mouthfeels, and meat descriptive attributes to be evaluated during the study using the Spectrum™ Universal Intensity Scale (Meilgaard and others 1999). Using this scale, a score of 0 indicates an absence of an attribute and a score of 15 indicates an extremely intense level of the attribute. Samples were evaluated for the flavor aromatics of pork lean/brothy, pork fat, cardboard, painty, fishy, soapy, soda, and chemical aromatics; metallic and astringent mouthfeels; for salt, sour, bitter, and sweet basic tastes; soapy aftertastes; and for meat descriptive attribute and texture attributes of muscle fiber tenderness, juiciness, and processed meat-like bite. Additionally, panelists were instructed to list other attributes detected with an intensity score.

Processed meat-like bite was defined as the intensity of processing detected in the texture of the pork loin chop. The scale was based on the Spectrum™ Universal Intensity Scale (Meilgaard and others 1999). Using this scale, a score of 0 indicated an absence of processed meat-like bite and it was anchored using a non-injected pork loin chop. A score of 15 indicated an extremely intense level of processed meat-like bite and it was anchored using Spam™.

The second pork loin chop was evaluated for pH, color, and WHC, concurrently with the trained sensory evaluation. The pork loin chops were removed from the vacuumed-packing and after 10 min random, duplicate pH readings were obtained using a penetrating probe (IQ150, IQ Scientific Instruments, Inc., San Diego, CA). Each day prior to evaluation, the meter was calibrated using pH 4 and 7 buffer solutions. One pH measurement was taken at each side of the pork loin chop *Longissimus* muscle and their average was calculated. The pH probe did not penetrate any further than 1 cm into the pork chop *Longissimus* muscle.

After the pH evaluation, instrumental color was measurement using the Minolta colorimeter (R-200, Minolta Co., Ramsey, NJ) to determine CIE L*, a*, and b* color space values. Instrumental color evaluation was taken at three random locations on the raw pork loin chop (*Longissimus* muscle) lean surface 10 min after removal from the vacuum package (AMSA 1993). The average of the three measurements was calculated and reported. The Minolta colorimeter was standardized each day prior to evaluation using a white tile.

After instrumental color evaluation, the pork loin chops were evaluated by up to 10 trained descriptive attribute sensory panel for surface color (lean color and percentage two-toned color) as described AMSA (1993). The National Pork Board (Des Moines, IA) color reference cards were used for surface color where 1 = pale pinkish gray to white; and 6 = dark purplish red. Percentage discoloration also was scored using a 7-point scale where 7 = 100%

discoloration and 1 = 0% discoloration. The color of the discolored portion of the pork lean color was evaluated using the National Pork Board (Des Moines, IA) color reference cards where 1 = pale pinkish gray to white; and 6 = dark purplish red. The color scales were defined in ballot development sessions according to (AMSA 1993) where samples similar to those that would be presented in the study were used. Pork chop samples were evaluated each day concurrently with sensory evaluation.

After sensory color evaluation, water-holding capacity was determined on the pork loin chops using the drip loss procedure as modified by Honikel (1987). Approximately, 20 g of muscle sub-sample from the center of each chop was obtained and weighed. The sub-sample was suspended in cheese-cloth within a Whirl-pak ® bag and held at 4 °C for 48 h. Each sub-sample was re-weighed and drip loss was calculated using the following formula.

Drip loss = ((Sub-sample beginning weight – Sub-sample weight after 48h)/ (Sub-sample beginning weight)) * 100

Experiment 2

The ten brine formulations providing varying combinations of sodium chloride and sodium phosphate (Brifisol® 85 BK Giulini, Park Plaza III, 3695 Alamo St., Suite 203, Simi Valley, CA, 93063) are defined in Table 1. Processing for this experiment was as previously described under Experiment 1, except that 15, 2.54 cm thick pork loin chops, were cut from each pork loin after the 24 h post-injection equilibration period. This provided three sequential chops, as an experimental unit, to be randomly assigned to a storage day within a loin. For each storage day, the first anterior pork chop was used for package purge and sensory evaluation, the second anterior chop was used to determine pH and WHC, and the third anterior pork chop was used for instrumental color and trained sensory color evaluation. Storage days were randomly assigned to the sets of three consecutive pork chops after they were cut from the loin and chops were vacuumed-packaged individually in B2570T bags (Cryovac Division, WR Grace & CO., Duncan, SC., U.S.A.). The vacuum bags used in this study were .32 mil Suran®-coated polyvinyl chloride having an OTR of 3-6 cc $O_2/m^2/24h$, atm. at 4.44°C and 0% relative humidity (RH) and a moisture vapor transmission rate of 0.5-0.6 g/2.54 $m^2/24h$ at 37.78°C and 100% RH. During sensory evaluation, trained panelists used an 8-point muscle fiber tenderness and juiciness evaluation scale (AMSA 1995) rather then the 15-point Universal Intensity Scale (Meilgaard and others 1999). However, package purge, pH, WHC, and color evaluation protocols were not changed from the previous experiments.

Experiment 3

The ten brines used in experiment 3 contained varying combinations of sodium lactate (Purac, Inc., Licolnshire, IL) and sodium phosphate (Brifisol® 85, BK Giulini, Simi Valley, CA, 93063) (Table 1). Sodium chloride was standardized at .75% in the final product. The processing and evaluation in this experiment were as previous defined in Experiment 2. However, to provide a better heat seal, the vacuum bag used in this Experiment was the B2655 bag (Cryovac Division, WR Grace & CO., Duncan, SC., U.S.A.). The B2655 bags were .32 mil Suran®-coated polyvinyl chloride having an OTR of 3-6 cc $O_2/m^2/24h$, atm. at 4.44°C and 0% relative humidity (RH) and a moisture vapor transmission rate of 0.5-0.6 g/2.54 $m^2/24h$ at 37.78°C and 100% RH.

Experiment 4

The ten brine formulations in experiment 4, providing varying combinations of potassium lactate (Purac, Inc., Licolnshire, IL) and sodium phosphate (Brifisol® 85, BK Giulini, Simi Valley, CA, 93063), are shown in Table 1. Sodium chloride was standardized at .75% in the final product. The processing and evaluation in this experiment was as previously defined.

Experiment 5

The ten brine formulations evaluated in this experiment contained varying combinations of sodium diacetate (Purac, Inc., Licolnshire, IL) and sodium phosphate (Brifisol® 512, BK Giulini, Park Plaza III, 3695 Alamo St., Suite 203, Simi Valley, CA, 93063) (Table 1). Sodium chloride and potassium lactate were standardized at .75 and 2%, respectively, in the final product. Additionally, all the processing and evaluation in this experiment was as previously defined.

Statistical Analysis

The level of ingredients for the brine formulations were based on a central composite model also defined as a second-order designed regression analysis. The model provides comparison of the interaction of two ingredients where five levels of each ingredient are used. This model assigned a coded value of -2 to the low levels/no addition of ingredients, -1 to the next highest level; +2 to the high levels of ingredients; +1 to the second highest level of ingredient, and 0 to the center (average) point of added ingredient. Ingredient levels are spaced equally. This experimental model included 9 points (or treatments): (0, 0), (-2, 0), (+2, 0), (-1, -1), (+1, -1), (-1, +1), (+1, +1), (0, -2), (0, +2), and a control point which had no injection of ingredients (-2, -2). The data generated using the central composite model was used to develop response surface graphs to identify general trends and relationships between independent and dependent variables (Meilgaard and others 1999).

Analysis of Variance using Proc GLM was conducted for each experiment where panel, replication, and treatment by storage day interaction were included in the model statement (SAS 1999). The least squares means, p - values, and root means square errors are reported in Appendices for each variable in the five experiments. The results from the analysis of variance were used to determine which variables were significantly ($P \leq .05$) affected by treatment x storage day interactions. For data that had significant ($P \leq .05$) interactions, a second SAS (1999) program was preformed using Proc Reg. The squares and cross product terms for the ingredients were included in the Proc Reg model to predict response surface “bends”. The Proc Reg SAS program generated central composite response surface regression equations from the variables’ least squares means on each storage day. These regression equations were used to develop response graphs in Microsoft® Excel 97 (Microsoft Corporation, Redmond, WA). Two subsequent variables of either sodium chloride, sodium phosphate, sodium lactate, potassium lactate, or sodium diacetate, depending on the experiment, were used for either the x or y-axis and the tested variable was used for the z-axis.

Some descriptive attribute sensory variables were significantly affected by treatment x day interactions ($P \leq .05$) but when the surface response curves were examined, the surface response curves were almost flat or very slight changes (<1) due to treatments were detected. These attributes were either present at very low levels, or almost zero, or there were no changes in the attributes over storage or due to treatments. These attributes tended to be other attributes that were infrequently identified by sensory panelists. Therefore, a response surface graph was not presented for these sensory attributes. However, the regression equations for these sensory attributes are presented along with regression equations for all the attributes with significant storage x treatment interaction in Appendixes AAD to AAH.

For the variables that did not have a significant ($P > 0.05$) treatment by storage day effect, analysis of variance was conducted using the Proc GLM program in SAS (1999). Treatment, day, panel, replication, and the treatment by storage day interaction were included in the Proc GLM model statement. The least squares means, p - values, and root means square errors are presented in the Appendixes for variables with significant ($P \leq 0.05$) treatment or day main effects. Using the Proc Reg program in SAS (1999) central composite response surface regression equations were generated for those variables that were significantly affected by treatment. The squares and cross product terms for the ingredients were included in the Proc Reg model to predict response surface "bends". Surface response graphs were generated using Microsoft ® Excel 97 (Microsoft Corporation, Redmond, WA) from the regression equations for variables effected by treatment. For variables that had a storage day effect the means and p – values are reported in the Appendixes.

Some descriptive sensory attribute variables were significantly affected by treatment or storage day, but were not present at consistent or detectable intensity levels as described above. Therefore, a surface response graph was not presented for these sensory attributes. However, the means and standard errors for these sensory attributes are presented in the results and discussion.

CHAPTER IV

RESULTS AND DISCUSSION

Experiment 1

Sodium phosphate (NaP) is frequently used in pork to increase meat pH and water-holding capacity, which subsequently reduces purge and cook loss. Additionally, the use of sodium phosphate has been shown to improve meat color, juiciness, and tenderness; however, high levels of sodium phosphate in meat may increase the processed meat-like bite in the final product (Miller 2001). The addition of phosphate to ground pork patties, beef, and pork loin chops increased muscle pH and the subsequent water-holding capacity (Keeton 1983; Trout and Schmidt 1986; and Cannon and others 1993, respectively). Purge and cook loss decreased, and juiciness and tenderness increased with the addition of phosphate to pork loins (Cannon and others 1993 and Sutton and others 1997). Krouse and others (1979) and Mendonca and others (1989) determined that color was improved in pork when phosphates were added, and Molins and others (1987) observed similar results in ground beef patties. Sodium chloride is commonly used in conjunction with sodium phosphate because there is a synergistic effect that occurs when they are used together that improves juiciness, tenderness, flavor, cook loss, and water-holding capacity more than the addition of either ingredient added alone (Keeton 1983; Molins and others 1987; and Detienne and Wicker 1999).

Experiment 1 was conducted to examine the effects of sodium phosphates (0 to .4%) and sodium chloride (0 to 1.5%) on pork loin chop palatability, texture, color, pH, and drip loss during vacuum-packaged, refrigerated storage. The sodium phosphate used in this experiment was a blend of sodium polyphosphates that is commercially available and has a high solubility (9.0 $\pm$ .3 pH), but is more commonly used in beef and not for pork products.

Sensory aromatics, feeling factors, and basic tastes: Pork lean/brothy flavor aromatic and salt basic tastes were the most intense flavors detected in the Experiment 1 pork chops. Other attributes found in the pork chops were slightly detectable levels of pork fat aromatic, sour and bitter basic tastes, and salty aftertaste. In addition, very low levels of soda flavor, sweet basic taste, and bitter aftertaste were found; and other attributes, such as, cardboardy and chemical flavors; and sour, soda, metallic, and mature aftertastes were found at intensity levels approaching zero. However, the intensity levels of some of these attributes were affected by the addition of sodium chloride, sodium phosphate, and/or storage time.

Analysis of variance was conducted to determine if the pork chops responded differently to the treatments across storage days. The interaction between treatment and storage time was significant ($P \leq 0.05$) for pork lean/brothy aromatic; salt basic taste; salty aftertaste; pork fat aromatic; and bitter and sour basic tastes (Appendix A, B, and C, respectively) (Figs. 1 – 6,

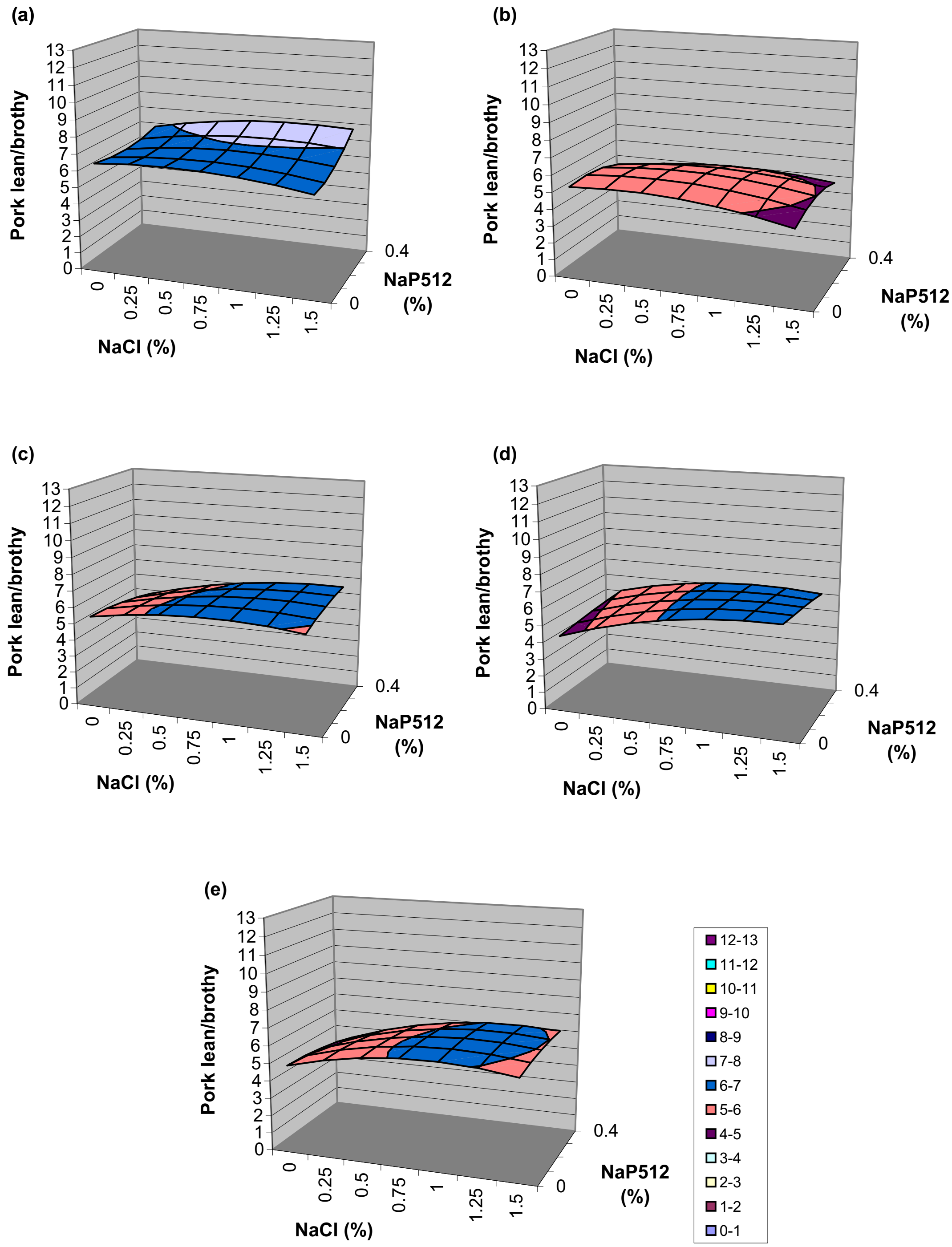

Figure 1. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the pork lean/brothy aromatic (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 1.

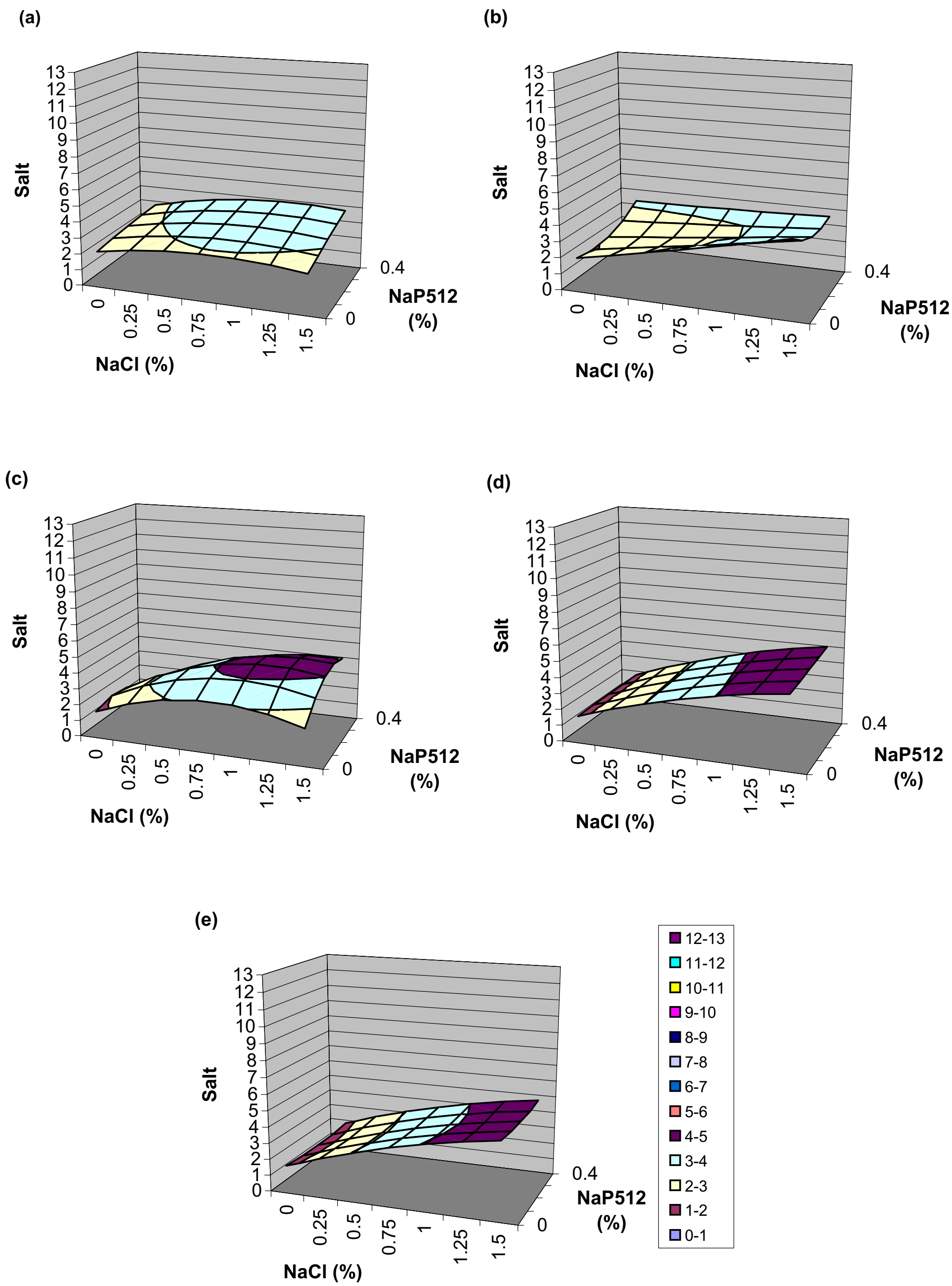

Figure 2. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the salt basic taste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 1.

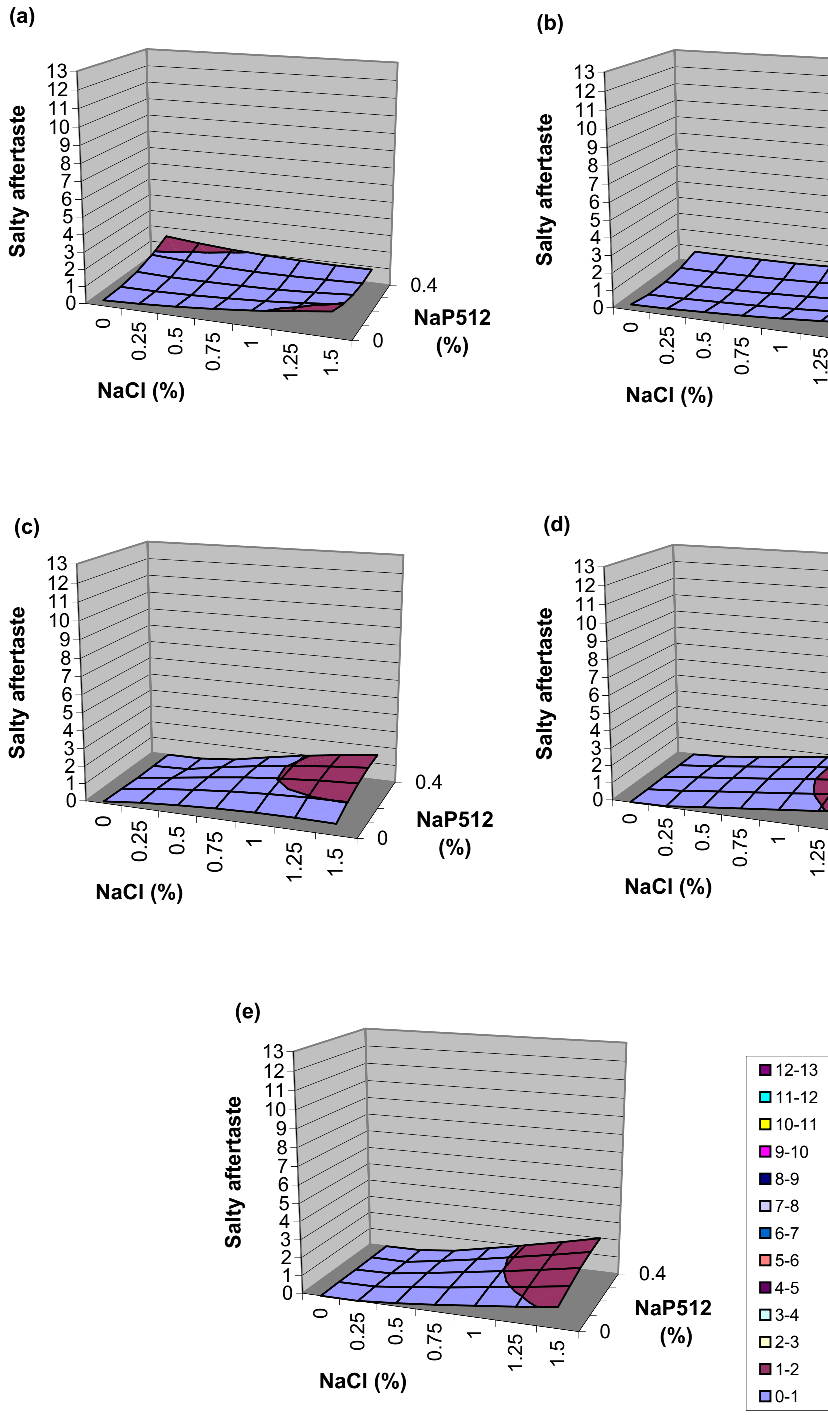

Figure 3. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the salty aftertaste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4^{o}C in Experiment 1.

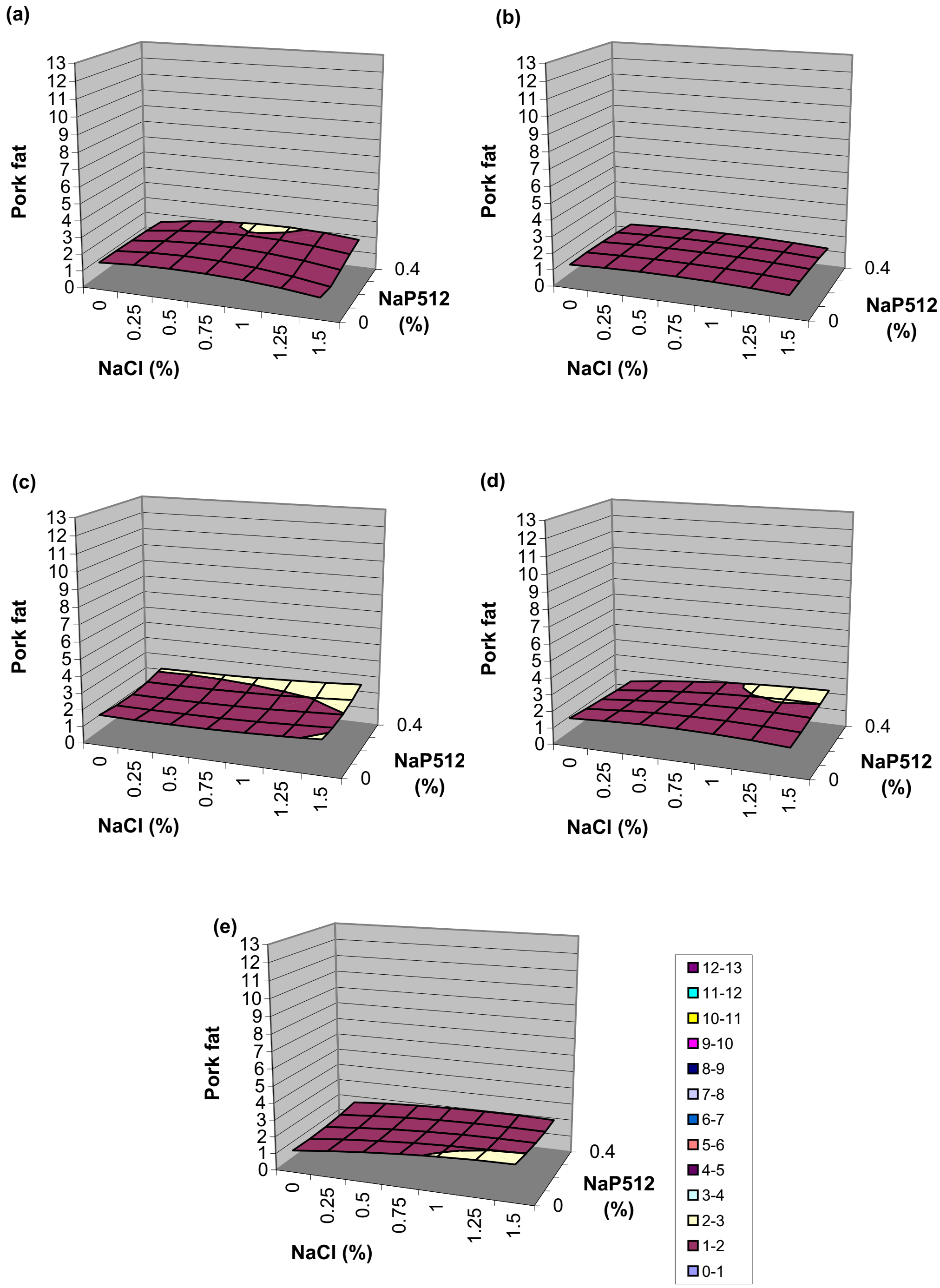

Figure 4. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the pork fat aromatic (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4 °C in Experiment 1.

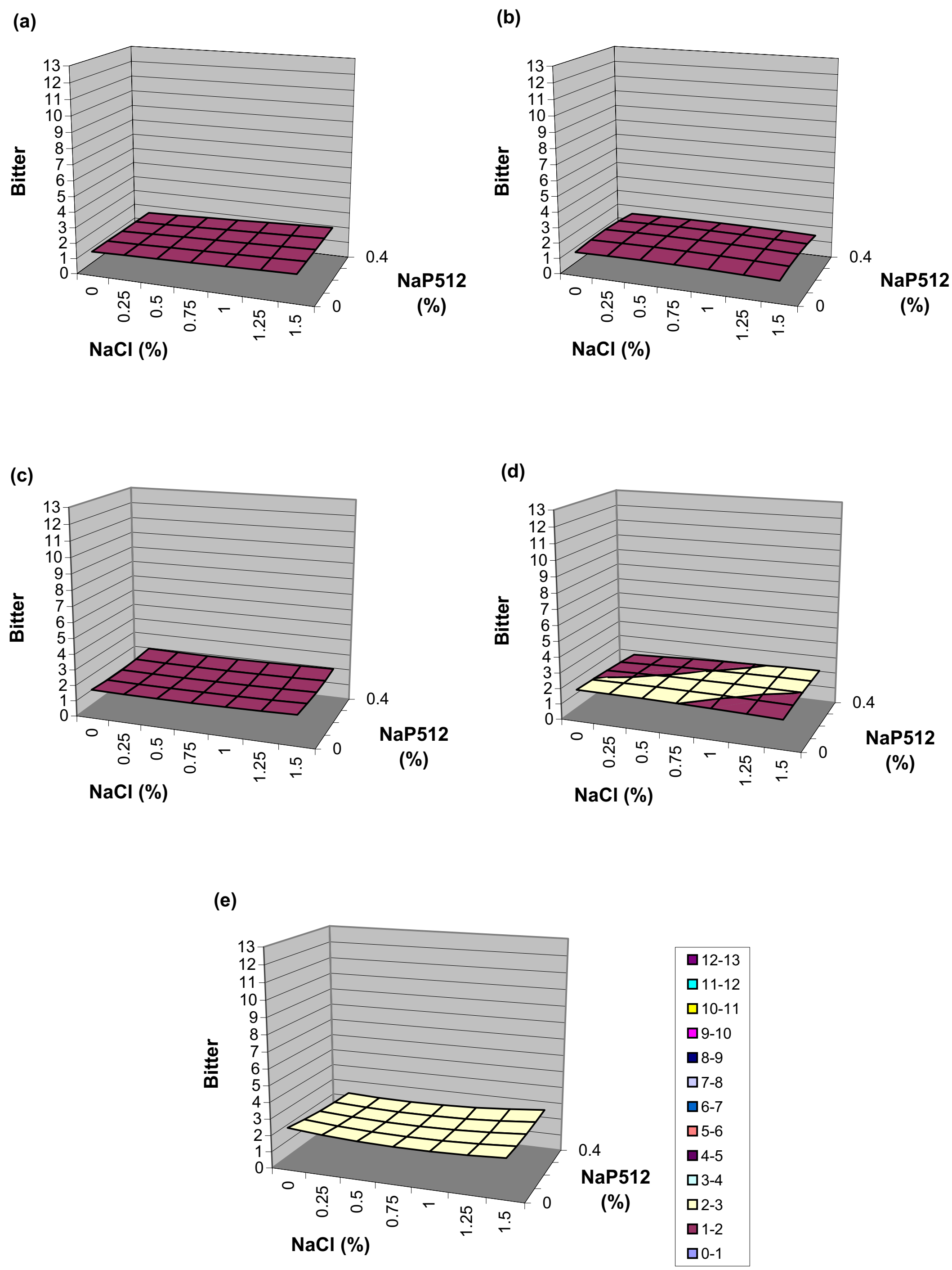

Figure 5. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the bitter basic taste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4 ^{o}C in Experiment 1.

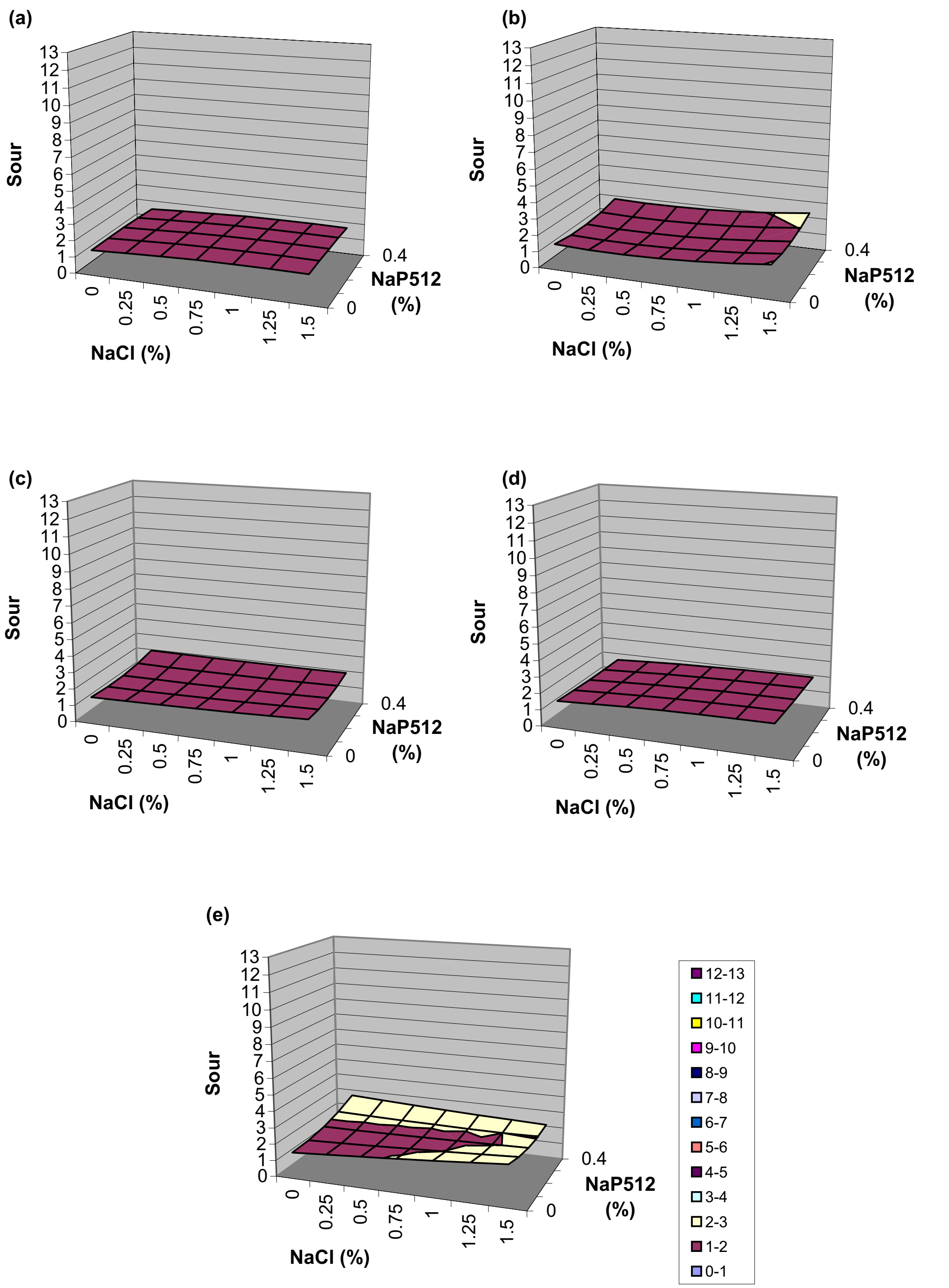

Figure 6. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the sour basic taste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4^{o}C in Experiment 1.

respectively). This interaction indicated that the addition of sodium chloride and/or sodium phosphate affected the intensities of the pork chop attributes differently with storage time and surface response curves were generated for these variables.

According to the least squares means, pork lean/brothy ranged in intensity from greater than four to less than eight. Generally, up to 28 d of storage the addition of NaP (up to .4%) alone had little effect on pork lean/brothy flavor aromatic (Fig. 1). However, the addition of NaCl (0 to 1.5%) alone tended to intensify the pork lean/brothy flavor when compared to the control chops after 14 d storage. According to Figure 1, the combination of approximately .4% NaP + 1.5% NaCl provided the highest intensity of the pork lean/brothy flavor when compared to the other pork chops on most storage days. Increased levels of pork lean/brothy is generally considered a positive sensory attribute. Consumers reported more intense meaty flavor and higher overall like in ground turkey patties containing .5% sodium tripolyphosphate phosphate than in control turkey patties containing no phosphates (Chambers and others 1992). Cooked beefy/brothy, beef fat, and browned flavors attributes were considered positive flavors in reduced fat beef patties (Kulshrestha and Rhee 1992).

Salt basic taste ranged in intensity from greater than one to less than five (Appendix B). As expected, high levels of NaCl (up to 1.5%) alone increased the salt basic taste when compared to the control chops. Generally, this effect was consistent across storage time. The addition of NaP (up to .4%) alone tended to not affect the salt basic taste of the pork chops up to 28 d storage. Although, the perceived salt basic taste tended to be highest in the pork chops containing .4% NaP + 1.5% NaCl when compared all other chops, regardless of storage day. Additionally, with storage salt basic taste increased in pork chops containing 0 to .4% NaP + .5 to 1.5% NaCl. It was expected that the sensory panelist would find salt basic taste in the pork chops containing sodium phosphate and sodium chloride because both ingredients have sodium ions that contribute to the salt basic taste. Salty aftertaste is the measurement of residual salt basic taste after the product is expectorated. As expected, salty aftertastes intensity levels increased in the pork chops as sodium phosphate and sodium chloride were added.

According to Figure 4, pork fat flavor was generally higher in pork chops containing 0 to .4% NaP + > 1% NaCl when compared to the controls or other treated chops, regardless of storage. The addition of sodium phosphate slightly increased pork fat aromatic in pork chops containing greater than .75% sodium chloride during storage, except at storage d 7. Pork fat is considered a positive aromatic and as chemical lipid increases, pork chops tended to be rated higher for overall like, juiciness, tenderness, and flavor (Miller and others 2000).

Bitter basic tastes tended to increase, regardless of treatment, after 14 d of storage and up to 28 d. Anwar (2000) observed similar results where bitter basic tastes found in beef steaks containing .25% sodium tripolyphosphate were not different from the non-injected control steaks. At 0 d of storage, sour basic taste did not differ due to sodium chloride addition. However, after 28 d of storage, pork chops with .3% or greater sodium phosphate and sodium chloride levels of .75% or greater had higher sour basic tastes. This slight increase in sour basic tastes was most likely due to the production of lactic acid by *Lactobacillus ssp.* during vacuum-packaged, refrigerated storage. Maca and others (1997a) also determined that sour flavor increased with storage time and that the dominant microflora was probably *Lactobacillus ssp.* since the ground beef patties were vacuumed-packaged. Phosphate has not been shown to be effective in delaying the growth of *Lactobacilli* (Mendonca and others 1989).

Examination of least squares means from Appendixes A - D indicated that there were significant interactions between treatment and storage day for cardboardy, soda, and chemical flavor aromatics; sweet basic taste; and bitter, soda, sour, metallic, and mature aftertastes, but the intensity levels of these attributes were approaching zero (Appendix E). Additionally, consistent trends were not apparent and these attributes will not be discussed.

There was not a significant ($P > 0.05$) interaction between treatment and storage day for nutty, soapy, acidic, burnt, mature, and other flavor aromatics; and metallic mouthfeel; and soapy, mouthburn, chemical, mature, musty, old, and browned aftertastes (Appendix A – D, respectively). To understand if these attributes were affected by treatment or storage day, Analysis of Variance was conducted using Proc GLM of SAS (1999) where replication, panel, treatment, day, and treatment x day effects were included in the model statement. Neither treatment nor storage day affected ($P > 0.05$) nutty (.01 ± .004), soapy (.57 ± .009), acidic (.00 ± .002), burnt (.00 ± .003), and other (.02 ± .008) flavor aromatics; metallic mouthfeel (.03 ± .009); and browned (.01 ± .006) and musty (.19 ± .006) aftertastes. However, storage day affected ($P \leq 0.05$) mature (.04 ± .003) flavor aromatic; soapy (.60 ± .020), mouthburn (.02 ± .000), chemical (.07 ± .012), and mature (.04 ± .009) aftertastes (Appendix AAD) attributes. Consistent trends were not observed for the aforementioned attributes during storage and levels were less than 1; therefore, these attributes will not be further discussed.

In other research, Keeton (1983) reported an increase in the flavor intensity of pork patties containing 1% NaCl when compared to control patties and that sensory panelists preferred a blend of .25% NaP + 1% NaCl in pork patties. This is consistent with the results from the current study, which indicated that the addition of sodium chloride (up to 1.5%) alone enhanced the pork lean/brothy flavor intensity and the salt basic taste. However, the pork chops injected with approximately .4% NaP + 1.5% NaCl provided the highest pork lean/brothy and salt basic taste when compared to all other pork chops, regardless of storage. Off-flavors, such as painty, fishy, or cardboardy, were not detected at significant intensity levels in the Experiment 1 pork chops containing sodium phosphate and sodium chloride. Smith and others (1984) also reported that no significant off-flavors were found in reheated pork or beef roasts containing sodium tripolyphosphates.

In summary, pork lean/brothy and salt basic tastes were the predominate flavors detected in the pork chops in Experiment 1. These flavors were found at higher levels in pork chops containing greater than .3% NaP and .75% NaCl. Sensory attributes found at lower intensities, pork fat flavor aromatic, sour and bitter basic tastes, and salty aftertastes, also increased slightly with the addition of greater than .3% NaP and .75% NaCl addition.

Texture: The treatment by storage day interaction was significant ($P \leq 0.05$) (Appendix F) for muscle fiber tenderness, juiciness, and processed meat-like bite (Figs. 7 – 9, respectively). The addition of sodium chloride alone did not affect muscle fiber tenderness at 0 d of storage. However, pork chops containing incrementally higher levels of sodium chloride were more tender for chops stored 7 or 28 d. Interestingly, for pork chops stored 14 and 21 d, as sodium chloride level increased from .5 to 1.5%, muscle fiber tenderness decreased slightly. It was expected that tenderness would improve due to muscle protein extraction and increased intermuscular water retention caused by the addition of sodium chloride to the pork chops (Offer and Trinick 1983, Offer and Knight 1988), but this trend was not consistent across storage times. Pork chops containing NaP (up to .4%) alone were more tender than the controls for chops stored on d 0 and 7, but subsequent storage on days 14 and

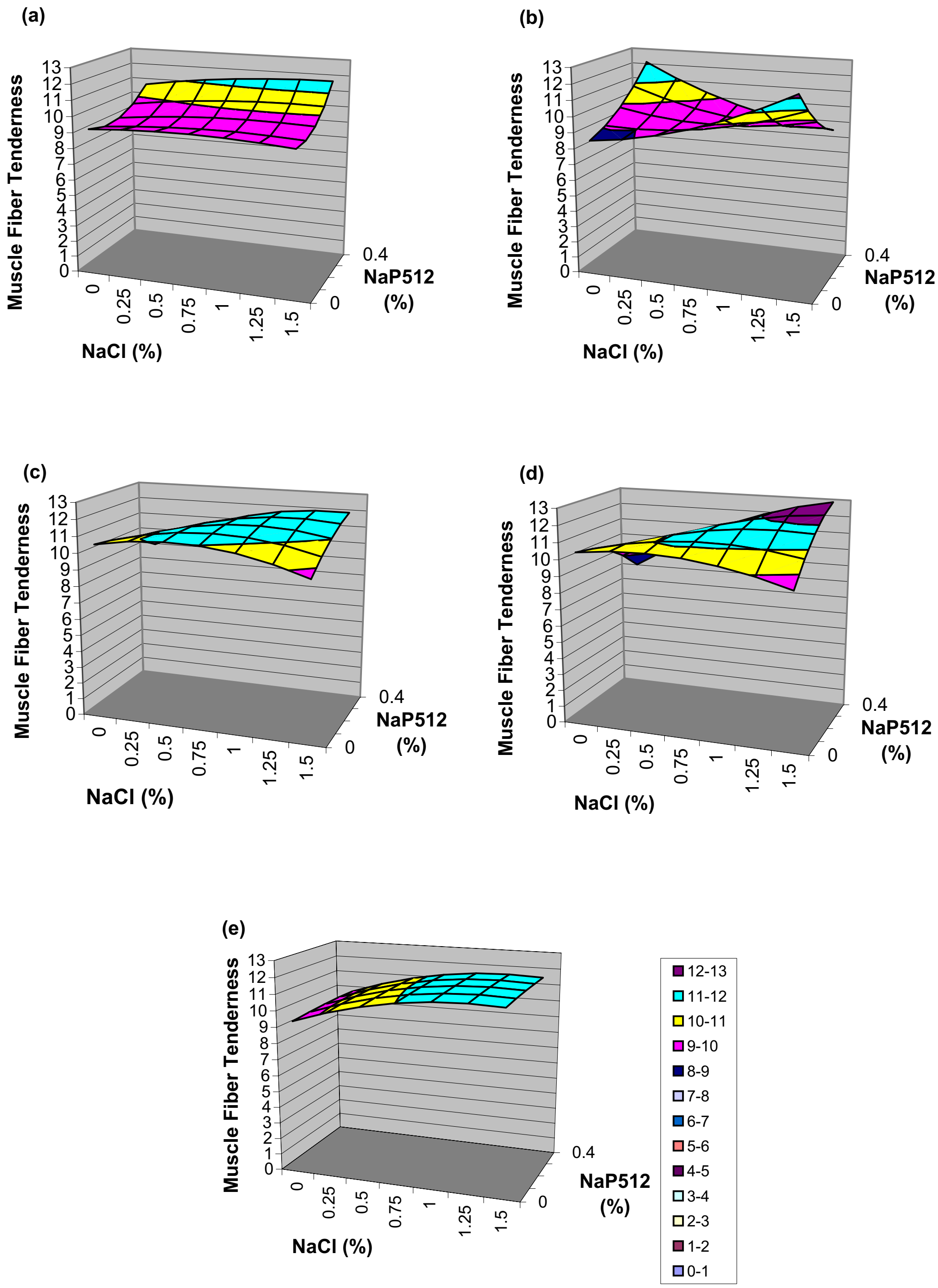

Figure 7. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the muscle fiber tenderness (0 = extremely tough; 15 = extremely tender) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4 ^{o}C in Experiment 1.

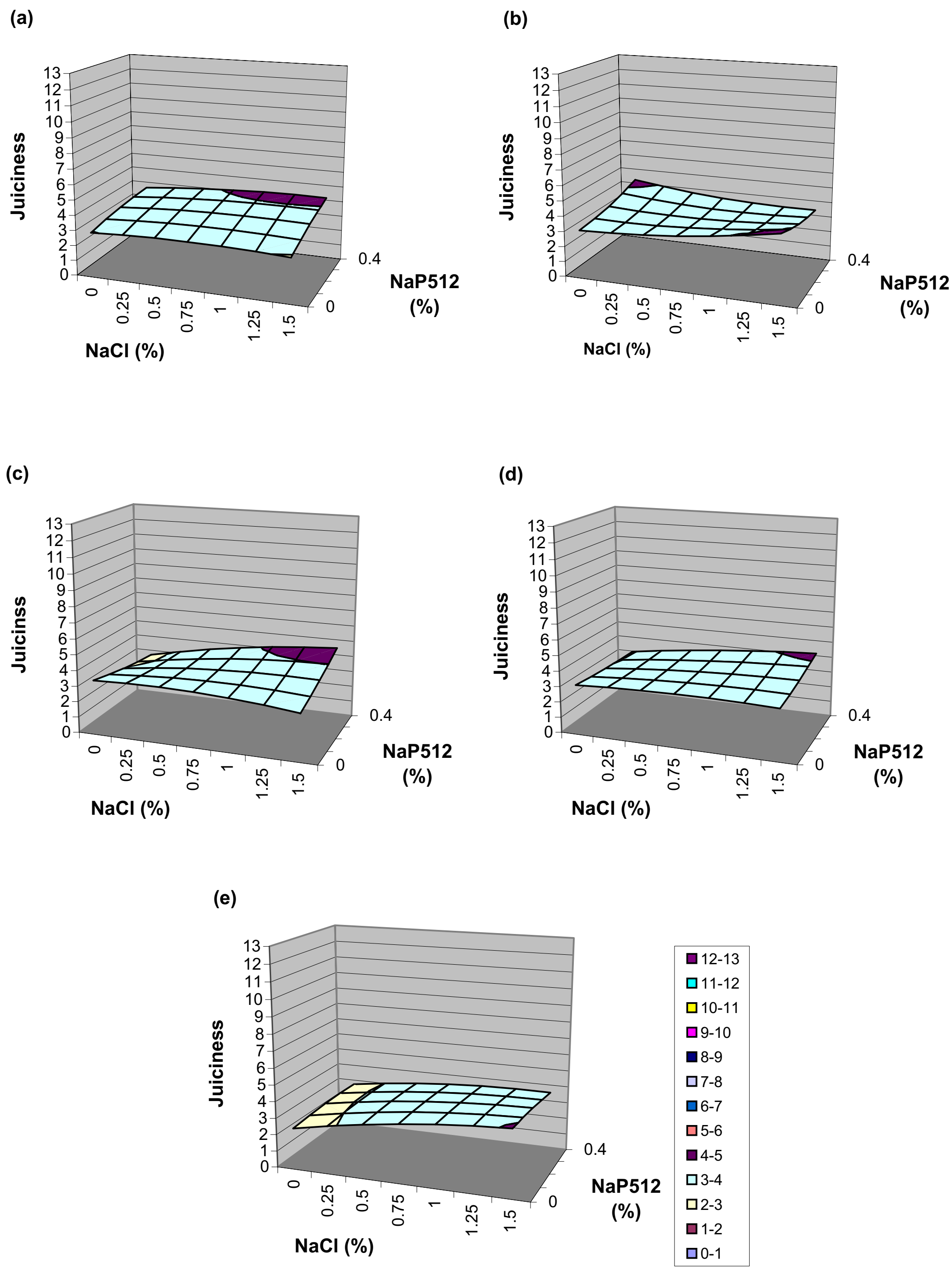

Figure 8. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the juiciness (0 = extremely dry; 15 = extremely juicy) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 1.

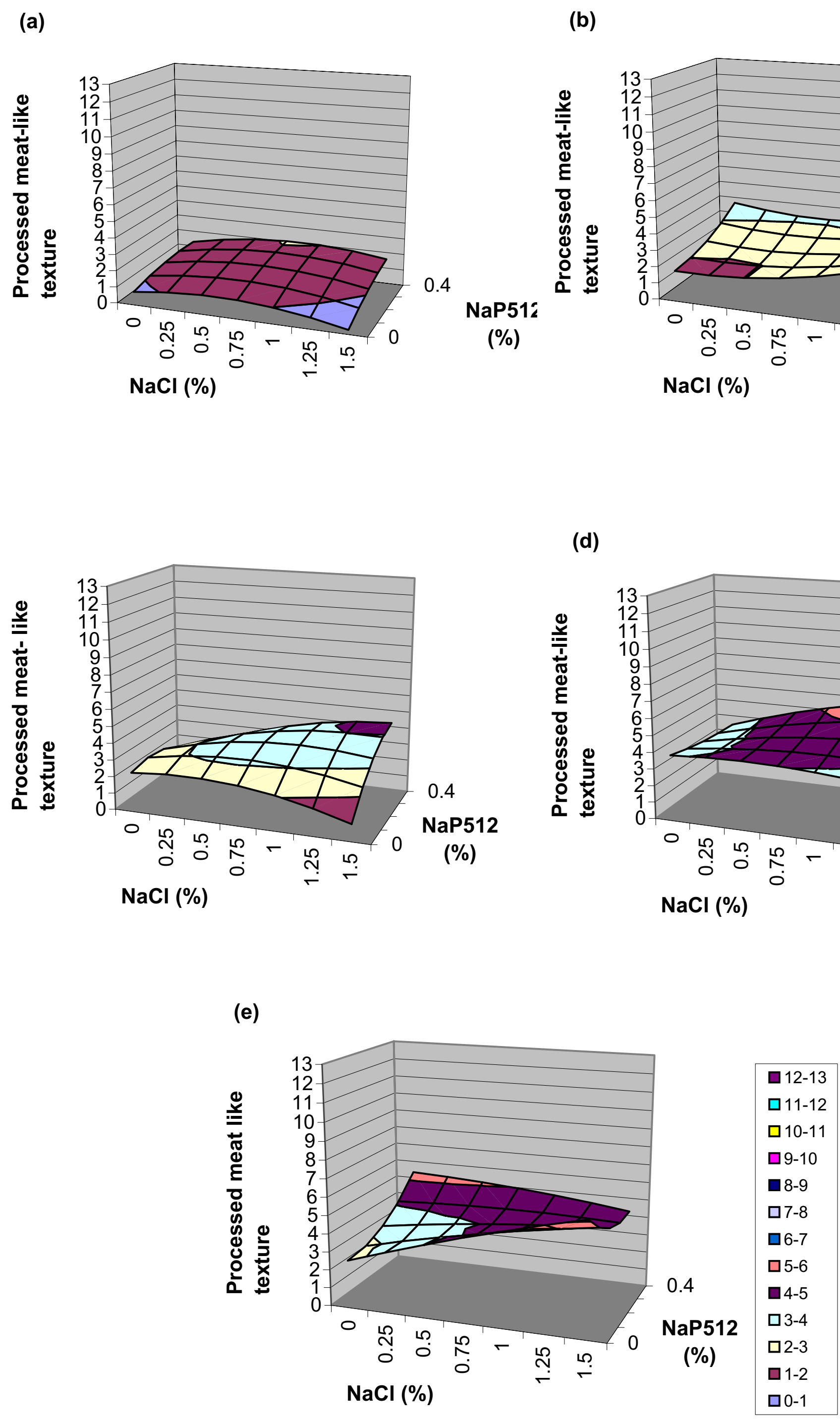

Figure 9. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the processed meat-like bite (0 = whole muscle or steak like; 15 = very soft and rubbery) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 1.

21, chops were incrementally more tender as sodium phosphate levels increased. For chops stored for 28 d, sodium phosphate addition did not affect muscle fiber tenderness. The combined effect of sodium phosphate and sodium chloride addition improved chop muscle fiber tenderness across storage days, except on d 7. Regardless of storage day, pork chops containing NaP (up to .4%) or NaCl (up to 1.5%) alone were generally more juicy or about as juicy as the controls. Cannon and others (1993) also observed improved juiciness in pork loins containing .5% NaP.

Other research reported similar results where NaP (.5%) addition to pork chops resulted in improved chop muscle fiber tenderness and juiciness when compared to the control chops on 0 d (Cannon and others 1993). This effect was most likely due to swelling of myofibrils and the formation of myosin gels which entrap water upon cooking, but this effect was negated with storage time due to an overall increase in tenderness in all of the pork chops during storage (Offer and Knight 1988).

The trained descriptive attribute sensory panel evaluated the processed meat-like bite of the pork samples using the 15-point Spectrum Universal Intensity Scale (1 = fibrous, non-processed pork loin chop, and 15 = extremely soft/rubbery, Spam™-like). The addition of sodium chloride alone of levels from 0 to .75% did not affect processed meat-like bite in pork chops stored from 0 to 21 d. However, for pork chops stored for 28 d, processed meat-like bite increased incrementally with subsequent increases in sodium chloride levels.

The addition of sodium phosphate alone did not consistently increase or decrease the amount of processed meat-like bite in pork chops stored 21 d. However, pork chops stored for 7 or 28 d had higher processed meat-like bite as sodium phosphate levels increased from .2 to .4%. There was a synergistic effect between sodium phosphate and sodium chloride addition in pork chops stored from 7 to 28 d. The processed meat-like bite tended to be higher in pork chops containing .3% or greater sodium phosphate and 1% or greater of sodium chloride. Increased processed meat-like bite in pork chops containing sodium phosphate or sodium chloride is most likely due to the promotion of water uptake and protein swelling. During the cooking process a protein matrix (myosin gel) forms within the muscle proteins, stiffening the myofibrils, which may be associated with a processed meat-like texture (Offer and Knight 1988).

Even though the addition of sodium phosphate or sodium chloride alone did not consistently improve tenderness, juiciness, and processed meat-like bite with storage, the combination of approximately .4% NaP + 1.5% NaCl produced pork chops that were more tender, juicy, and had higher levels of a processed meat-like than control chops on all storage days, except on 7 d where they were approximately as tender and juicy as the controls. Likewise, Keeton (1983) observed similar findings where ground pork patties containing .5% NaP + 2% NaCl were softer, less crumbly, juicier, and more elastic than other treatments and the control. Similarly, Warner-Bratzler shear values, an indicator of tenderness, were lowest in pork loins containing .15% sodium tripolyphosphate in combination with .5% salt or in the absence of salt with .45% sodium tripolyphosphate (Detienne and Wicker 1999). The higher tenderness, juiciness, and processed meat-like bite in the current study could also be associated with the decrease in drip loss and package purge observed in pork chops containing sodium phosphate in combination with sodium chloride. Neutral salts, such as sodium chloride, have the ability to hydrate muscle proteins by breaking the cross-linkages between peptide chains allowing water to bind to polar groups on the side chains. In addition, pyrophosphates have the ability to influence the pH of the muscle system, disrupt the stability of the actomyosin complex, and form complexes with alkaline metals, which also allows water to bind in available side chains, as discussed previously. Therefore, when phosphates are combined with sodium chloride and added to pork chops there is a synergistic effect that increases protein swelling, WHC, muscle fiber tenderness, juiciness, and processed meat-like texture.

Color: Color is an important attribute for pork because consumers use color as a determinant for purchase and quality assessment (Brewer and others 1991). It is well documented by previous research that alkaline phosphates stabilize meat color overtime and that the addition of sodium tripolyphosphates increases the redness of pork loin chops and ground beef patties (Molins and others 1987, Mendonca and others 1989). Sodium chloride addition also has been shown to make ground beef patties darker in color (Maca and others 1997a). Appendixes G and H, respectively, show that there was a significant (P

≤ 0.05) interaction between treatment and storage day for color, CIE L* color space values, the amount of discoloration, the color of discoloration (Figs. 10 - 13, respectively), but not for CIE a* and b* color space values (Appendix H). Since there is a direct correlation between color and pH of pork, the pH of each pork loin was evaluated prior to injection. The pH of the pork loins did not differ (P = .57) prior to injection; therefore, pork chop color attributes were not affected by the initial pH of the loins (Table 2).

The addition of greater than .75% NaCl alone tended to make the pork chops appear slightly lighter red in color on all storage days, except 7 d, when compared to control chops (Fig.10). Maca and others (1997a) reported similar results. The CIE L* color space values indicated similar trends except for pork chops stored for 28 d (Fig. 11). In these chops, increased addition of sodium chloride resulted in darker chops. The addition of .2% or greater sodium phosphate in combination with .75% or greater sodium chloride stored 0, 14, 21, and 28 d resulted in dark colored pork chops (Fig. 10 and 11). For pork chops stored 7 d, the R^2 value from the regression analysis used to generate surface response graphs was much lower than R^2 values on the other storage day regression equations. This most likely explains why the surface response curves for pork chops stored for 7 d differed from the curves for the other storage days. Treatment did affect ($P \leq 0.05$) CIE a * color space values (Appendix I and Fig. 14).

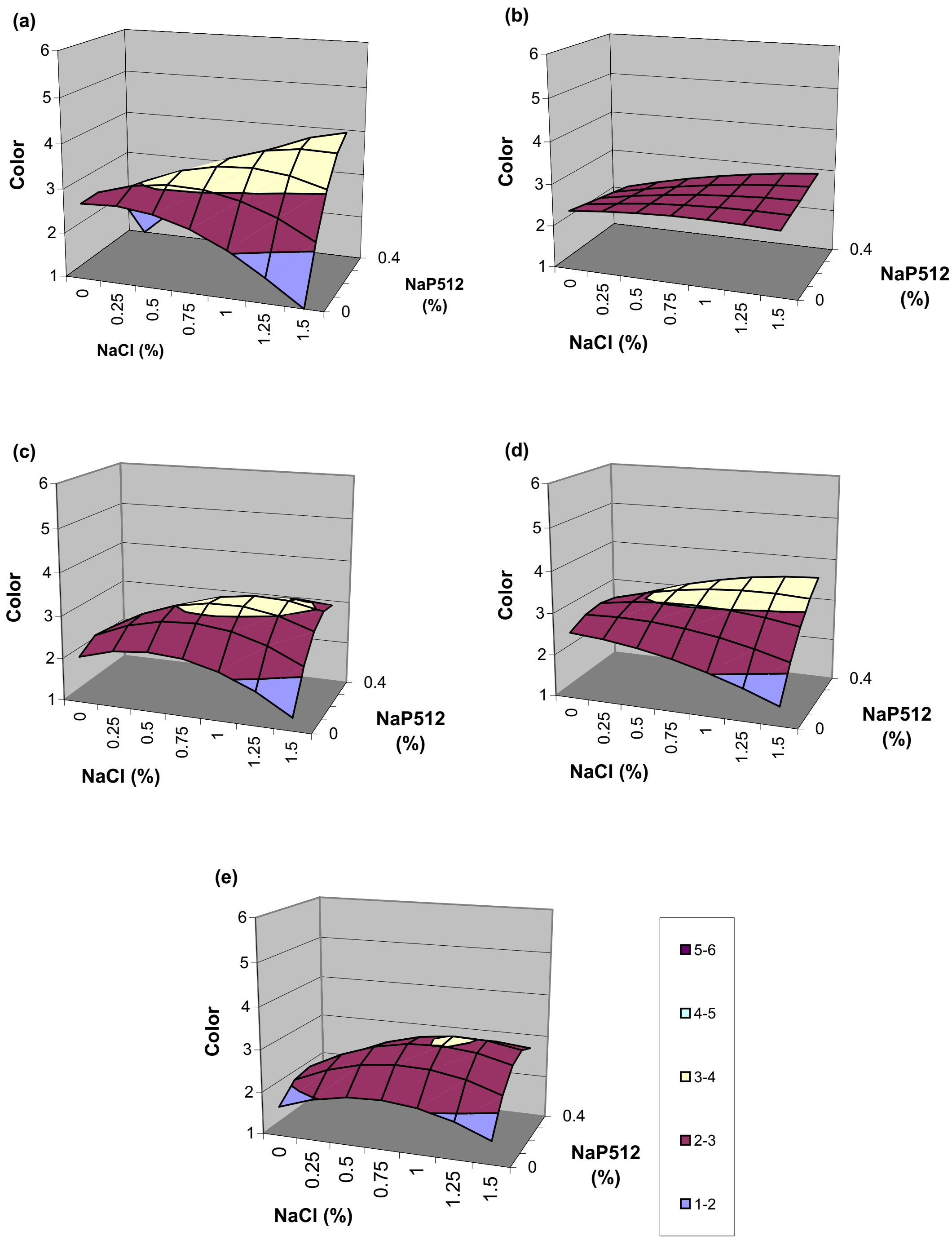

Figure 10. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the color (1 = pale pink; 6 = pinkish red) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4 ^{o}C in Experiment 1.

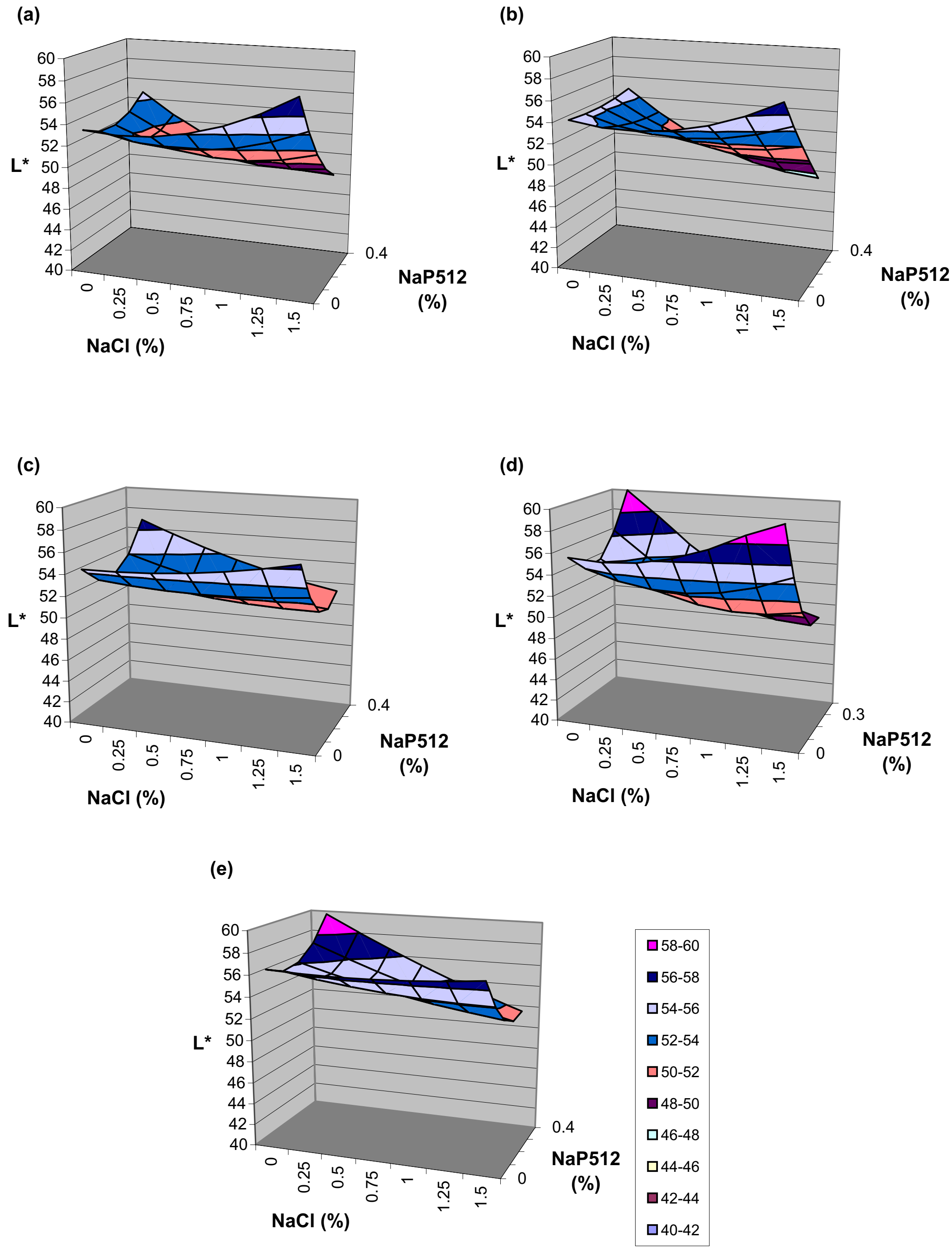

Figure 11. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the L* color space value (0 = black; 100 = white) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 1.

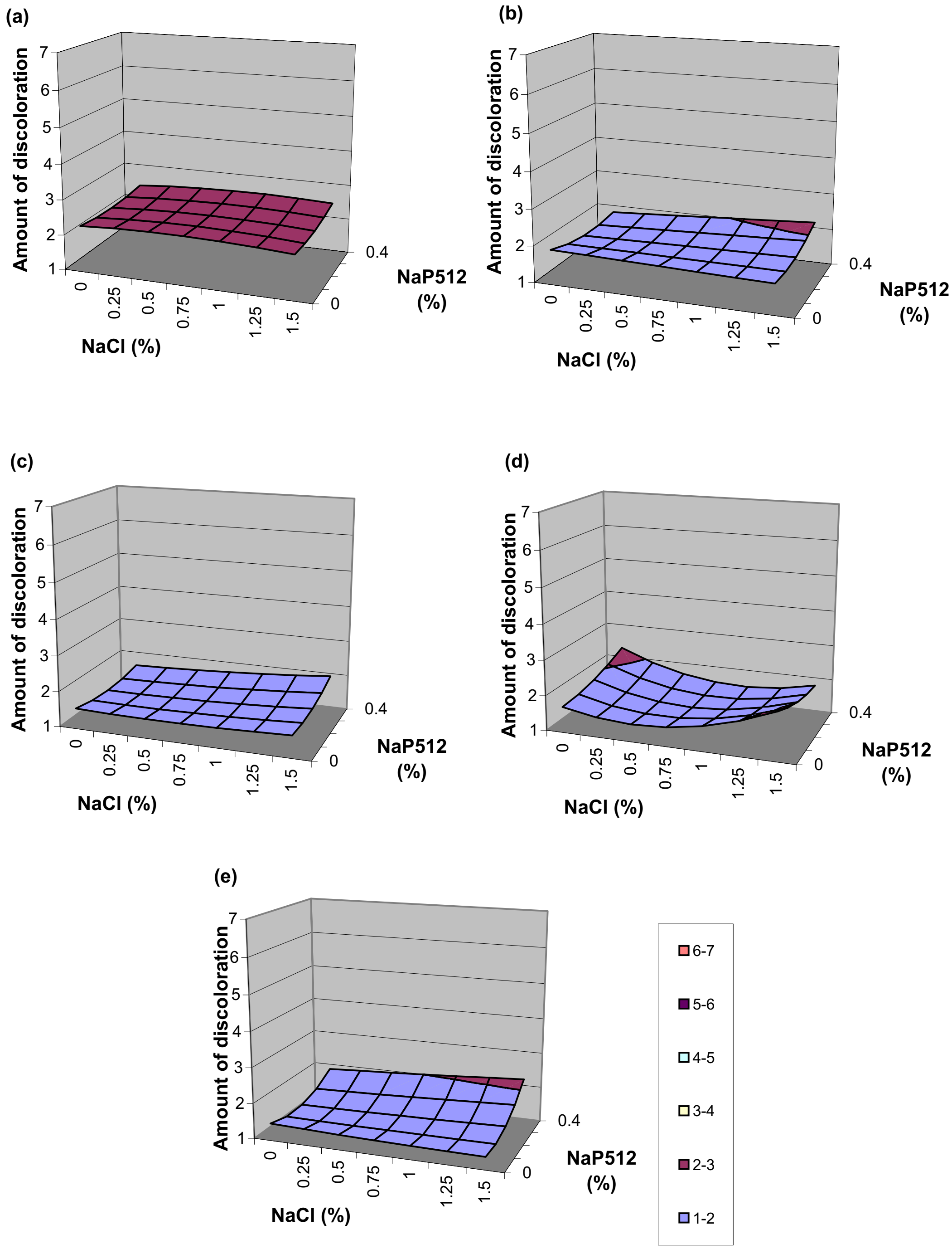

Figure 12. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the amount of discoloration (1 = 0% discoloration; 7 = 100% discoloration) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4^{o}C in Experiment 1.

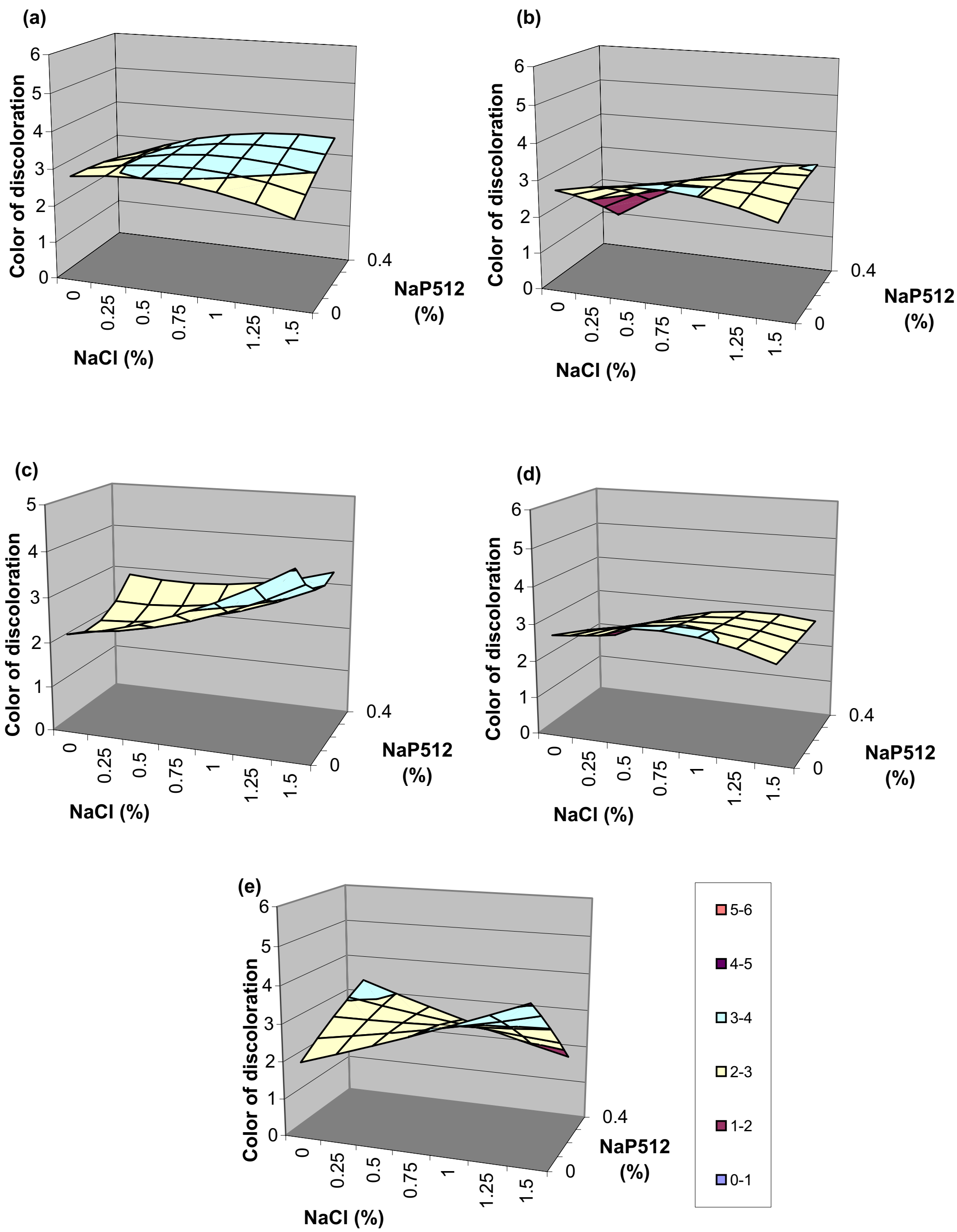

Figure 13. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the color of discoloration (0 = pinkish gray; 6 = pinkish red) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4^{o}C in Experiment 1.

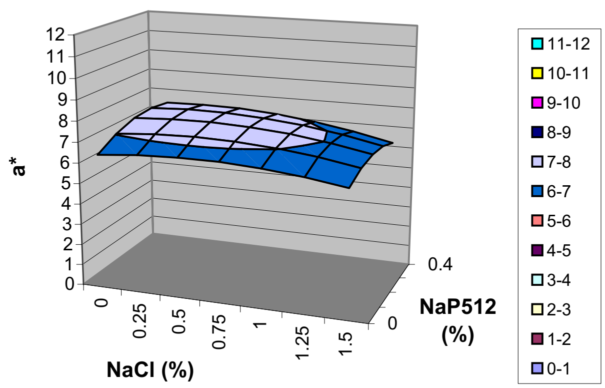

Figure 14. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the CIE a* color space value (+a = red; -a = green) of pork loin chops in Experiment 1.

Table 2- Least squares means for pork loin pH prior to injection for experiments 1, 2, 3, 4, and 5.

Experiment 1	(n^a = 30)	.5706[b]	0.2027[c]
1		5.9233	
2		5.7550	
3		5.8250	
4		6.0250	
5		5.9450	
6		5.9200	
7		6.0167	
8		5.8977	
9		5.9233	
10		6.1433	
Experiment 2	(n = 30)	.5745	0.2564
1		5.8000	
2		5.9000	
3		5.8900	
4		6.0850	
5		5.9625	
6		6.1650	
7		5.8500	
8		6.1875	
9		5.6825	
10		5.7675	
Experiment 3	(n = 30)	.0180	0.0810
1		5.5875	
2		5.6225	
3		5.5300	
4		5.5950	
5		5.6150	
6		5.7025	
7		5.5950	
8		5.7175	
9		5.4850	
10		5.9200	

Table 2- Continued

Experiment 4	(n = 30)	.0300	0.1520
1		5.8583	
2		5.5350	
3		5.6400	
4		5.5783	
5		5.6650	
6		5.6350	
7		6.0050	
8		5.8567	
9		5.6283	
10		5.6957	
Experiment 5	(n = 30)	.1627	0.1132
1		5.8183	
2		5.8117	
3		5.7967	
4		5.8500	
5		5.8150	
6		5.8467	
7		5.7117	
8		5.6267	
9		5.6283	
10		5.6300	

[a] n = total number of observations
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error

The CIE a* color space values indicated that pork chops injected with .75% NaCl alone were redder then the control chops (Appendix AY). The addition of .2% NaP alone made the pork chops appear slightly darker red in color when compared to the controls. Response surface curves showed that the addition of sodium phosphate at levels greater than .2% made the pork chops appear lighter than the controls, which was not expected. It is likely that the response surface curves were cubic, but that effect was not tested. Estimated values near the means of the independent variables, which is the middle area of the response surface curve, tend to have smaller standard errors than the estimates near the extreme values of the independent variables. This may explain why estimated values near the exterior points of the response surface curves showed slightly different effects than would be expected. Results indicated that pork chops containing .75% NaCl and greater than .2% NaP were the darkest, regardless of storage. This stabilizing effect of sodium phosphate in combination with sodium chloride in Experiment 1 can be attributed to their ability to increase the WHC of the muscle proteins; subsequently less water was on the surface to reflect light making the pork chops appear darker in color. Package purge and drip loss results support this hypothesis. These trends are supported by research conducted by Molins and others (1987) and Mendonca and others (1989). The higher a* color space scores can be contributed to the increase in muscle pH (Molins and others, 1987), even though pH did not differ in the current study.

Storage day did affect ($P \leq 0.05$) CIE b* color space values (Appendix ADD) which ranged from 3.20 on 0 d to 3.86 on 28 d indicating that the pork chops became more yellow with storage time regardless of treatment. Storage also affected ($P \leq 0.05$) CIE a* color space values which ranged from 6.96 at 0 d to 7.64 at 21 d to 7.00 at 28 d indicating that pork chops became more red with storage and then redness decreased at the end of storage.

Figure 12 indicated that the amount of discoloration ranged from greater than one to less than three on a 7-point scale (1 = no discoloration to 7 = 100% discoloration). When compared to the control chops, pork chops containing .75% NaCl or .2% NaP were generally less discolored and had darker discoloration on (Appendix G). Consequently, chops containing approximately .4% NaP + .75% NaCl were generally more discolored and had darker discoloration when compared to the controls, regardless of storage day (Appendix G) (Fig. 12). With storage time up to 28 d, the amount of discoloration decreased in the pork chops, regardless of treatment. Early discoloration would most likely be a result of uneven distribution of the brine injection, water uptake, and pH; however, with storage time the darker discoloration could be attributed to microbial growth or oxidation of myoglobin.

In summary, pork chops containing approximately .4% NaP + .75% NaCl had slightly darker discoloration then the control chops. However, sensory color, CIE L* and a * color space values indicated that pork chops containing the combination of approximately .2% NaP and .75% NaCl were darker red in color and maintained the color up to 28 d storage when compared to the controls. These results are supported by other research, which has reported that the addition of alkaline phosphate to meat products improved and stabilized meat color over storage time (Molins and others 1987; and Mendonca and others 1989). Package purge also decreased with storage time and with the addition of sodium phosphate and sodium chloride in Experiment 1, which indicates that less free water was available to reflect light making the pork chop appear darker in color.

Cooking analysis, pH, and drip loss: As indicated in Appendixes J - K, there was a significant ($P \leq 0.05$) treatment by storage day interaction for package purge and drip loss (Figs. 15 – 16, respectively), however, the interaction was not significant ($P \leq 0.05$) for cook time, cook loss, and pH.

According to the least squares means, package purge ranged from greater than one to less than eight, and increased with storage regardless of treatment (Appendix J). Increased levels of greater than .2% NaP alone slightly decreased package purge in chops after 0 d of storage and increased levels of NaCl decreased package purge (Fig. 15). The decrease in package purge with increasing sodium chloride levels is most likely due to the increase in the WHC of pork loin chops containing sodium chloride. The effects of sodium phosphate and sodium chloride on water uptake have been attributed partially to a rise in pH, changes in the isoelectric point of the meat system, and the swelling of the

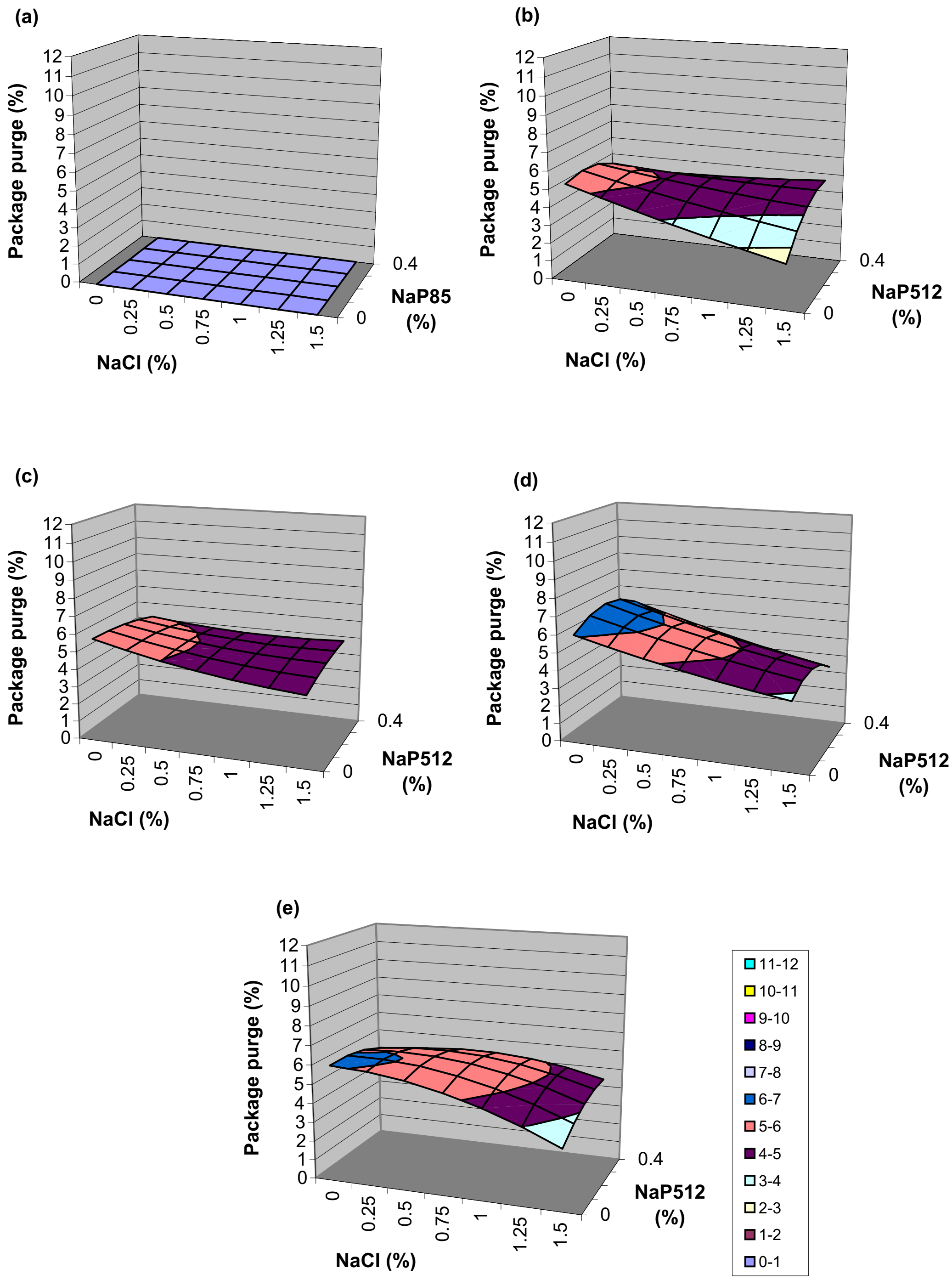

Figure 15. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the package purge of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4 °C in Experiment 1.

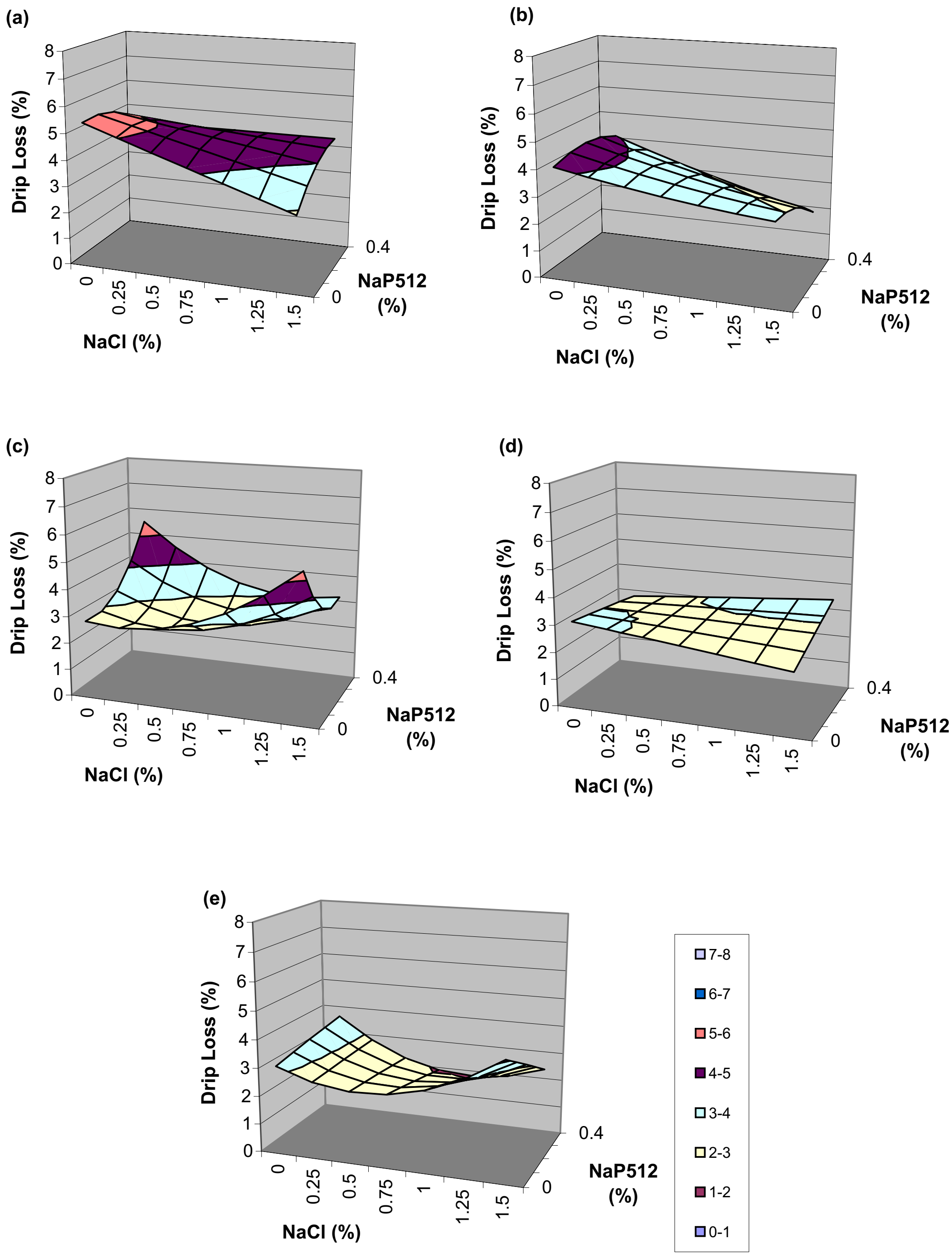

Figure 16. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the drip loss of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4 °C in Experiment 1.

myofibrils. The mechanisms of how sodium phosphate and sodium chloride work synergistically in the meat system is highly debated, however, it has been noted that there are marked increases in the water uptake when they are used together in meat products (Keeton 1983, Offer and Knight 1988).

With increased storage, drip loss decreased in all the pork chopsregardless of treatments (Appendix K). This was expected because package purge increased with storage time, which would indicate that there would be less water in the pork chops to loose during the drip loss experiment. The least squares means indicated that the addition of .75% NaCl or greater levels of resulted in lower drip loss, regardless of storage day (Fig. 16). Additionally, the addition of NaP alone up to .4% tended to decrease drip loss slightly, except on d 14 (Fig. 16). Overall, the combination of higher amounts of sodium phosphate (up to .4%) and sodium chloride (up to 1.5%) appeared to decrease the amount of drip loss when compared to the controls on most storage days. Likewise, Keeton (1983) reported a synergistic effect between sodium chloride and sodium phosphate.

Although it has been well documented that the addition of sodium chloride and sodium phosphates increase the ability of meat proteins to hold water and reduce package purge, the key is to combine this information with optimal sensory and color attributes (Molins and others 1987; Keeton 1983; Jones and others 1987; and Vote and others 2000). Based on the results of this experiment, it would be recommended that pork chops contain the combination

Table 3- Least squares means for brine pH for experiments 1, 2, 3, 4, and 5.

Treatment		
Experiment 1 (n = 27)	.2404[a]	0.6230[b]
0.1% NaP512[1] + 0.375% NaCl[2]	7.6783	
0.1% NaP512 + 1.125% NaCl	7.5067	
0.2% NaP512 + 0% NaCl	8.0250	
0.2% NaP512 + .75% NaCl	7.2383	
0.2% NaP512 + 1.5% NaCl	6.9333	
0.3% NaP512 + 0.375% NaCl	7.9650	
0.3% NaP512 + 1.125% NaCl	7.2067	
0.4% NaP512 + 0.75% NaCl	7.0950	
0% NaP512 + 0.75% NaCl	8.1117	
Experiment 2 (n = 27)	.0135	0.3934
0.1% NaP85[3] + 0.375% NaCl	7.5075	
0.1% NaP85 + 1.125% NaCl	6.9150	
0.2% NaP85 + 0% NaCl	8.3700	
0.2% NaP85 + .75% NaCl	7.1375	
0.2% NaP85 + 1.5% NaCl	6.6800	
0.3% NaP85 + 0.375% NaCl	6.5225	
0.3% NaP85 + 1.125% NaCl	6.8800	
0.4% NaP85 + 0.75% NaCl	7.1450	
0% NaP85 + 0.75% NaCl	8.2175	
Experiment 3 (n = 27)	.0001	0.0349
1.0% NaL[4] + 0.1% NaP	6.9575	
1.0% NaL + 0.3% NaP	7.0050	
2.0% NaL + 0% NaP	6.3075	
2.0% NaL + 0.2% NaP	7.0175	
2.0% NaL + 0.4% NaP	7.0200	
3.0% NaL + 0.1% NaP	6.9800	
3.0% NaL + 0.3% NaP	7.1725	
4.0% NaL + 0.2% NaP	7.0634	
0% NaL + 0.2% NaP	7.1125	
Experiment 4 (n = 27)	.0393	0.3040
1.0% KL[5] + 0.1% NaP	7.0283	
1.0% KL + 0.3% NaP	6.8317	
2.0% KL + 0% NaP	7.3417	
2.0% KL + 0.2% NaP	6.8733	
2.0% KL + 0.4% NaP	6.6067	
3.0% KL + 0.1% NaP	6.9333	
3.0% KL + 0.3% NaP	6.5783	
4.0% KL + 0.2% NaP	6.8867	
0% KL + 0.2% NaP	7.4433	

Table 3- Continued

Treatment		
Experiment 5 (n = 27)	.0001	0.1165
0.05% NaDi[6] + 0.1% NaP	6.2400	
0.15% NaDi + 0.1% NaP	5.9483	
0.05% NaDi + 0.3% NaP	6.7583	
0.15% NaDi + 0.3% NaP	6.1050	
0% NaDi + 0.2% NaP	7.2850	
0.2% NaDi + 0.2% NaP	5.8150	
0.1% NaDi + 0% NaP	5.7383	
0.1% NaDi + 0.4% NaP	6.4867	
0.1% NaDi + 0.2% NaP	6.0933	

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaP512: sodium phosphate 512, [2]NaCl: sodium chloride, NaP85[3]: sodium phosphate 85, NaL[4] sodium lactate, KL:[5] potassium lactate, NaDi[6]: sodium diacetate.

of sodium phosphate and sodium chloride to minimize package purge and drip loss.

Neither treatment nor storage day significantly ($P > 0.05$) affected the pH of the pork loin chops ($5.847 \pm .029$). According to Table 3, the pH of the brine solutions did not ($p = .24$) differ among treatments, but it should be noted that there was a 1.3 pH unit difference between the brine solution with highest pH and the brine solution with the lowest pH. The lack of significance within the brine solutions is most likely due to the high variability of the brine solution pH. Additionally, Table 2 showed that the pH of the pork loins did not differ ($p = .57$) prior to injection. It would then be reasonable to assume that because the brine pH and loin muscle pH did not significantly differ, the pH of the treated pork loin chops would expectantly not differ ($P > 0.05$). To further test if the pH of the pork chops were influenced by the pH of the pork loins prior to injection, analysis of variance was conducted using SAS (1999) where the preinjected loin pH was used as a covariate. The results indicated that preinjected loin muscle pH did not influence the pH of the pork chops during storage ($P \leq 0.05$). Other studies have shown that sodium phosphates addition acts to improve WHC, color, package purge, and cook loss by increasing the muscle pH, binding metal ions, and/or depolymerization or dissociation of the myosin and actin filaments, as mentioned previously. However, these effects are dependent on temperature, the initial pH of the muscle tissue, and the concentration of Mg^{2+}, Ca^{2+}, and Cl^- (Offer and Knight 1988). In the current study, the temperature of the brine solutions were not recorded; however all processing was done in the same location and the same water source was utilized for all the Experiments. Treatment and storage day ($P \leq 0.05$) affected the cook loss of pork chops (Appendix AI and AE). According to Figure 17, cook loss ranged from greater than five to less than 35%. Pork chops containing .2% NaP alone or.75% NaCl alone had more cook loss than the controls (Figure 17) (Appendix AY). However, cook loss decreased in pork chops containing the combination of sodium phosphate (up to .4%) and sodium chloride (up to 1.5%). In fact, cook loss was lowest in pork chops containing .3% NaP + 1.125% NaCl when compared to any other treatment (Appendix AE). In similar research, Detienne and Wicker (1999) also determined that cook loss was lowest in pork loins containing .45% sodium tripolyphosphate in combination with 1.5% sodium chloride. As mentioned previously, there is a synergistic effect when sodium chloride is combined with sodium phosphate. Storage day also significantly affected cook loss (Appendix AE). Cook loss decreased with storage time and ranged from 25.73 on 0 d to 19.46 on 28 d. This effect can be contributed to enzymatic muscle protein deterioration during storage that results in water released from the protein matrix and increasing the percentage of free water. Free water is more easily lost during cooking.

Storage day affected ($P \leq 0.05$) cook time (Appendix Table AAD) as well. Cook time ranged from 25.51 m on 0 d to 20.97 m on 28 d indicating that cook time decreased with increased storage time. Although there is little research

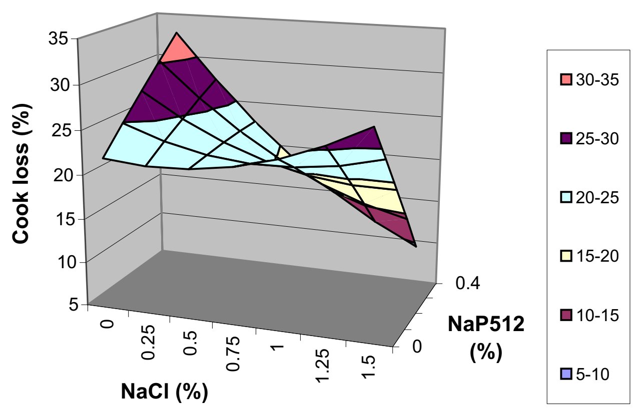

Figure 17. Response surface of sodium phosphate 512 (NaP512) and sodium chloride (NaCl) levels on the cook loss of pork loin chops in Experiment 1.

examining the effects of sodium phosphate and sodium chloride on cook time, it is likely that the amount of time it took for the pork chops to reach 70°C decreased with storage time because muscle proteins had lower WHC. This is evident in the current study by a decrease in package purge with storage time and higher cook loss in chops stored longer.

The results from Experiment 1 indicated that pork loin chops should contain approximately .75 to 1% sodium chloride in combination with .2% sodium phosphate. This ingredient combination resulted in high pork lean/brothy aromatics, minimal salt basic taste, increased muscle fiber tenderness and juiciness and, minimal processed meat-like bite over storage time. Additionally, the color of the pork loin chops with this treatment combination was darker red and package purge and drip loss was lower. Consumer research should be conducted to verify these results.

Experiment 2

As mentioned in Experiment 1, sodium phosphate is primarily used in pork to reduce purge and cook loss; and improve meat color, juiciness, and tenderness, although high levels have increased processed meat-like bite (Miller 2001). Experiment 2 examined the interaction of sodium chloride at 0 to 2% and sodium phosphates from 0 to .4% on the palatability, texture, color, pH, and water-holding capacity of pork loin chops. The sodium phosphate used in this experiment was a rapid acting blend of sodium polyphosphates and diphosphates (pyrophosphates) (8.5 $\pm$ .3 pH). This phosphate is less soluble in water compared to the sodium phosphate blend used in Experiment 1 due to the presence of the pyrophosphates. The low solubility of this blend makes it difficult to dissolve the mixture in the brine solution. Pyrophosphate (diphosphate) is the active form of phosphate that aides in increasing water-holding capacity, and has a higher buffering capacity, which assists in maintaining the pH in the muscle system, as mentioned previously. Appendixes L - Q shows the effects that sodium phosphate and sodium chloride had on sensory aromatics, feeling factors, basic tastes, and texture, color, cooking analysis, drip loss and pH for Experiment 2.

Sensory aromatics, feeling factors, and basic tastes: In Experiment 2, overall pork chop flavor consistent mostly of pork lean/brothy flavor aromatic and salt basic tastes. Intensity levels of pork fat flavor aromatic, and sour and bitter basic tastes were slightly detectable; and very low intensity levels of soda flavor; metallic and astringent mouthfeels; sour, salty, bitter, soda, metallic, and musty aftertastes were detected in the pork chops. Other attributes that were detected at intensity levels that approached zero were chemical, browned, musty, serum/bloody, livery, vinegar; sweet basic taste; and other aftertastes.

There was a significant ($P \leq 0.05$) interaction between treatment and storage day for pork lean/brothy aromatic, salt basic taste, pork fat flavor aromatics, and soda aftertaste variables (Appendixes L - N, respectively) (Figs. 18 – 21).

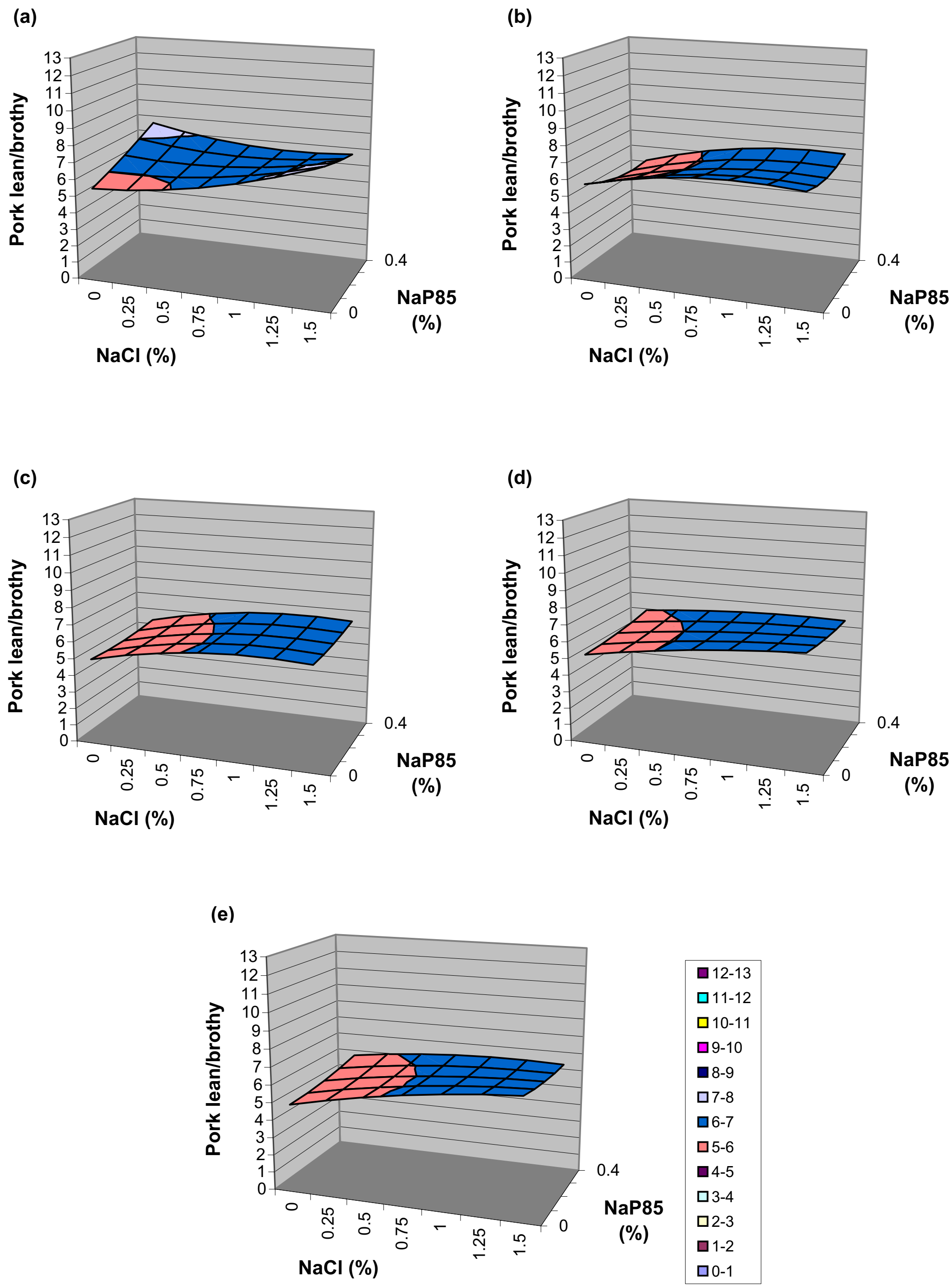

Figure 18. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the pork lean/brothy aromatic (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 2.

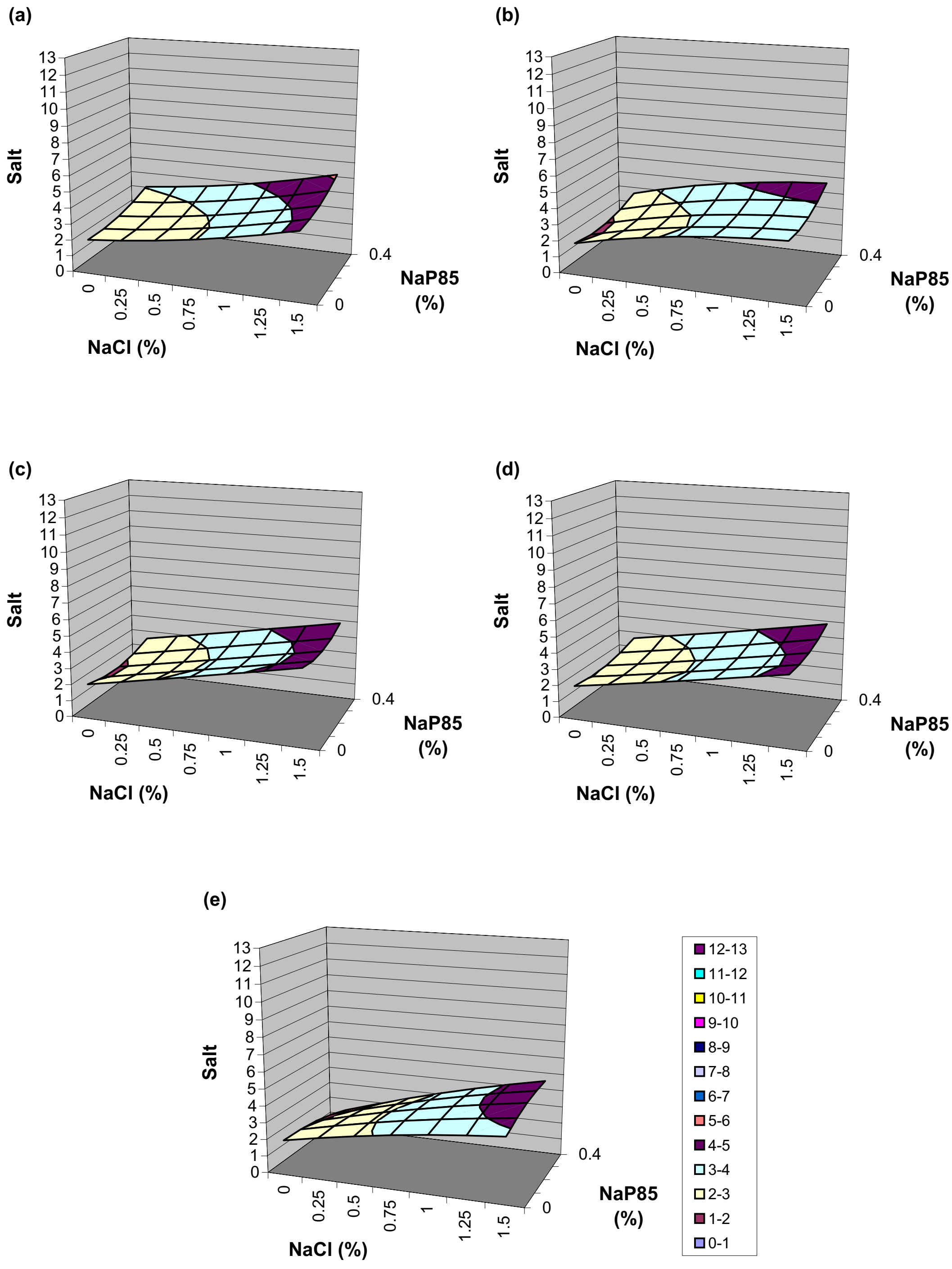

Figure 19. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the salt basic taste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 2.

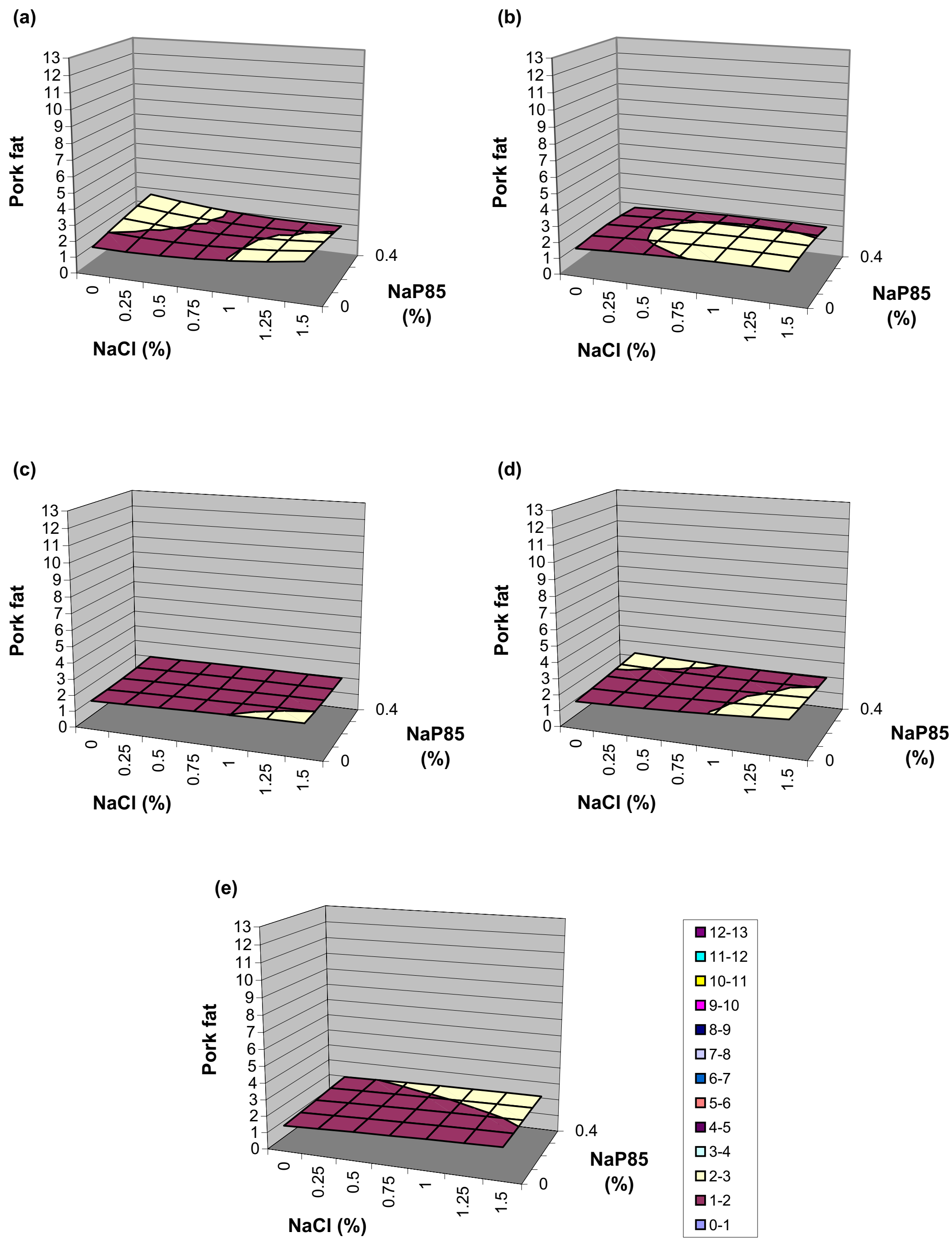

Figure 20. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the pork fat aromatic (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4oC in Experiment 2.

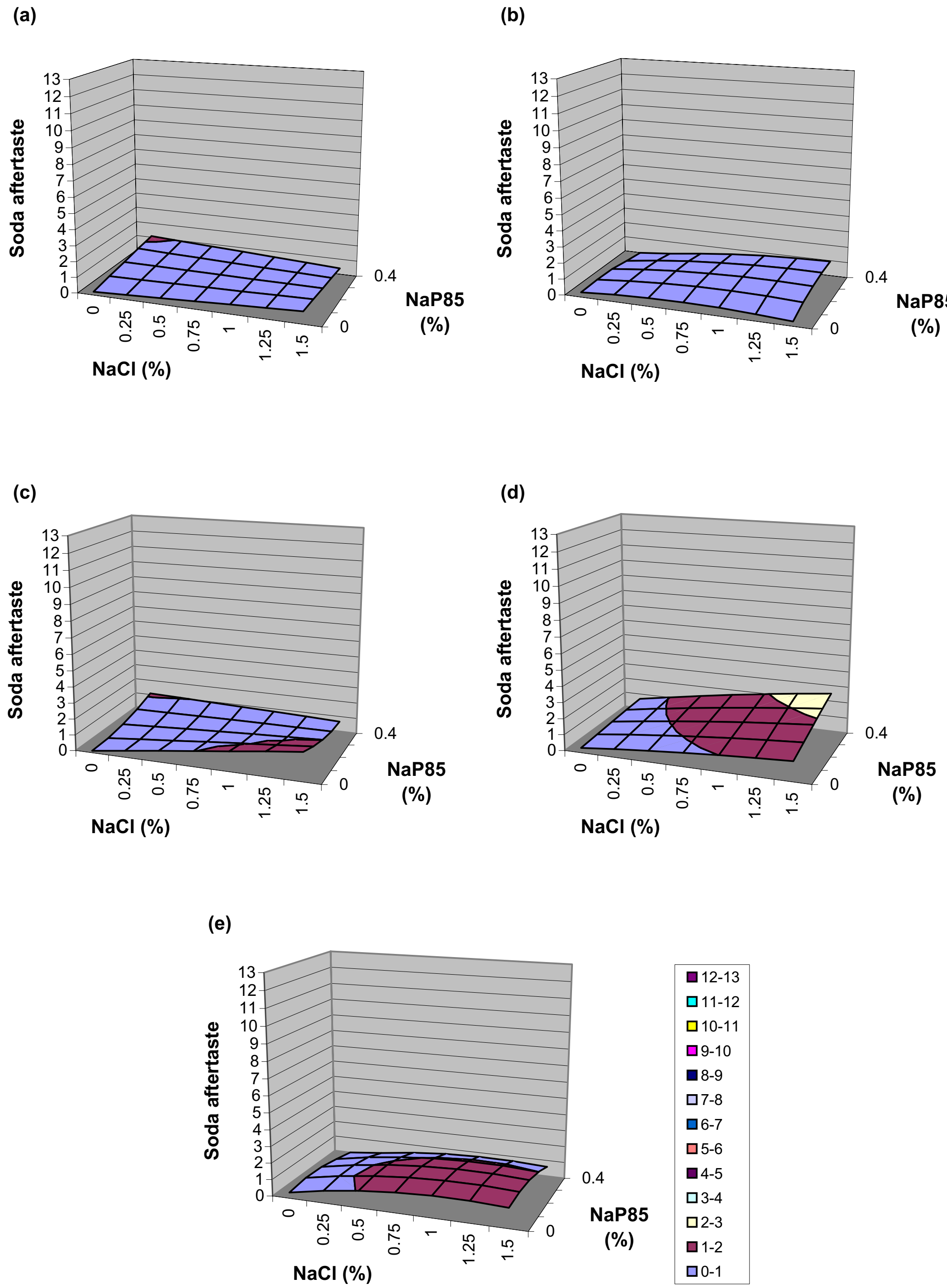

Figure 21. Response surface of sodium phosphate 85 (NaP85) and sodium chloride(NaCl) levels on the soda aftertaste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4^{o}C in Experiment 2.

Pork lean/brothy ranged in intensity from greater than four to less than eight, and overall decreased slightly, regardless of treatment, up to 28 d storage (Appendix L). Pork chops treated with .2% NaP were higher in pork lean/brothy when compared to the control on 0, 21, and 28 d, but slightly lower on 7 and 14 d. This is not consistent with results from Experiment 1, which indicated that the addition of sodium phosphate had little effect on the pork lean/brothy flavor. Figure 18 indicated that as sodium chloride levels increased from 0 to 1.5%, cooked pork lean/brothy increased, which is consistent with the results from Experiment 1. As in Experiment 1, pork chops containing approximately .4% NaP + 1.5% NaCl were highest in pork lean/brothy after 7 d storage when compared to all other pork chops (Fig. 18).

Salt basic taste tended to increase with the incremental addition of sodium chloride up to 1.5% regardless of storage day (Fig. 19). Similar results were reported in Experiment 1. Additionally, as in Experiment 1, sodium phosphate tended to not have as much of an affect on salt basic taste as sodium chloride. As expected, when high levels of sodium phosphate (up to .4%) are combined with subsequent increases in sodium chloride (up to 1.5%) levels, salt basic taste intensity increased. As previously described in Experiment 1, the presence of sodium ions from sodium phosphate and sodium chloride contribute to the intense salt basic taste of the pork loin chops.

Pork fat, ranging in intensity from greater than one to less than three, overall decreased slightly with storage time (Appendix L). The least squares means indicated that pork fat flavor and soda aftertaste were higher in the treated chops when compared to the controls, regardless of storage. However, among the treated chops there were minimal effects on the intensity of the pork fat flavor, regardless of storage day, although, soda aftertastes were highest in chops containing approximately .4% NaP + 1.5% NaCl.

Examination of least squares means indicated that some sensory attributes were present at very low levels. As mentioned previously, panelists were extensively trained and it was not surprising that some attributes were barely detectable. Although the interaction between treatment and storage day affected soda, chemical, browned, musty, serum bloody, and liver flavor aromatics; metallic and astringent mouthfeels; sour, bitter, and sweet basic tastes; salty, sour, bitter, musty, and other aftertaste attributes, they will not be discussed because the intensity levels were approaching zero and/or the difference among the highest and lowest intensity levels was less than 1 point (Appendix L - O, respectively).

The treatment by storage time interaction did not affect ($P > 0.05$) cardboardy, beefy, nutty, vinegar, acidic, burnt, mature, canned meat, poultry, and other flavor aromatics; soapy, mouthburn, chemical, mature, acidic, browned, serum bloody, smoky, and oily aftertastes variables (Appendixes L - N, respectively). Neither treatment nor storage day affected cardboardy (.04 ± .008), beefy (.00 ± .003), burnt (.00 ± .002), mature (.01 ± .003), other (.00 ± .003) flavor aromatics; mature (.00 ± .001), acidic (.01 ± .004), browned (.04 ±

.009), serum/bloody (.03 ± .008), smokey (.00 ± .002), and oily (.01 ± .003) aftertastes attributes. Treatment affected nutty flavor and chemical aftertaste (Appendix P). Storage day affected vinegar (.02 .± .005), acidic (.03 ± .006), canned meat (.02 .± .005), and poultry (.05 .± .008) flavor aromatics; and soapy (.17 .± .014) and mouthburn (.05 .± .008) aftertastes attributes (Appendix Q, respectively). However, these attributes were barely detectable by highly trained panelists and will not be discussed further.

As in Experiment 1, pork lean/brothy and salt basic taste, followed by pork fat were the predominate flavors found in the Experiment 2 pork chops. Additionally, the combination of greater than .2% NaP and .75% NaCl seemed to enhance these positive flavors more than the addition of either ingredient alone.

Texture: Treatment by storage day interaction was significant ($P \leq 0.05$) (Appendix R, respectively) for muscle fiber tenderness, juiciness, and processed meat-like bite (Figs. 22 – 24, respectively). The least squares means indicated that the pork chops with .2% NaP alone or .75% NaCl alone were more tender, juicy, and had more processed meat-like when compared to the controls. Additionally, Figures 22-24 showed that further addition of sodium phosphate alone or sodium chloride alone generally increased the intensity of these attributes regardless of storage. Cannon and others (1993) reported similar results. Overall, these results are not consistent with those reported in Experiment 1, and it is likely that the different phosphate blends used in

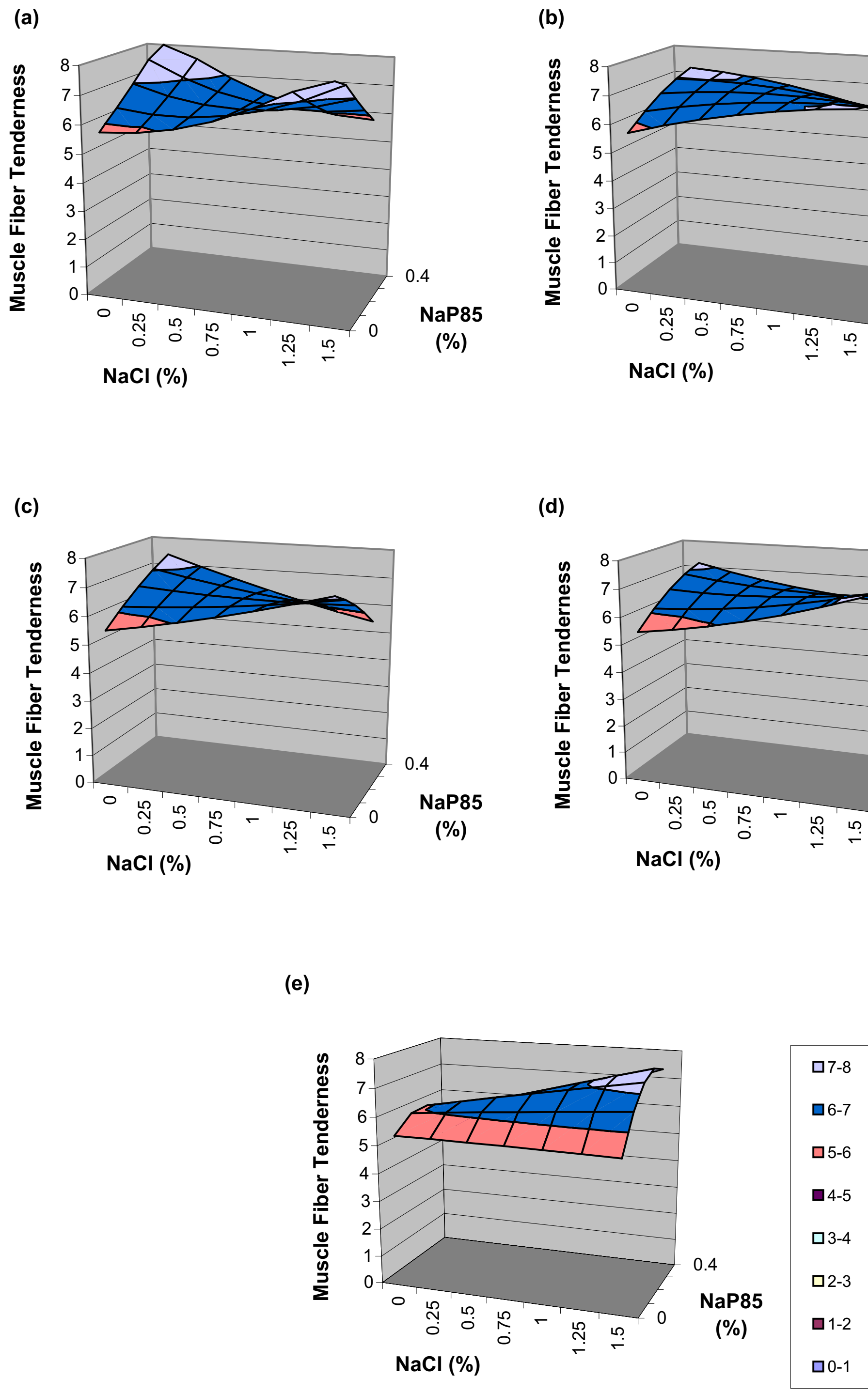

Figure 22. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the muscle fiber tenderness (0 = extremely tough; 8 = extremely tender) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 2.

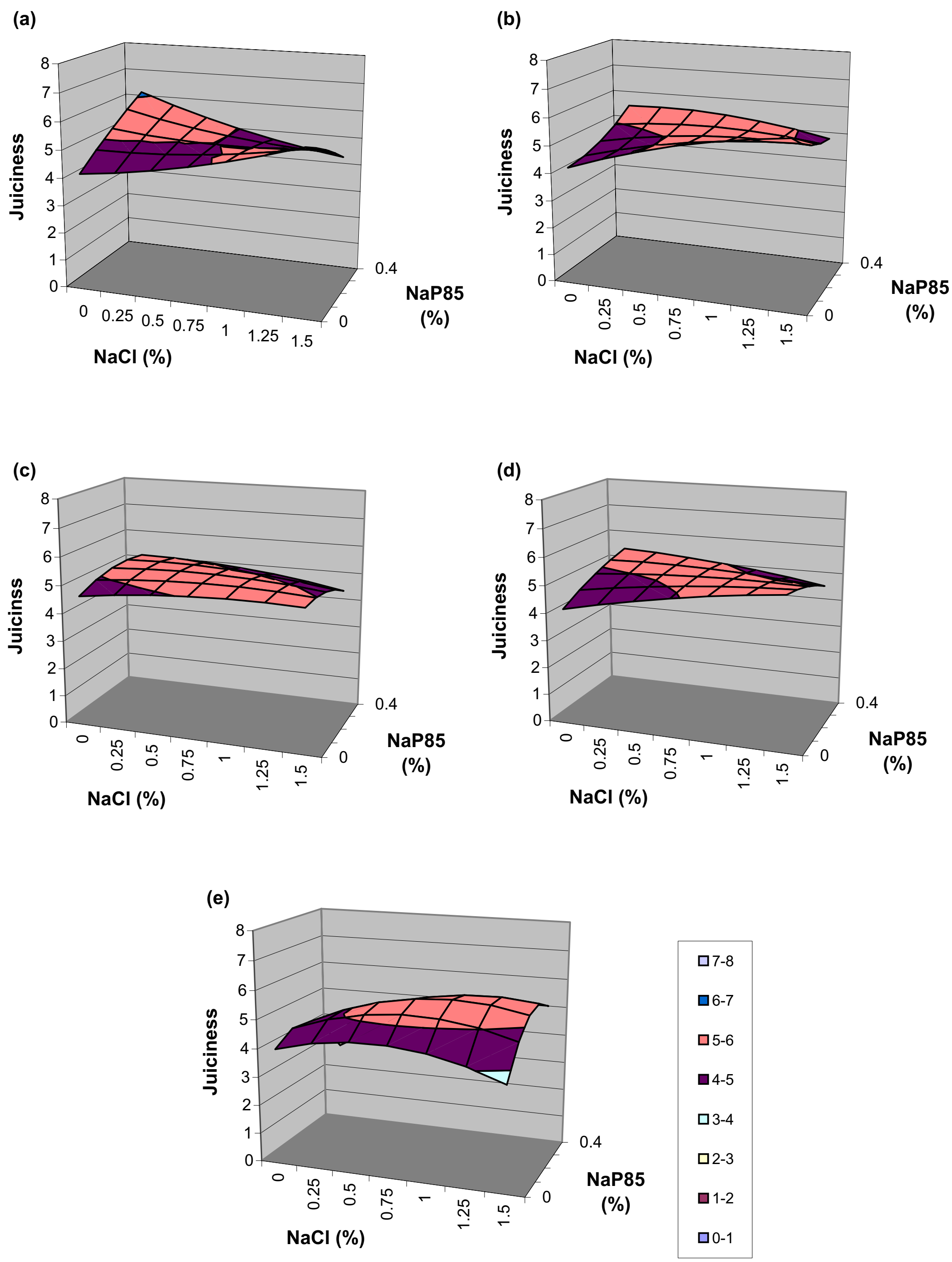

Figure 23. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the juiciness (0 = extremely dry; 15 = extremely juicy) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 2.

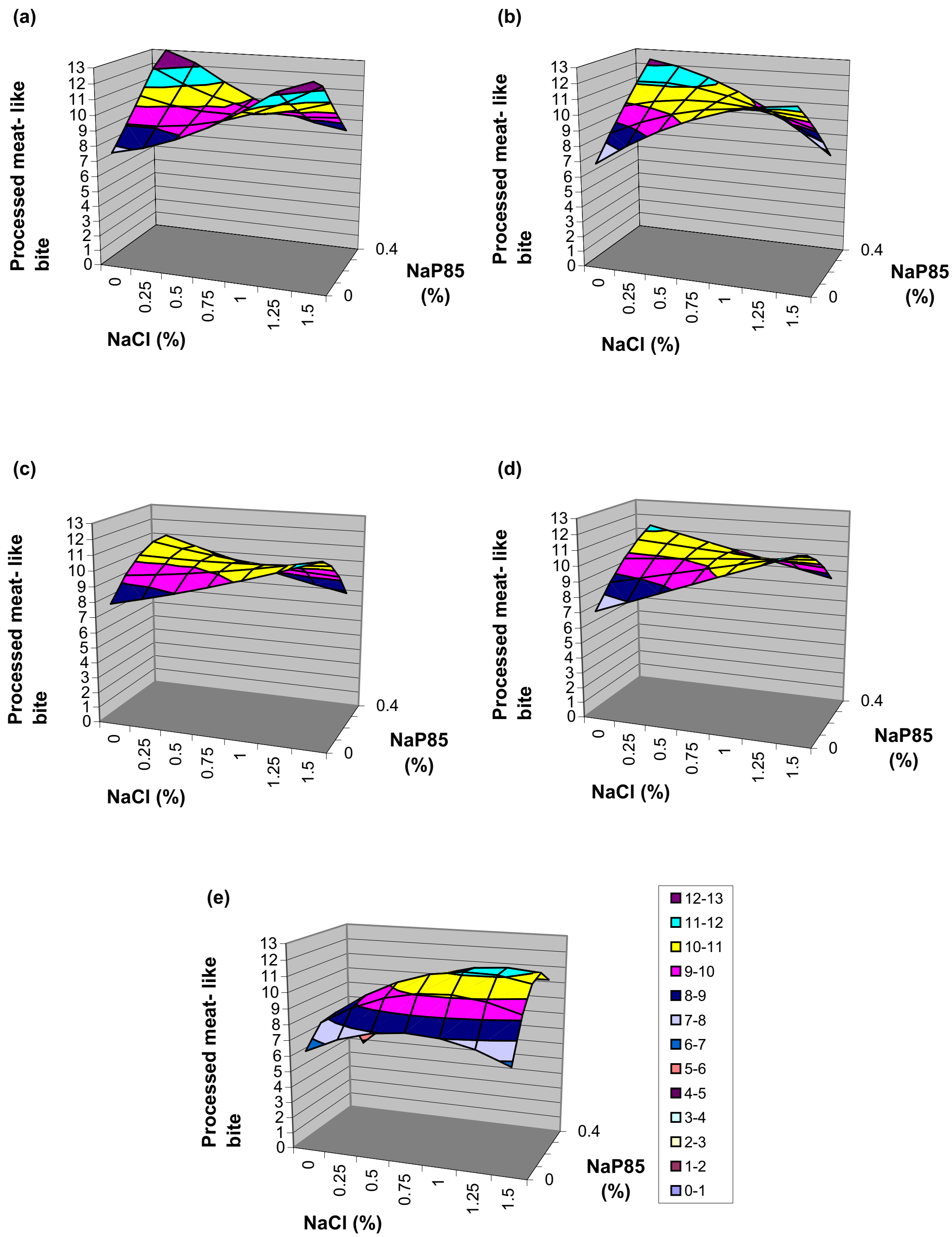

Figure 24. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the processed meat-like bite (0 = whole muscle or steak like; 15 = very soft and rubbery) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 2.

Experiment 1 and 2 and the changes made in Experiment 2 to the meat descriptive attribute sensory scale, as mentioned previously, may have contributed to the differences.

Pork chops containing the combination of approximately .4% NaP + 1.5% NaCl were also more tender, juicy, and had higher amounts of processed meat like bite than the control chops, but these attributes were slightly lower in the chops treated with sodium phosphate or sodium chloride alone, except on 28 d. Similar results for tenderness, juiciness, and processed meat-like bite were reported in Experiment 1.

At 28 d, chops containing the combination of .2% NaP and .75% NaCl appeared to be the most tender, juicy, and had the highest levels of processed meat-like bite. These results are most likely due to the synergistic effects of sodium phosphate and sodium chloride that maintained these attributes during storage. As mentioned previously, the combination of sodium chloride and sodium phosphate increased the tenderness and juiciness by changing the isoelectric point, increasing muscle pH, by binding metal ions, and increased protein swelling (Cannon and others 1993; Keeton 1983; Offer and Knight 1988; Sutton and others 1997). All other pork chops containing sodium phosphate or sodium chloride alone decreased in tenderness, juiciness, and had less processed meat-like bite attributes (Appendix R). Similar results were found in research conducted by Keeton (1983), Molins and others (1987), and Detienne and Wicker (1999) as previously discussed.

Therefore to maximize these attributes, it is recommended that pork chops contain approximately .2% NaP (Brifisol® 85) + .75% NaCl to increase palatability when compared to the controls and maintained these positive attributes during storage. However, flavor attributes, such as, salt basic taste and salty aftertaste, maybe be negatively affected by the high levels of these attributes.

Color: A treatment by storage day interaction was significant ($P \leq 0.05$) for subjective color, CIE a*, and b* color space values, and amount of discoloration (Appendix S – T, respectively) (Figs. 25 - 28, respectively), but not for color of discoloration and CIE L* color space values. The pH of the pork loins did not differ ($p = .57$) prior to injection and therefore pre-injection pH should not have induced variation in the color of the pork chops.

Regardless of treatment, sensory color scores decreased with storage or pork chops became lighter. Sensory color scores tended to increase (become darker red) as the level of sodium phosphate (up to .4%) alone or sodium chloride (up to 1.5%) alone increased when compared to the controls for most storage days. Similar results were reported in Experiment 1. As previously mentioned, Maca and others (1997a), Krouse and others (1979), and Mendonca and others (1989) also reported that the addition of sodium phosphate and sodium chloride improved color scores. The combined addition of higher levels of sodium chloride and sodium phosphates increased pork chop lean color, regardless of storage. Results in Experiment 1 reported similar affects on color.

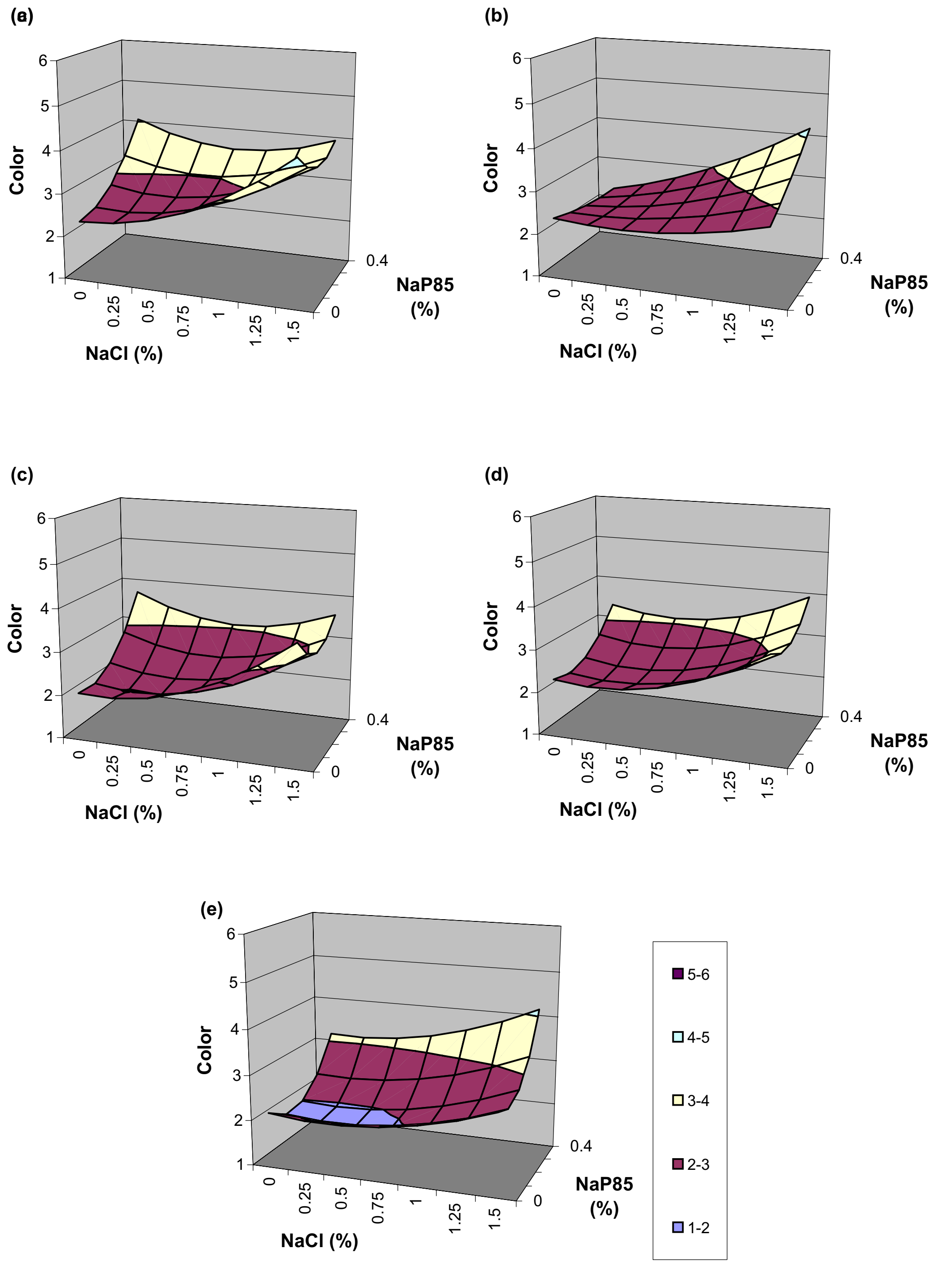

Figure 25. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the color (1 = light pink; 6 = dark pink) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 2.

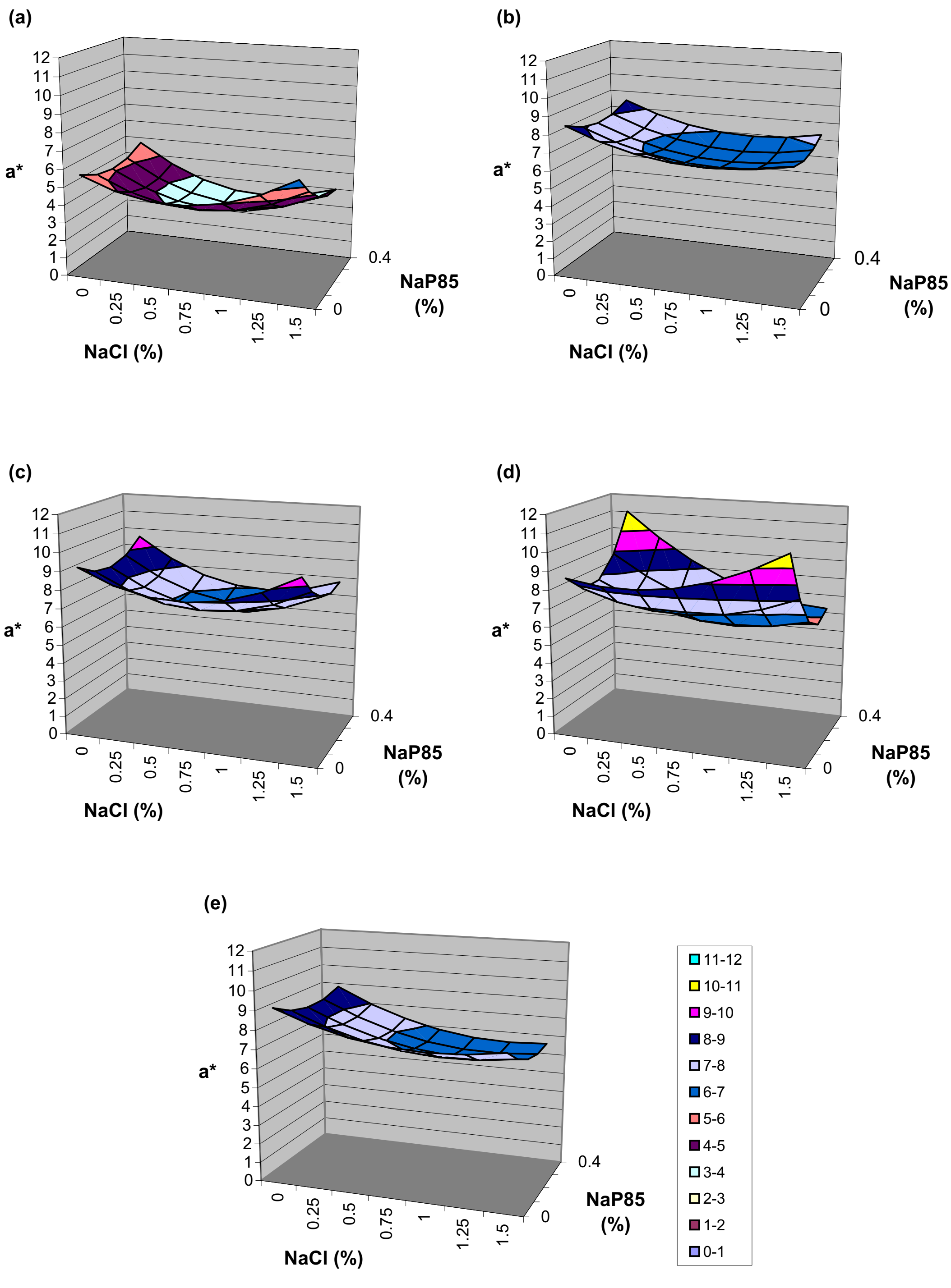

Figure 26. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the a* color space value (+a = red; -a = green) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 2.

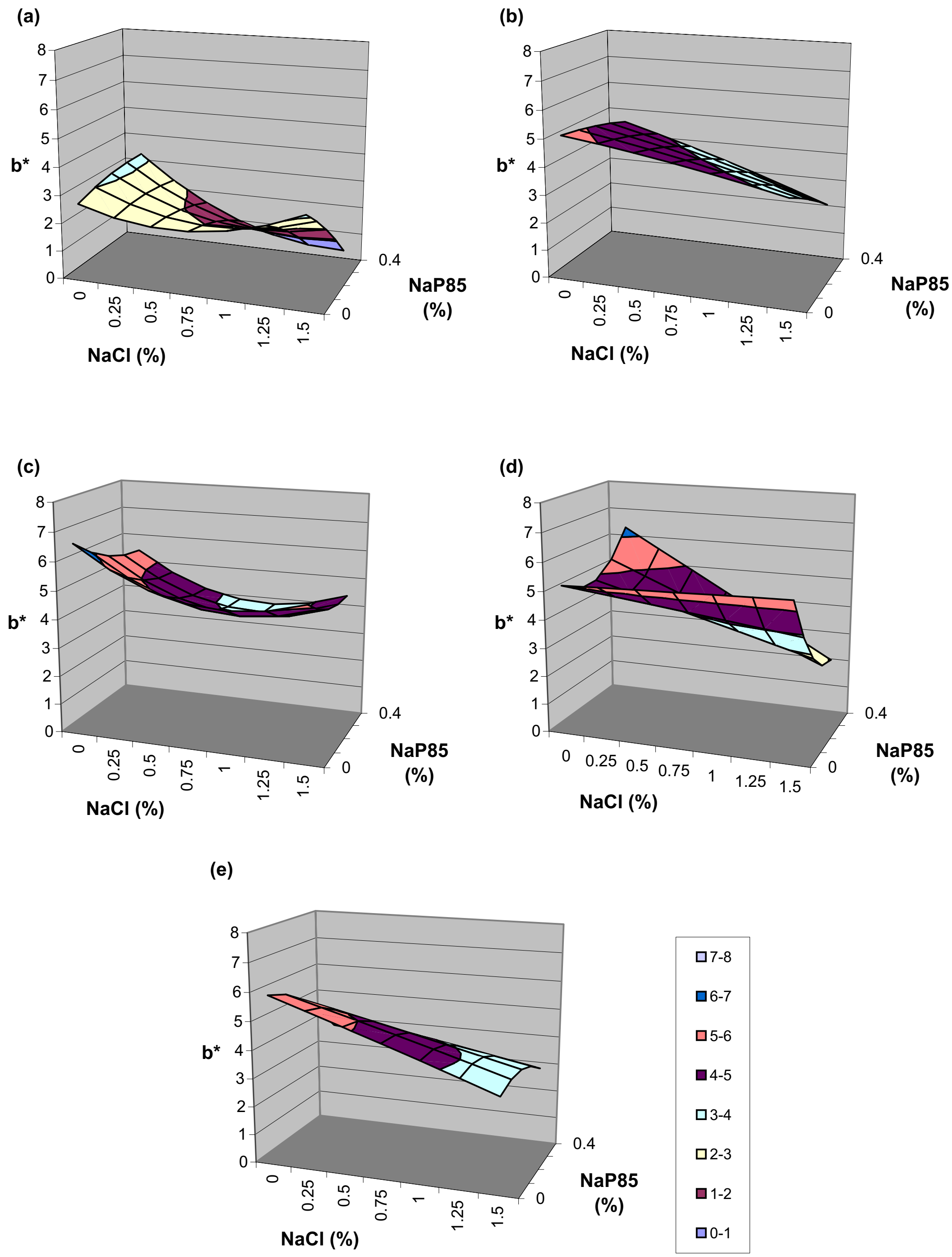

Figure 27. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the b* color space value (+b = yellow; -b = blue) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 2.

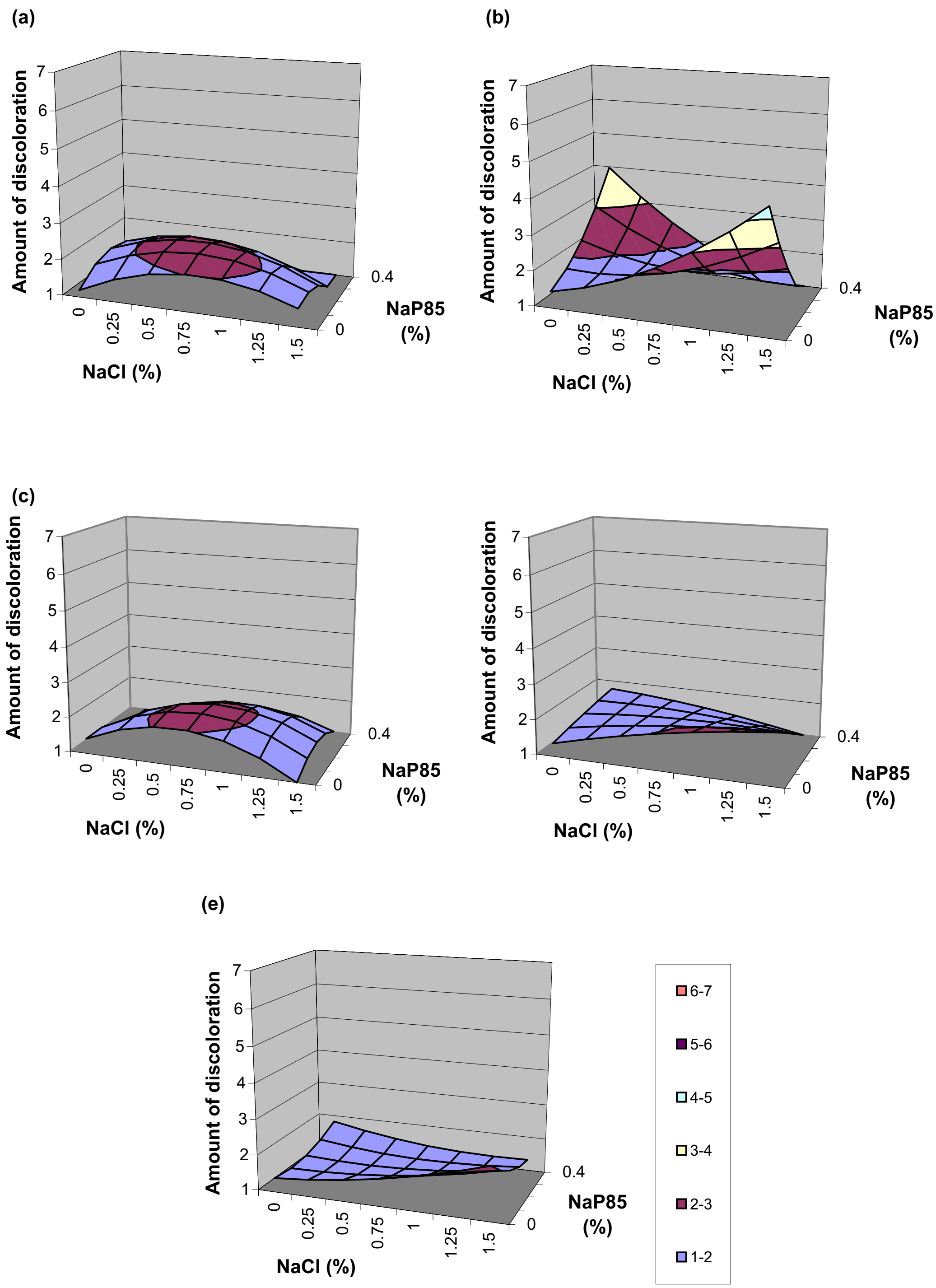

Figure 28. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the amount of discoloration (1 = 0% discoloration; 7 = 100% discoloration) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4^{o}C in Experiment 2.

This color effect was expected, as sodium phosphate addition increases muscle pH, allowing water to bind, which results in less free water available to reflect light.

According to the least squares means, the treated chops generally had higher CIE a* color space values or were less red than the controls regardless of storage (Appendix T). However, Figure 26 indicated that among the treated chops, those with high amounts of sodium phosphate and/or sodium chloride were redder than the other treated chops except for chops stored 28 d. These results are concurrent with results from Experiment 1. Regardless of treatment, with increased storage, CIE a* color space values increased slightly or pork chops became redder.

Figure 27 and Appendix T indicated that increasing the sodium phosphate or sodium chloride concentration alone caused the pork chops to become generally less yellow on most storage days when compared to the controls. In support of the current study, research conducted by Sutton and others (1997) observed lower b* color space values in pork loins containing phosphate. Additionally, chops containing approximately .4% NaP + 1.5% NaCl were less yellow when compared to any other pork chops (Fig. 27). The least squares means indicated that with storage, CIE color b* values increased, indicating pork chops became more yellow (Appendix T). This trend also was reported in Experiment 1, but storage day was the only main effect reported for on the CIE b* color space value in that study.

The amount of discoloration ranged from greater than zero or 0% discoloration, to less than six or 90% discoloration. Similar to Experiment 1, discoloration tended to be more prevalent in pork chops containing .2% NaP alone or .4% NaP + .75% NaCl when compared to the controls on 0, 7, and 14 d, but these chops had slightly less discoloration than the controls on 21 and 28 d (Appendix S). Early discoloration would most likely be a result of uneven distribution of the brine injection. With storage time, the amount of discoloration is expected to decrease due to the equilibrium of ingredients throughout the pork loin chops. The addition of .75% NaCl tended to make the pork chops more discolored than the controls, regardless of storage day (Appendix S). Overall, with storage, the amount of discoloration decreased which is most likely due to equal distribution of sodium phosphate and/or sodium chloride within the chops.

Treatment did not significantly ($P < 0.05$) affect color of discoloration, however, storage day did affect the color of the discoloration (Appendix Q). With storage time, the color of the discoloration of the pork loin chops became darker which may have been due to the growth of spoilage bacteria (Appendix Q). As mentioned previously, the discoloration within the pork chops could be attributed to injection variation within the muscle early in storage, microbial growth, and oxidation of myoglobin with further storage.

Treatment had no affect ($P > 0.05$) on CIE L* color space values, although, storage day affected CIE L* color space values (Appendix Q). Color space values for L* ranged from 41.47 on 0 d to 55.94 on 28 d, indicating that pork chops became lighter with storage time. This was expected due to increased package purge, which would provide more moisture on the surface of the pork loin chop to reflect light making it appear lighter in color.

To summarize the color results, pork chops containing greater than .2% NaP and greater than .75% NaCl were consistently darker, redder, and less yellow when compared to the controls, regardless of storage day. The amount of discoloration was not consistently affected by the treatments during storage, however, treated chops tended to be more discolored than the controls.

Cooking analysis, pH, and drip loss: There was a significant ($P \leq 0.05$) treatment by storage day interaction for package purge (Fig. 29) but not for cook time, cook loss, pH, and drip loss (Appendixes U and V, respectively). Package purge, ranged from greater than four to less than eleven, and increased with storage regardless of treatment (Appendix U). The addition of sodium phosphate alone increased the package purge on d 7 and slightly increased package purge on 14 and 28 d. This trend also was apparent in Experiment 1. Similar research has shown that sodium tripolyphosphates ability to bind water decreased package purge (Sutton and others, 1997). Like Experiment 1, the addition of sodium chloride (up to 1.5%) tended to decrease the package purge incrementally on all storage days (Fig. 29). Pork chops containing high levels of sodium chloride in combination with sodium phosphate tended to have less package purge than the non-injected controls and pork chops containing only

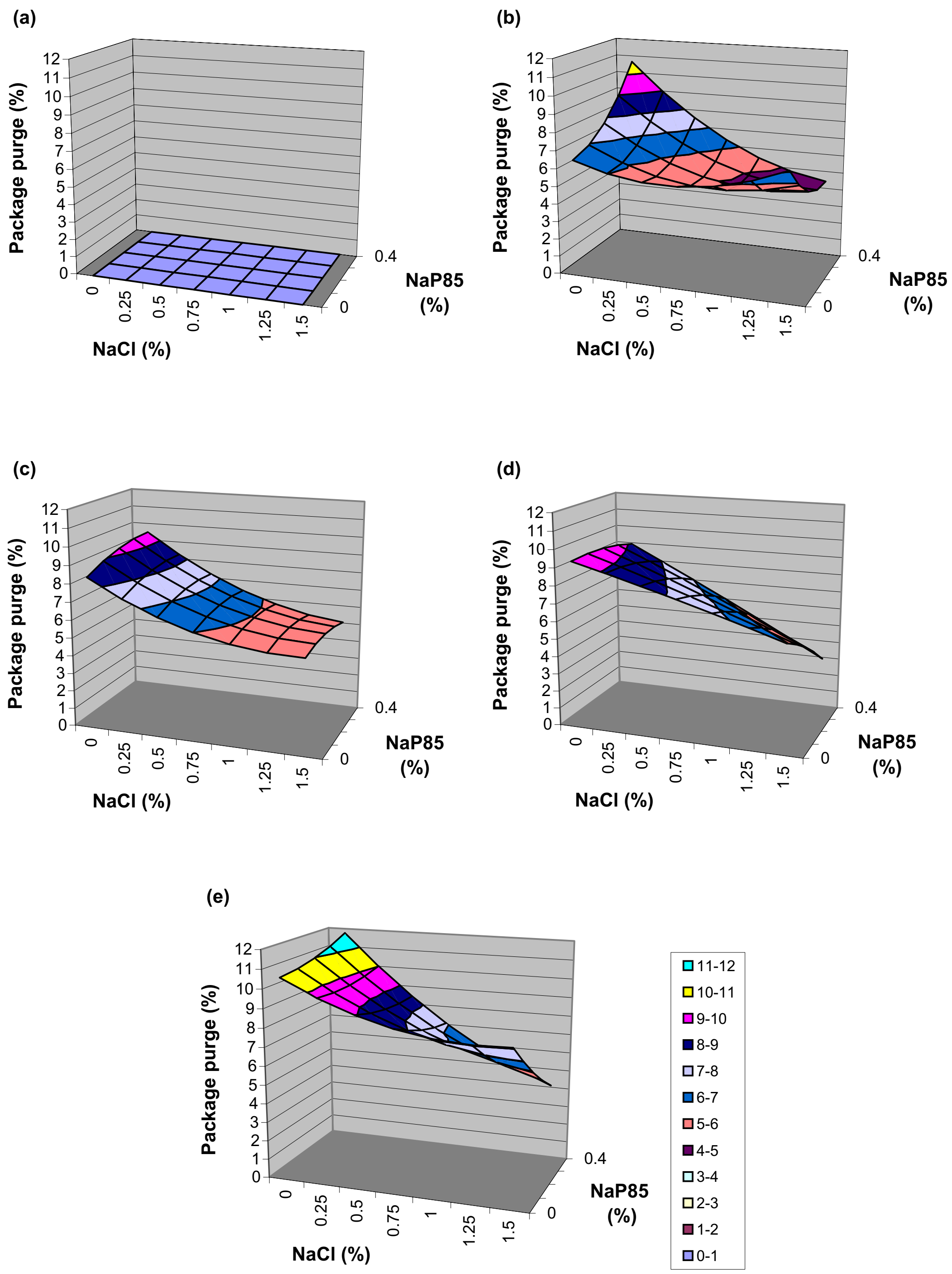

Figure 29. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the package purge of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 2.

sodium chloride or sodium phosphate, regardless of storage (Fig. 29) (Appendix U). As previously discussed, the addition of sodium phosphate and sodium chloride improve the water-holding capacity of the muscle proteins, which reduces package purge (Molins and others 1987; Keeton, 1983; Jones and others, 1987; and Vote and others, 2000). The results from Experiment 1 and Experiment 2 were very similar in respect to package purge, despite the use of different phosphate blends.

The cook loss and pH of the pork loin chops were significantly ($P \leq 0.05$) affected by treatment (Figs. 30 and 31, respectively) (Appendix P). Therefore, surface response graphs were generated for cook loss and pH. Cook loss ranged from greater than 15 to less than 22% (Appendix P). According to the least squares means, treated pork chops had less cook loss than the controls. Sodium chloride has the ability to hydrate muscle proteins by breaking the peptide cross-linkages allowing water to bind to the side chains, thereby, decreasing the percent cook loss of the pork chops. In contrast to Experiment 1, the addition of sodium phosphate or sodium chloride alone to pork chops decreased the percent cook loss of the pork chops when compared the non-injected controls. However like Experiment 1, the combination of high amounts of sodium phosphate (up to .4%) and sodium chloride (up to 1.5%) appeared to decrease the cook loss the most when compared to all other chops (Fig. 30). It is not clearly understood why sodium phosphate alone and sodium chloride alone had a negative effect on the cook loss of the Experiment 1 pork chops,

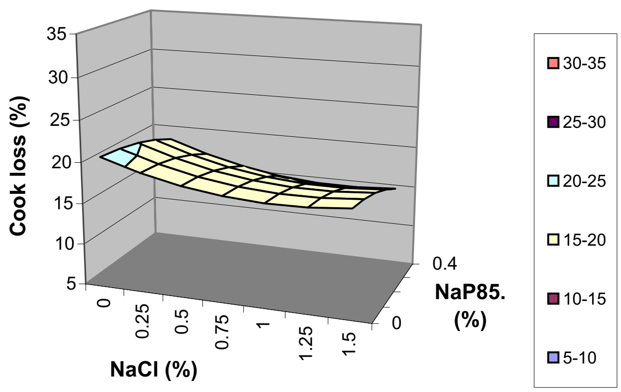

Figure 30. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the cook loss of pork loin chops in Experiment 2.

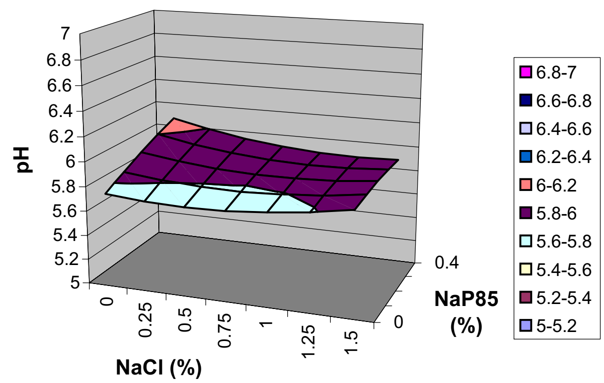

Figure 31. Response surface of sodium phosphate 85 (NaP85) and sodium chloride (NaCl) levels on the pH of pork loin chops in Experiment 2.

although like results in Experiment 1 there was a synergistic effect between sodium chloride and sodium phosphate that decreased cook loss in the treated pork chops. Similar results were reported by Keeton (1983) in pork patties.

As expected, the pH of the brine solutions differed ($P \leq 0.05$) ($p = .01$) (Table 2) since there were treatment main effects. Table 3 indicated that the pH of the pork loins prior to injection did not differ ($p = .57$) suggesting that there was little variation among loin pH. Therefore, it is likely that the pH of the pork loins prior to injection did not induce final pork chops pH variation, but that the pH of the brine solutions did induce variation among the treated pork chops. Least squares means indicated that pH ranged from greater than 5.7 to less than 6.0 (Appendix P). The addition of sodium chloride alone slightly decreased the muscle pH when compared to the controls (Fig 31). However, incremental increases in sodium phosphate (up to .4%) subsequently raised muscle pH; in fact pork chops containing approximately .4% NaP appeared to have the highest pH when compared to all the other chops (Fig 31). Previous research has found that the addition of phosphates to meat systems increases muscle pH (Offer and Trinick 1983; Detienne and Wicker 1999). In previous research, sodium phosphate has been shown to increase meat pH by increasing the ionic strength of meat proteins; moving the pH away from the protein's isoelelectric point (Offer and Knight 1988). As expected, the control chops had the lowest pH. These results cannot be compared to those in Experiment 1 because there were no significant ($P \leq 0.05$) treatment or day main effects for pH, as mentioned previously.

Additionally, pH, cook time, and drip loss were significantly ($P \leq 0.05$) affected by storage day (Appendix Q, respectively). As storage time increased, the pH of the pork loin chops became higher, ranging from 5.78 on 0 d to 5.88 on 28 d. The cook time and drip loss of the pork loin chops decreased with increased storage time regardless of the treatment, as similarly reported in Experiment 1. The decrease in drip loss with storage was likely due to the increase in free water derived from enzymatically deteriorated muscle proteins during storage.

In summary, the results from the trained descriptive attribute panel for Experiment 1 (Brifisol® 512) and Experiment 2 (Brifisol® 85) were similar and consistent with previous research. Pork lean/brothy, salt, and pork fat were the predominate flavors in the pork chops, and were higher in the treated chops when compared to the controls. The color results in Experiment 1 and 2 were concurrent and are supported by previous research. In both Experiments, the combination of sodium phosphate and sodium chloride improved the lean color of the pork chops. Additionally, package purge and cook loss results in Experiment 2 were consistent with results reported in Experiment 1, which indicated that these attributes were lower in pork chops containing the combination of sodium phosphate and sodium chloride when compared to the controls. The pork chop texture in Experiment 1 and Experiment 2 were not consistent. These differences can be attributed to the differences in the sodium phosphate blends used in Experiments 1 and 2. The sodium phosphate used in Experiment 1 was a blend of alkaline polyphosphates that solubilized easily into the brine solution, increase muscle pH, and binds Ca and Mg very well, which aids in the separation of the actin and myosin complex allowing water to bind. This was supported by the decreased drip loss and slightly improved juiciness and package purge in the Experiment 1 pork chops. Alkaline pyrophosphates and polyphosphates made up the sodium phosphate blend used in Experiment 2. This blend is less soluble in water, however, it is thought to be the most active phosphate form in increasing water holding capacity (Offer and Knight 1988). Phosphates act as chealating agents and bind Mg to aid in the separation of the actin and myosin complex, increase muscle pH, which improve texture, palatability, and acts to increase and maintain lean color. The addition of sodium phosphate alone or sodium chloride alone positively affected the texture attributes in Experiment 2, but this was not the case in Experiment 1. However, the combination of sodium phosphate and sodium chloride did consistently improve the texture attributes in both Experiments. The synergistic effect observed when sodium phosphate and sodium chloride are used together may be due to the small increase in pH, ionic strength, and NaCl induced protein swelling (Keeton 1983, Offer and Knight 1988). Based on the results from Experiment 2, it is recommended that pork chops contain at least .2% NaP (Brifisol® 85) and at least .75% NaCl.

Experiment 3

Sodium lactate is used primarily in pork to prevent spoilage and increase shelf-life; however, research has shown that its use can also maintain desirable sensory characteristics, such as color, flavor, and texture (Brewer and others 1991; Lamkey and others 1991; Papadopoulas and others 1991b; Miller 2001). Lean flavors increased with the addition of sodium lactate in pork sausage, roasts beef, and ground beef (Brewer and others 1991, Maca 1995, Papadopoulas and others 1991a, Eckert and others 1997, respectively). Sodium lactate also has been shown to improve tenderness and juiciness by increasing the muscle proteins' water-holding capacity (Maca 1995; Papadopoulas and others 1991b). The use of sodium phosphate as a non-meat ingredient in pork loin chops is mainly to improve water-holding capacity, that will subsequently reduce package purge and increase the juiciness of the cooked pork chops (Cannon and others 1993; Sutton and others 1997). Some of the functionality of both of these non-meat ingredients is due to their effect of increasing pH in the product. Increasing meat pH moves the pH away from the average meat protein isoelectric point (Trout and Schmidt 1986; Papadopoulas and others 1991ab; Eckert and others 1997; Maca and others 1997a). The effects of these two ingredients in whole muscle meat products has been extensively studied (Maas and others 1989; Papadopoulas and others 1991ab; Cannon and others 1993; Eckert and others 1997; Maca and others 1997a; Sutton and others 1997), but understanding the use of these two ingredients in combination has not been adequately examined. The objective of Experiment 3 was to examine the interaction of sodium lactate at 0 to 4% and sodium phosphate at 0 to .4% on pork chop palatability, texture, color, pH, and drip loss during vacuum-packaged, refrigerated storage.

Sensory aromatics, feeling factors, and basic tastes: In Experiment 3, pork chop flavor was predominately made up of pork lean/brothy flavor aromatics and salt basic tastes, while metallic and astringent mouthfeels, and sour and bitter basic tastes were slightly detectable. Also, pork chops had very low intensity levels of pork fat and soda flavor aromatics as well as sour, salty, and soda aftertastes. Chemical, browned, and soapy flavor aromatics; sweet basic tastes; and bitter, soapy, mouthburn, browned, chemical, and metallic aftertastes were close to zero or not detected in the pork chops in Experiment 3. However, the level of sodium lactate and/or sodium phosphate and storage day affected some of these attributes.

A significant ($P \leq 0.05$) treatment by storage day interaction was detected for pork lean/brothy flavors and salt basic tastes (Appendix Table W and X); therefore, surface response curves were generated for each storage day (Figs. 32 – 33, respectively).

Pork lean/brothy ranged from greater than four to less than seven. According to the least squares means, control pork chops were lower in pork lean/brothy flavor than pork chops containing any treatment regardless of storage day. However, surface response graphs indicated that pork chops

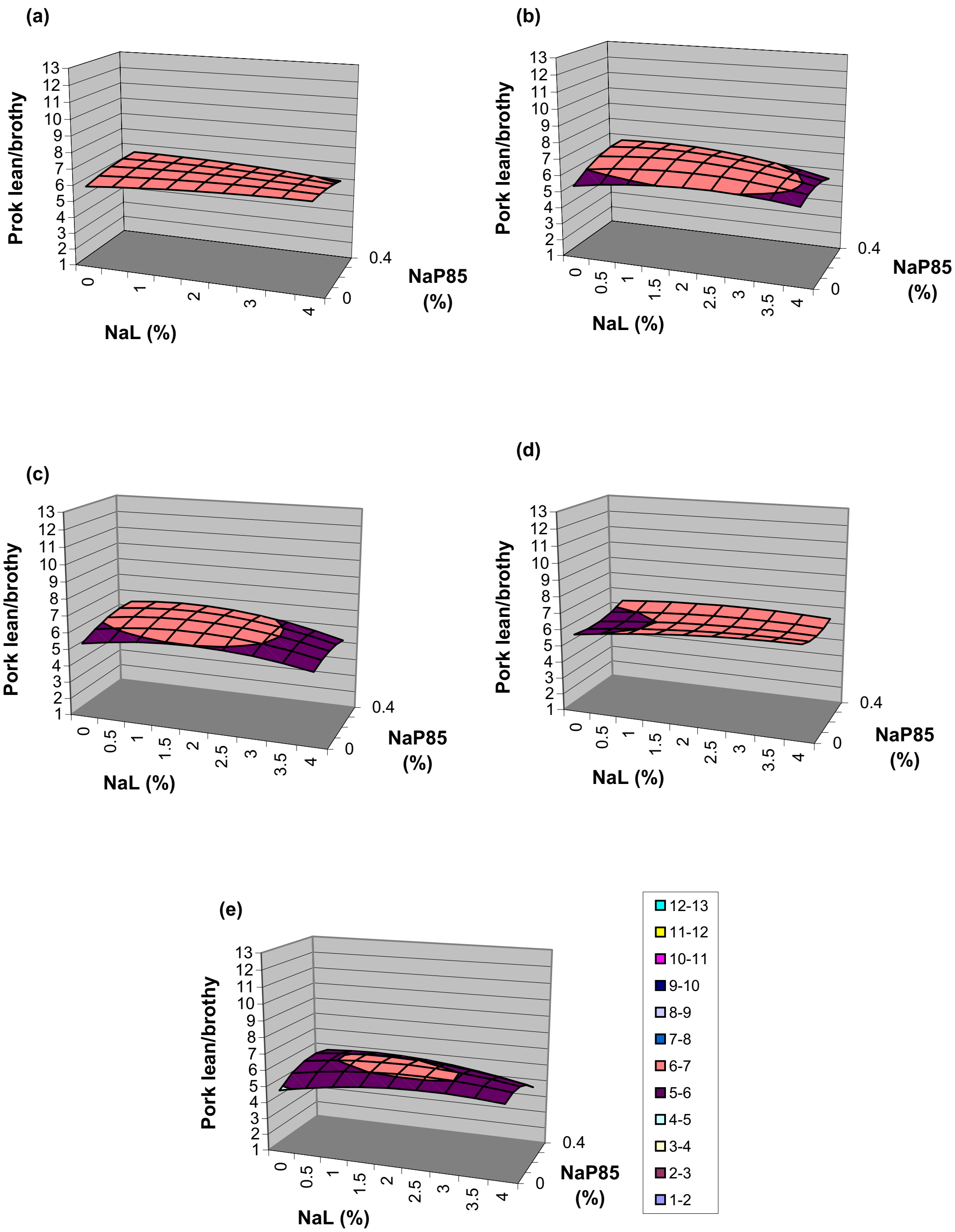

Figure 32. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the pork lean/brothy aromatic (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

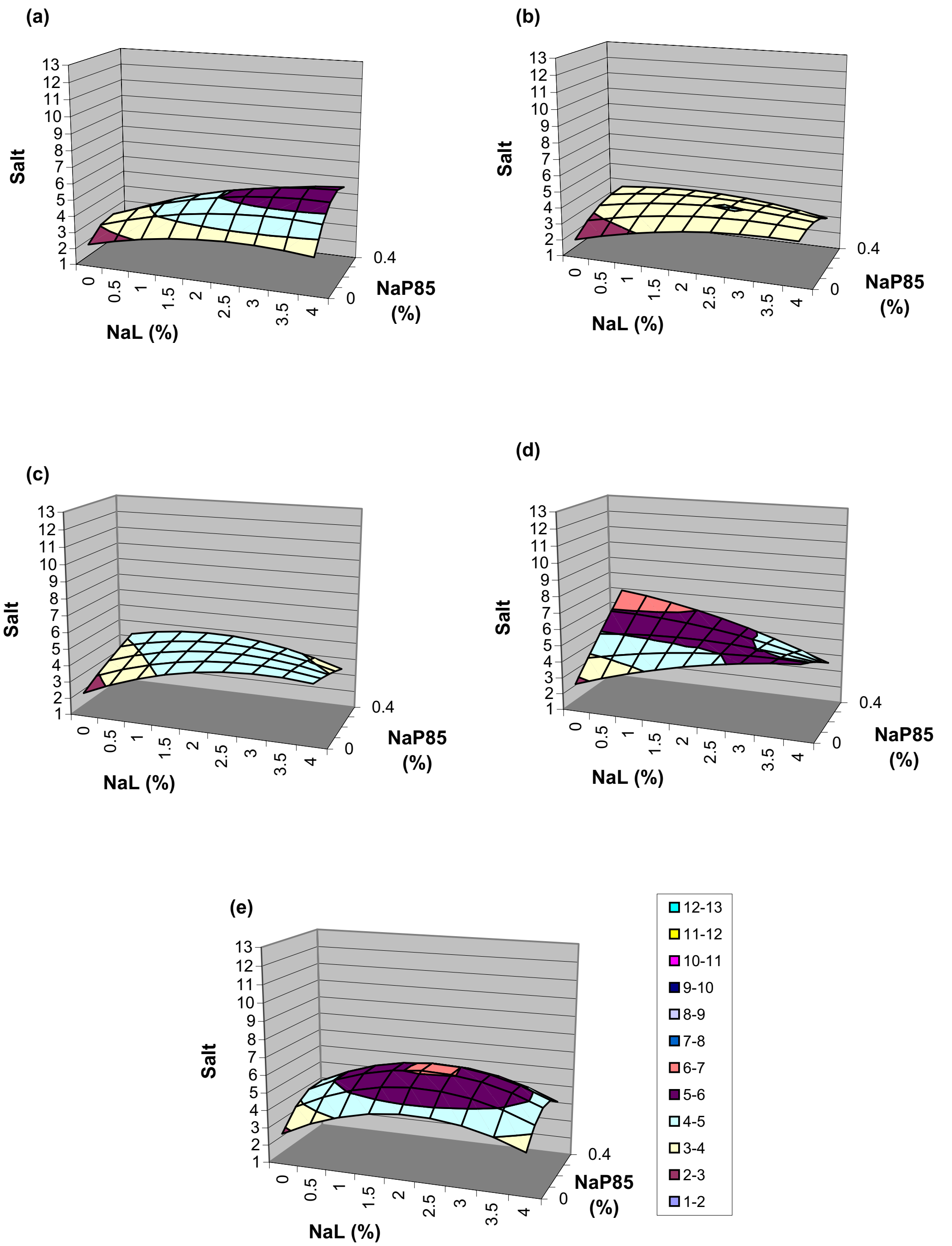

Figure 33. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the salt basic taste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

containing 4% NaL + .4% NaP and the control chops on 7, 14, and 28 d had approximately the same pork lean/brothy flavor intensity. Similar research conducted by Maca (1995) reported that beefy/brothy flavors were lowest in roasts treated with 4% sodium lactate + .1% sodium propionate, but roasts containing 3% sodium lactate + .2% sodium propionate were highest in beefy/brothy. It should be noted that pork chops in Experiment 3 containing approximately 2% NaL + .2% NaP were consistently higher in pork lean/brothy when compared to the controls, and pork lean/brothy slightly decreased in intensity with storage time in the 2% NaL + .2% NaP chops. In support of the current study, other research has shown that overall the addition of sodium lactate has improved beefy/brothy and other flavors in pork sausage, roast beef, and ground beef (Brewer and others 1991; Papadopoulas and others 1991a; Eckert and others 1997, respectively). The minor differences in the results of the current study and previous research may be attributed to the use of different ingredient combinations and meat products. Overall, pork lean/brothy flavors decreased as storage time increased in the current study. Those results are consistent with the results from Maca (1995) where beefy flavor of ground beef patties decreased after 14 d. St. Angelo and others (1988) observed that the desirable cooked beefy brothy flavor decreased, simultaneously, with the increase in cardboardy and painty flavor notes, described as warmed over flavor development. As lipid oxidation progresses and off-flavors develop there is an increase to yield compounds that are present at ppm levels, the desirable beefy flavors- heteroatomic compounds present at ppm levels- are masked. Cardboardy and painty flavors were not detected by the trained panelist in the current study. These are flavors associated with increased levels of lipid oxidation. However, the pork lean/brothy flavor compounds begun to deteriorate or decrease in intensity with up to 28 d of storage, indicating some lipid oxidation or deterirative processes were occurring.

Salt basic taste ranged from greater than two to less than seven. Regardless of storage day, as sodium lactate and/or sodium phosphate levels increased, salt basic taste increased. These flavor notes were expected to increase due to the addition of sodium ions found in sodium phosphate and sodium lactate. Other research also has reported positive flavor aromatics, such as salt basic tastes, in pork loin chops, beef roasts, ground beef patties, and fresh pork sausage that contained sodium lactate (Sutton and others 1997; Papadopoulas and others 1991c; Eckert and others 1997; Lamkey and other 1991, respectively). Likewise, Sutton and others (1997) observed high pork lean/brothy and salt basic taste in pork loin chops containing sodium lactate. In addition, Papadopoulas and others (1991c) found that beef roasts containing sodium lactate resulted in higher roast beef flavors and salt basic tastes than the control roasts. Even though previous research indicated that the addition of sodium lactate was advantageous, results from the current study revealed that the combination of approximately 2% NaL + .2% NaP generally resulted in improved pork lean/brothy flavors and salt basic tastes up to 28 d storage.

According to the least squares means, pork fat, soda, and chemical flavor aromatics; metallic and astringent mouthfeels; sour basic tastes; and salty, bitter and soda aftertastes also had treatment x day interactions (Appendixes W – Z, respectively). Generally these attributes, except for bitter basic tastes, were higher in treated pork chops when compared to non-injected controls stored 0 to 28 d. Bitter basic tastes were lower in the pork chops treated with sodium lactate and/or sodium phosphate when compared to the non-injected controls and stored 0 to 28 d. However, regardless of storage day, inconsistencies were observed in the intensities of the aforementioned flavor aromatics, mouthfeels, and aftertastes, among the treated pork chops. The interaction of treatment and storage day also affected ($P \leq 0.05$) the browned flavor aromatic; however, the least squares means indicated that it was found at very low intensity levels by highly trained descriptive attribute panelists (Appendix W). Therefore, it will not be discussed further.

The interaction of treatment and storage day was not significant ($P > 0.05$) for soapy flavor aromatics; sweet basic tastes; and soapy, mouthburn, browned, chemical, and metallic aftertastes (Appendix Table W – Z, respectively). However, storage day did affect ($P \leq 0.05$) soapy ($.12 \pm .01$), mouthburn ($.31 \pm .04$), browned ($.10 \pm .02$), chemical ($.02 \pm .00$), and metallic aftertastes ($.61 \pm .04$) (Appendix AA). Additionally, treatment and storage day affected sweet basic taste ($.16 \pm .00$) but not soapy ($.13 \pm .013$) flavor (Appendixes AB and AA, respectively). Even though these attributes were affected by treatment and/or storage day, they will not be discussed further as they were detected at very low intensity levels.

Off-flavor development in pork chops has been contributed to either flavors associated with added ingredients, increased lipid oxidation, or microbial growth. Sour flavors and aftertastes, associated with added ingredients, were higher in pork chops treated with sodium lactate and/or sodium phosphate when compared to the control chops. Off-flavors associated with lipid oxidation are increased levels of painty and fishy and lower levels of pork lean/brothy. In the current study these off-flavors were minimized with the sodium phosphate and sodium lactate addition. In other research, off-flavor production and sour flavors were minimized due to the addition of sodium lactate (Brewer and others 1991; Maca 1995; and Evans 1992). Although browned flavor aromatics were detected in the pork chops in this study, the results were inconclusive when examining the treatment x day interactions. In contrast, previous studies have concluded that chemical and browned flavor aromatics have been associated with the addition of sodium lactate (Maca 1995, Papadopoulas and others 1991). Soured flavors associated with increased microbial growth with storage were not detected. Based on the sensory panel results, the combination of approximately 2% NaL + .2% NaP increased and maintained positive flavor notes, such as, pork lean/brothy and salt basic tastes when compared to non-injected control chops and limited off-flavor production.

Texture: Results from Experiment 3 indicated that there was a significant ($P \leq 0.05$) treatment by storage day interaction for muscle fiber tenderness, juiciness, and processed meat-like bite (Figs. 34 - 36, respectively) (Appendix AC). However, regardless of storage time, the non-injected control chops were generally less tender, drier, and had lower levels of processed meat-like than the treated chops. According to the least squares means, the addition of 2% NaL increased the pork chop muscle fiber tenderness, juiciness, and processed meat-like bite (Appendix AC). However, Figures 34 – 36 indicated that subsequent increases, up to 4%, of sodium lactate decreased the tenderness, juiciness, and processed meat-like bite of the pork chops. Pork chops also became more tender, juicy, and more processed meat-like with the use of sodium phosphate alone up to .4%; however, this trend was inconsistent across storage days. It should be noted that pork chops containing approximately 4% NaL + .4% NaP were tougher, drier, and had less processed meat-like bite when compared to pork chops containing approximately 2% NaL + .2% NaP. This may be due to high standardized sodium chloride levels at .75% in the pork chops and/or because the estimated values located on the extreme points of the curve tend to have higher standard errors than those located closer to the means of the independent variables, which is the middle area of the response surface curve. Higher standard errors would contribute to potential over or under-estimating of the shape of surface response curves at the extreme levels. Papadopoulas and others (1991b) found similar results in cooked beef rounds in

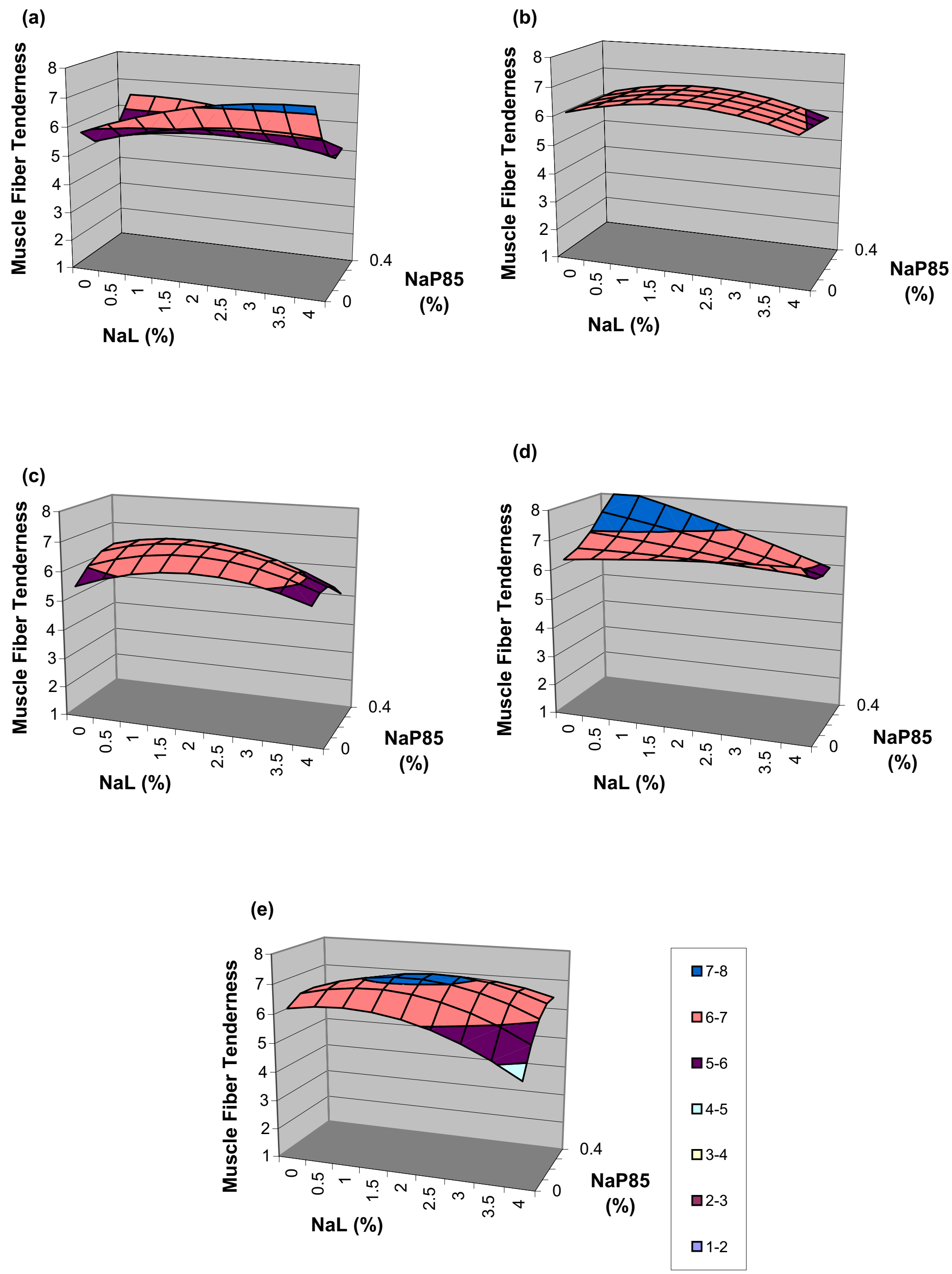

Figure 34. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the muscle fiber tenderness (0 = extremely tough; 8 = extremely tender) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

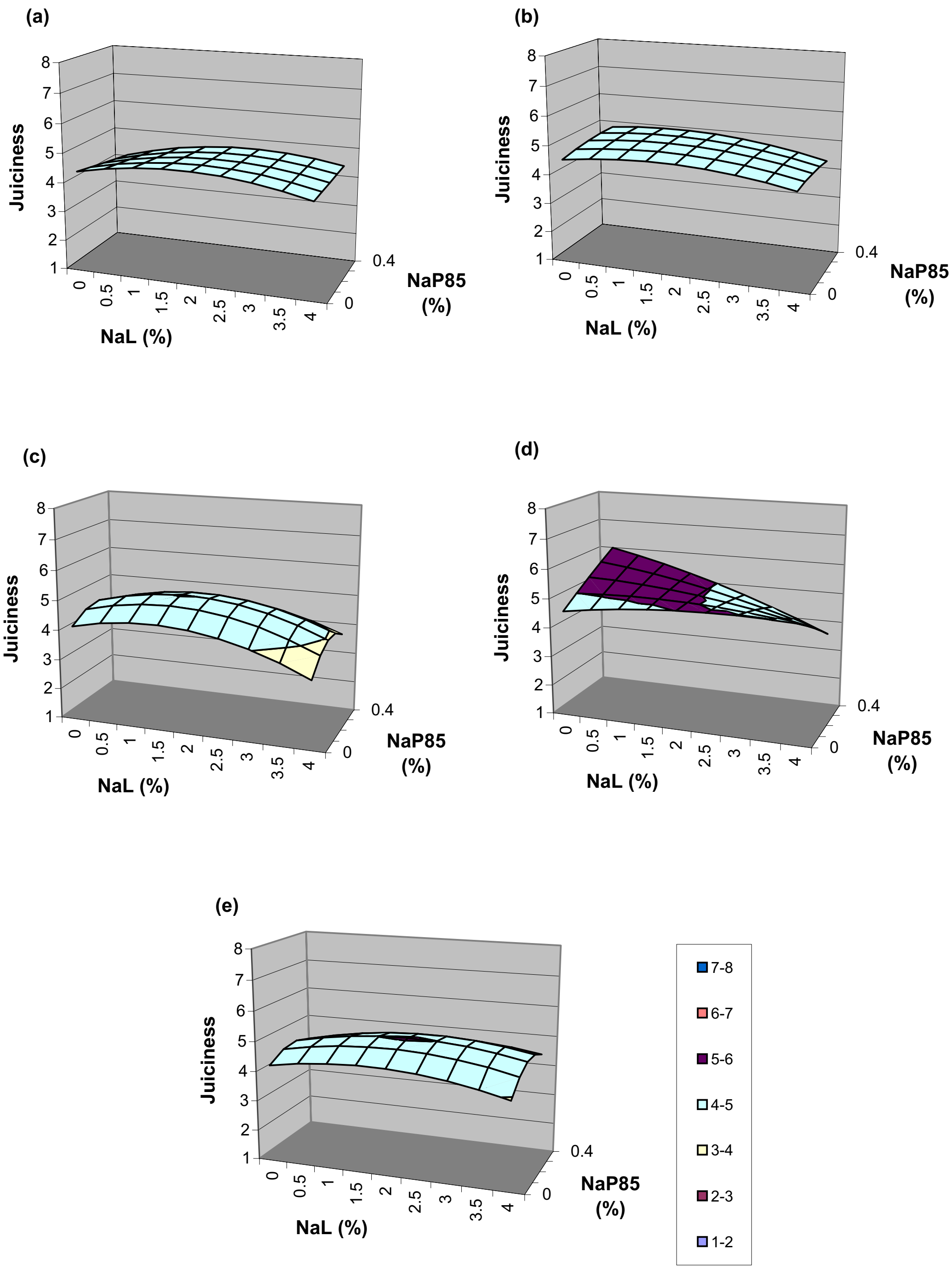

Figure 35. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the juiciness (0 = extremely dry; 15 = extremely juicy) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

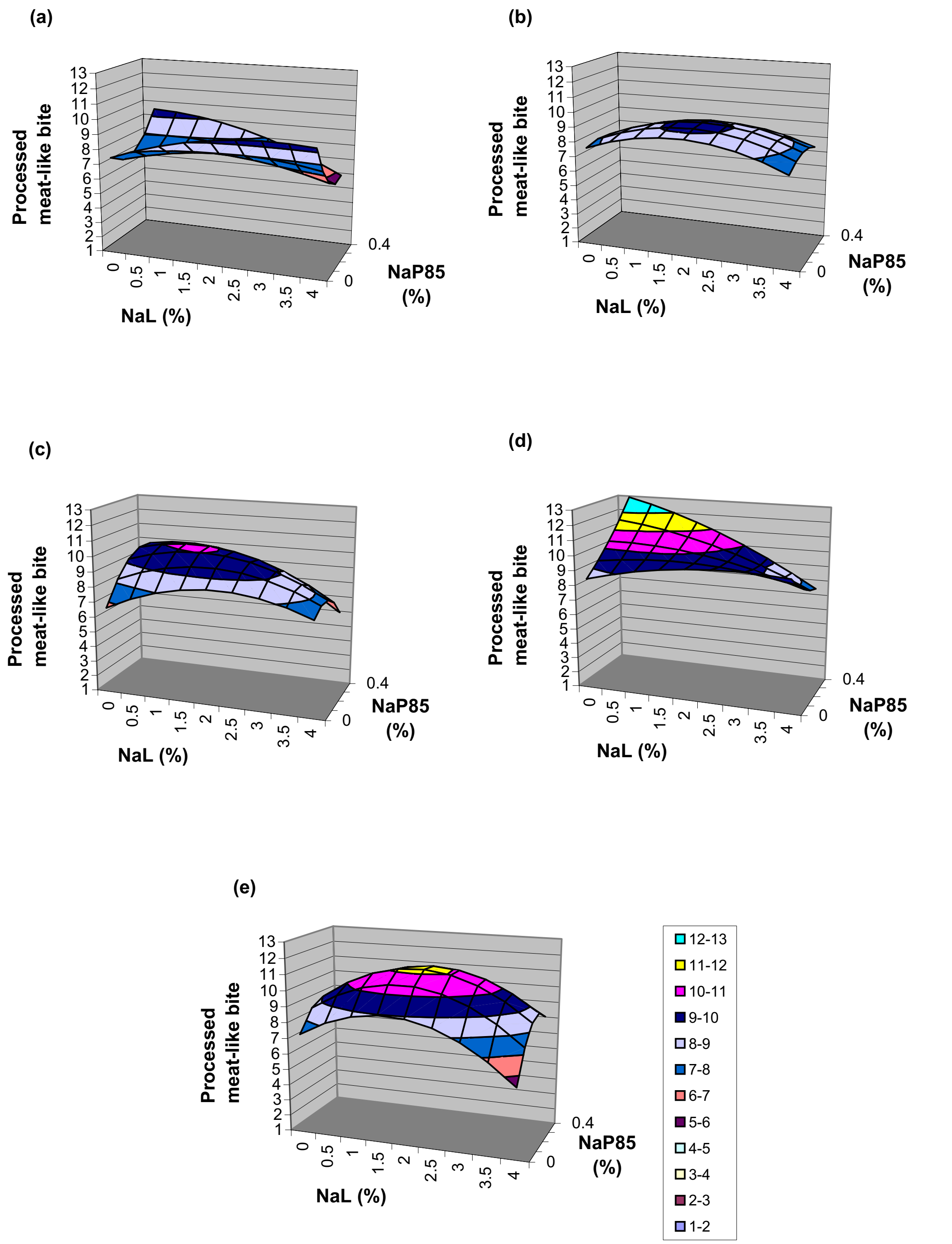

Figure 36. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the processed meat-like bite of (0 = whole muscle or steak like; 15 = very soft and rubbery) pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

that sodium lactate addition up to 3% increased muscle fiber tenderness and top rounds containing 1 to 4% NaL were juicier than controls. However, Maca (1995) reported that beef roasts containing sodium lactate and/or sodium propionate did not differ in juiciness compared to the controls. In Experiment 3 the addition of 2% NaL increased the perceived juiciness of the pork chops. Pork chops in the current study containing approximately 2% NaL + .2% NaP were the most tender and juicy when compared to the controls over 28 d of storage, but these treated pork chops had more processed meat-like then the non-injected controls. It is likely that these observations are due to the ability of both sodium lactate and sodium phosphate to improve the water holding capacity of the muscle proteins. By increasing WHC, higher levels of water is bound to muscle protein and this results in a dilution effect on muscle proteins contribution to meat tenderness and an increase in perceived juiciness. This is supported in the current study by the decrease in drip loss and percent cook loss in pork chops containing sodium lactate and sodium phosphate.

Color: The interaction between treatment and storage day was significant ($P \leq 0.05$) for color, CIE L* and b* color space values and the amount of discoloration (Figs. 37 - 40) (Appendix AD), but not for the color of the discoloration or CIE a* color space value (Appendix Table AE).

As sodium lactate was added at higher levels, pork chop color tended to become darker and less yellow when compared to the non-injected control chops, regardless of storage day. Pork chops also became slightly darker and

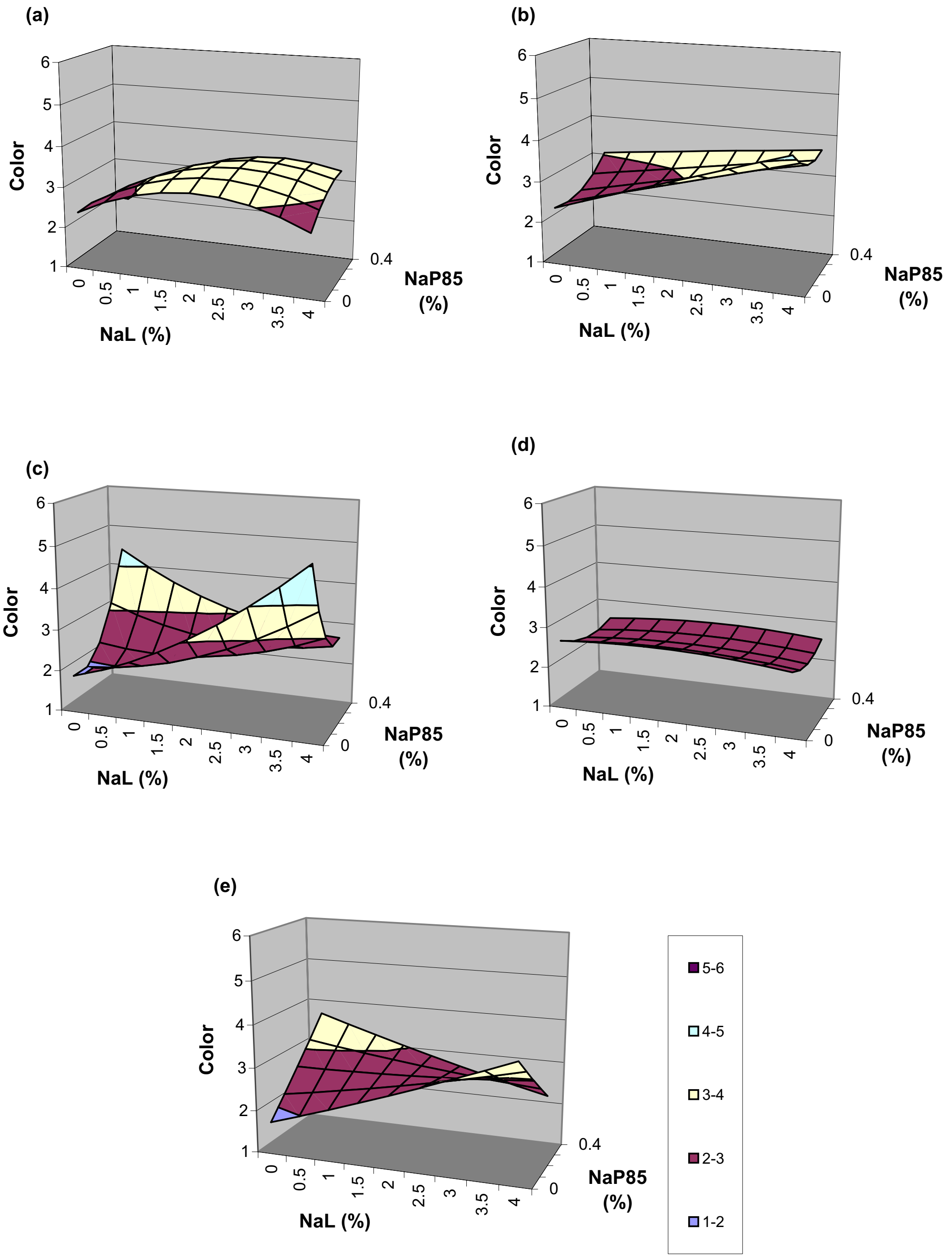

Figure 37. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the color (1 = pale pink; 6 = pinkish red) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

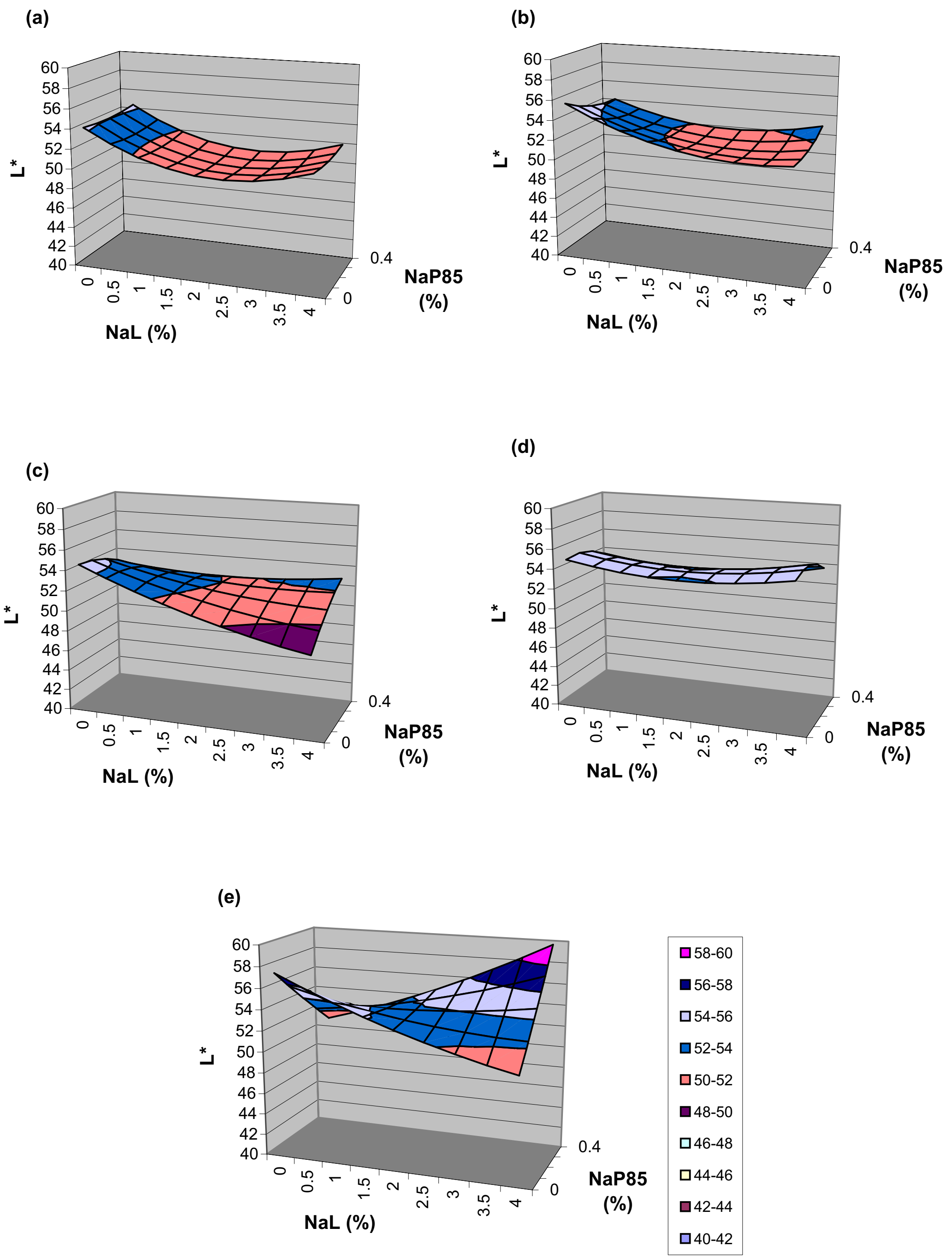

Figure 38. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the CIE L* color space value (0 = black; 100 = white) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

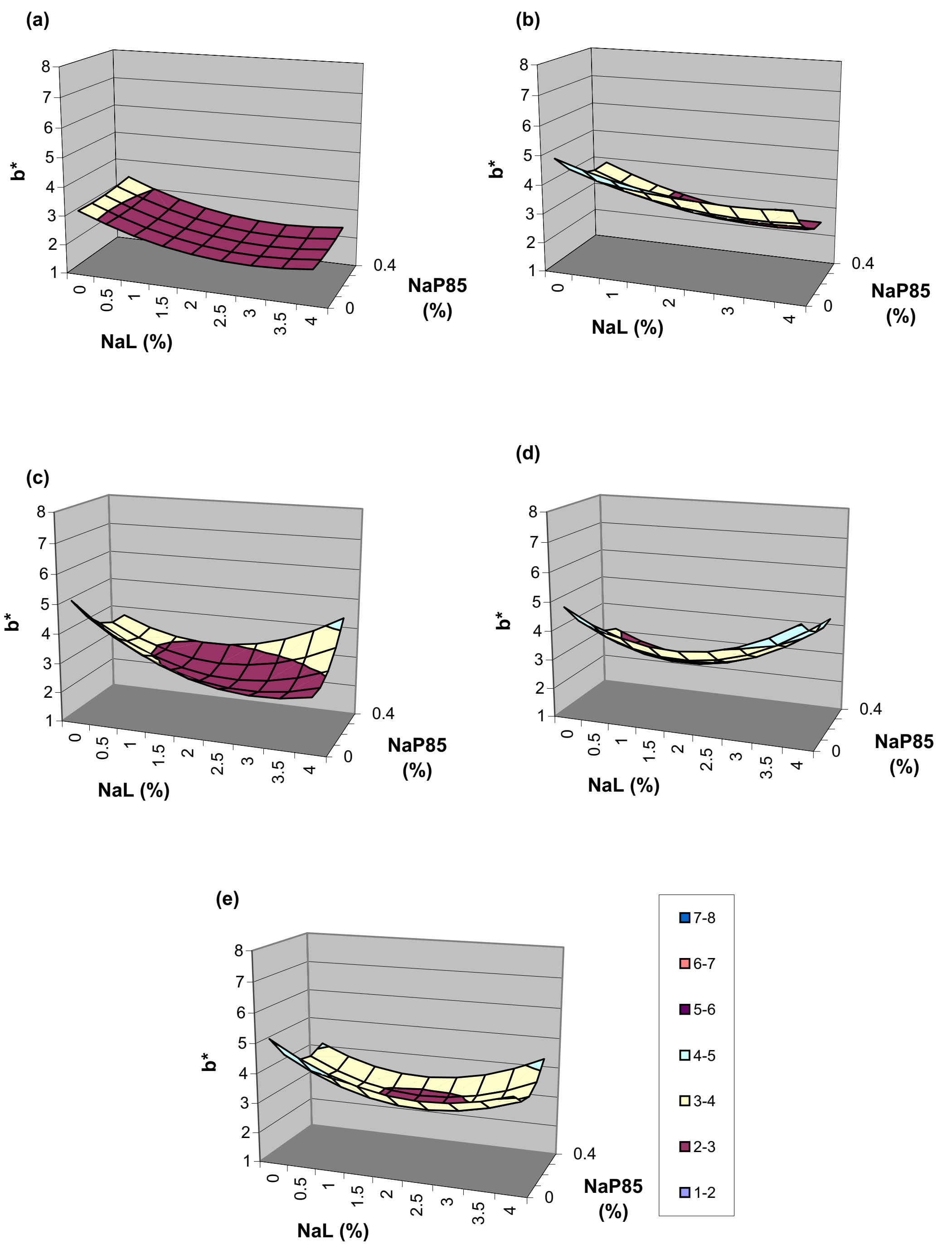

Figure 39. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the CIE b* color space value (+b = yellow; -b = blue) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

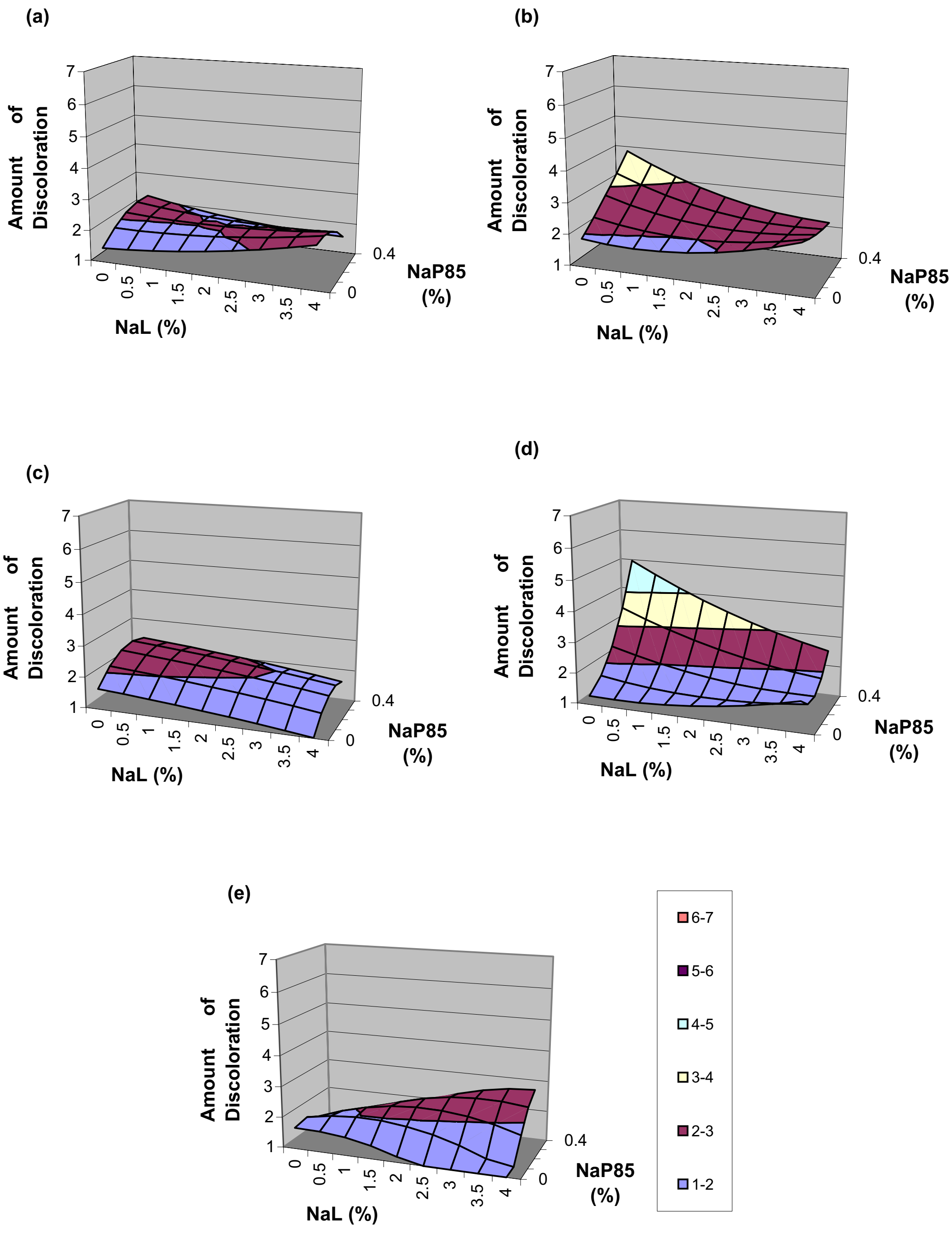

Figure 40. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the amount of discoloration (1 = 0% discoloration; 7 = 100% discoloration) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

less yellow with the addition of sodium phosphate; however, this trend was inconsistent with storage time. When approximately 4% NaL + .4% NaP was added to the pork chops, CIE L* and b* color space values indicated that pork chops were lighter and more yellow, respectively, than the non-injected controls and most treatments up to 28 d storage. However, pork chops containing the combination of approximately 2% NaL + .2% NaP were darker and less yellow when compared to the non-injected controls, regardless of storage time.

The amount of discoloration within the pork chops increased with the addition of sodium phosphate alone. Sodium lactate alone did not consistently affect the amount of discoloration during the 28 d study. However, when sodium lactate was added in combination with sodium phosphate, sodium lactate seemed to aide in minimizing the negative effects of sodium phosphate on the pork chop discoloration. Maca and others (1997a) reported similar results in cook beef top rounds. They found that the addition of sodium lactate improved lean color and helped stabilize the color over storage time. This darker red color can be associated with higher pH values found in pork chops containing sodium phosphate.

Treatment did ($P \leq 0.05$) impact CIE a* color space values, but storage day did not (Appendix AA). Color space values for CIE a* ranged from greater than four to less than eight (Fig 41). According to the least squares means, pork chops containing either .2% NaP or 2% NaL were the only treatments redder than the control chops.

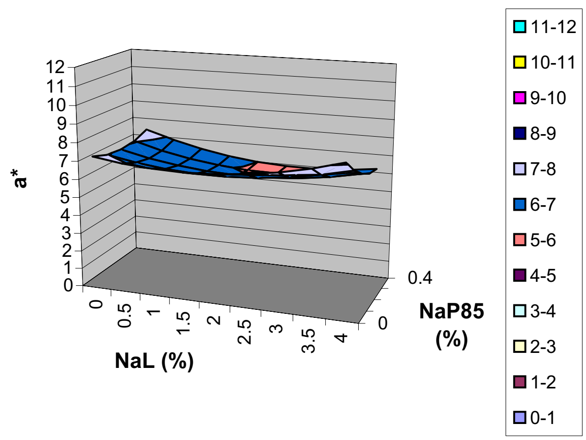

Figure 41. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the CIE a* color space value (+a = red; -a = green) of pork loin chops in Experiment 3.

There was no ($P \geq 0.05$) effect of treatment or storage day on the color of discoloration ($2.65 \pm .06$).

Other literature also reported that L* and b* color space values decreased with the addition of sodium lactate; indicating that cooked beef rounds were darker and less yellow than untreated cooked beef rounds (Papadopoulas and others 1991b). Maca (1995) reported that lean color was increased with the addition of 3% NaL to ground beef when compared to the control. This is consistent with results from the current study that observed darker, less yellow pork chops when they contain sodium lactate. Sodium lactate addition slightly increased the muscle pH and decreased package purge compared to the controls chops, indicating that less water was on the surface to reflect light making the chops appear darker in color. In contrast to the current study, other research has reported that the addition of sodium lactate and sodium phosphate increased the redness of fresh pork sausage (Brewer and others 1991) and of beef top rounds (Maca and others 1999). However, the inconsistencies are likely due to slightly different processing, meat products, and color measurements. However, as in the current study, with time fresh pork sausage and ground beef patties became lighter in color (Brewer and others 1991, Maca and others 1997a, respectively).

Cooking analysis, pH, and drip loss: The addition of sodium lactate and sodium phosphate has been shown to influence cooking characteristics, pH, and drip loss of beef and pork products (Keeton 1983, Trout and Schmidt 1986, drip loss of beef and pork products (Keeton 1983, Trout and Schmidt 1986, Maca 1995, Papadopoulas and others 1991b, Evans 1992 Papadopoulas and others 1991c). In general, sodium phosphate addition has been shown to increase pH that subsequently increases water holding capacity. For example, increasing muscle pH or moving the pH further away from the muscle's isoelectric point would expectantly decrease package purge, cook loss and drip loss. Sodium lactate addition also has been shown to slightly increase muscle pH and water holding capacity, even though this effect is minimal (Maca 1995, Papadopoulas and others 1991b, Evans 1992, Papadopoulas and others 1991c). The interaction and potential synergism with the combined use of these two ingredients on pH and water holding capacity traits has not been fully examined.

There was a significant ($P \leq 0.05$) treatment by storage day interaction for cook loss, package purge, and drip loss (Figs. 42 - 44, respectively), but not for cook time or pH (Appendixes AF - AG, respectively). Cook loss ranged from greater than seven to less than 23. According to the least squares means, after 14 d of storage the control pork chops had higher cook losses than any of the treated chops. Among the treated pork chops, the effects of sodium phosphate in combination with sodium lactate or sodium phosphate alone on the cook loss was inconsistent across storage time up to 28 d. However, according to Figure 42 the addition of sodium lactate alone decrease cook loss for pork chops stored 7, 21, and 28 d, which is consistent with previous research where sodium lactate

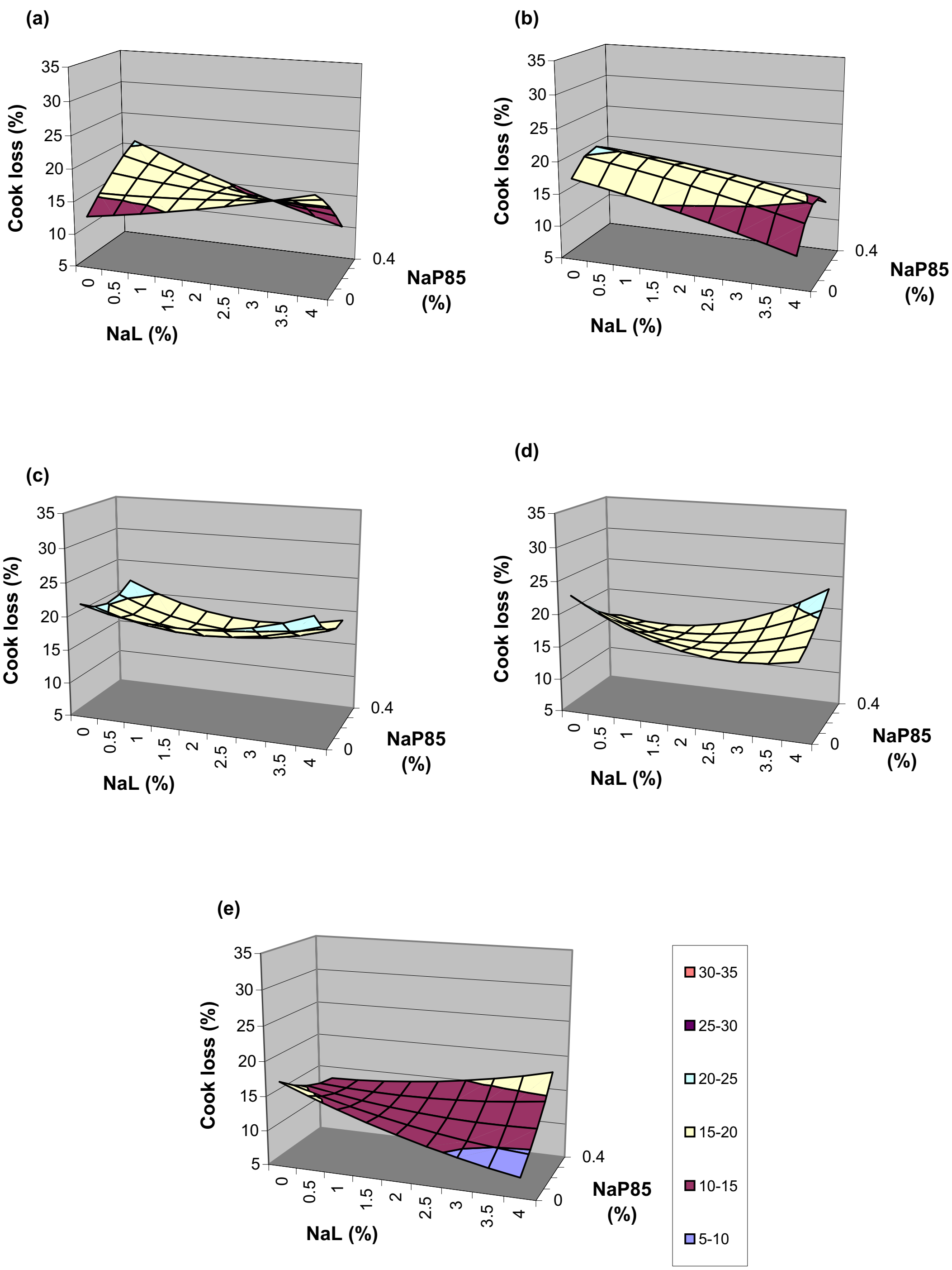

Figure 42. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on cook loss of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

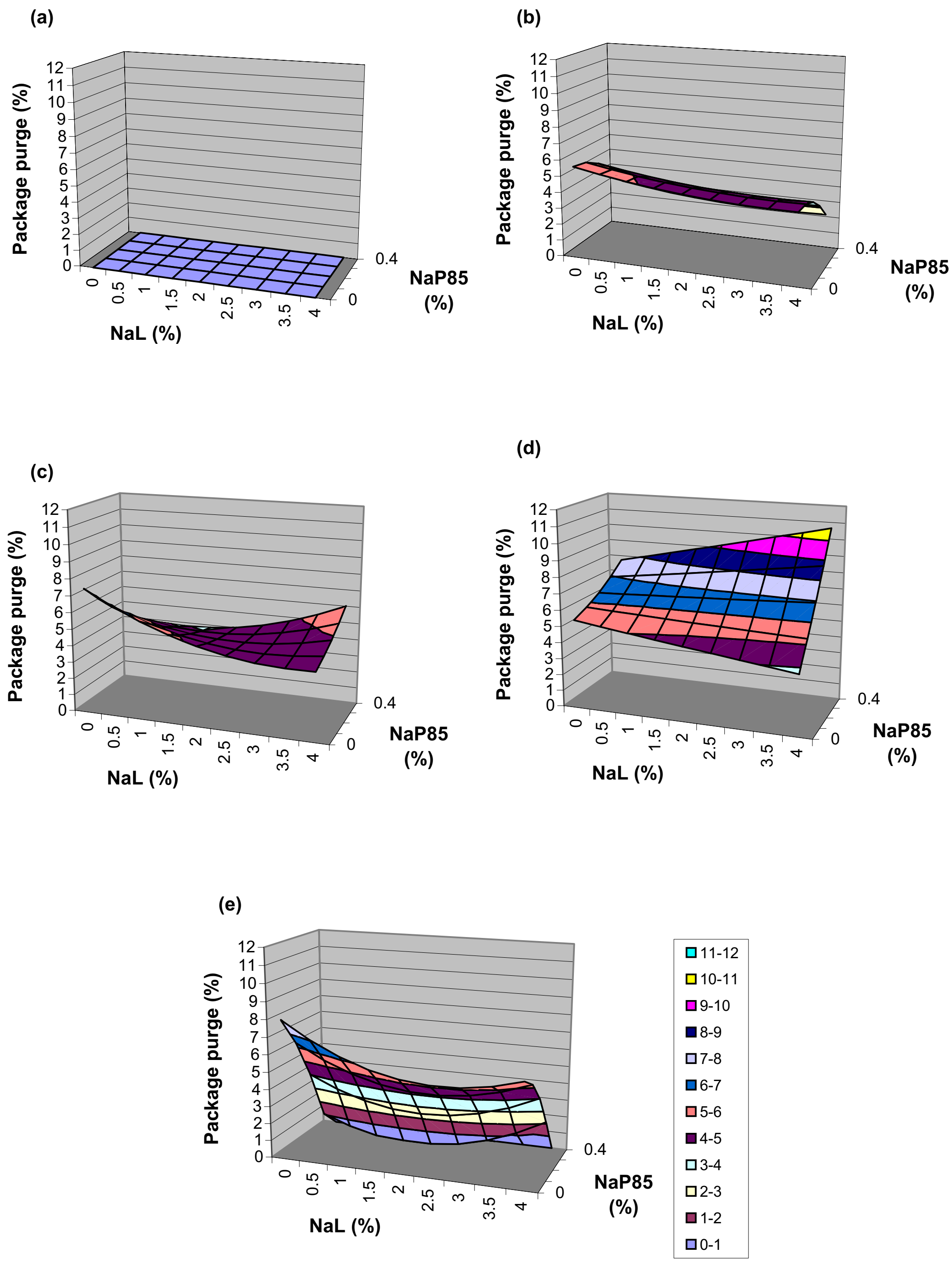

Figure 43. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the package purge of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

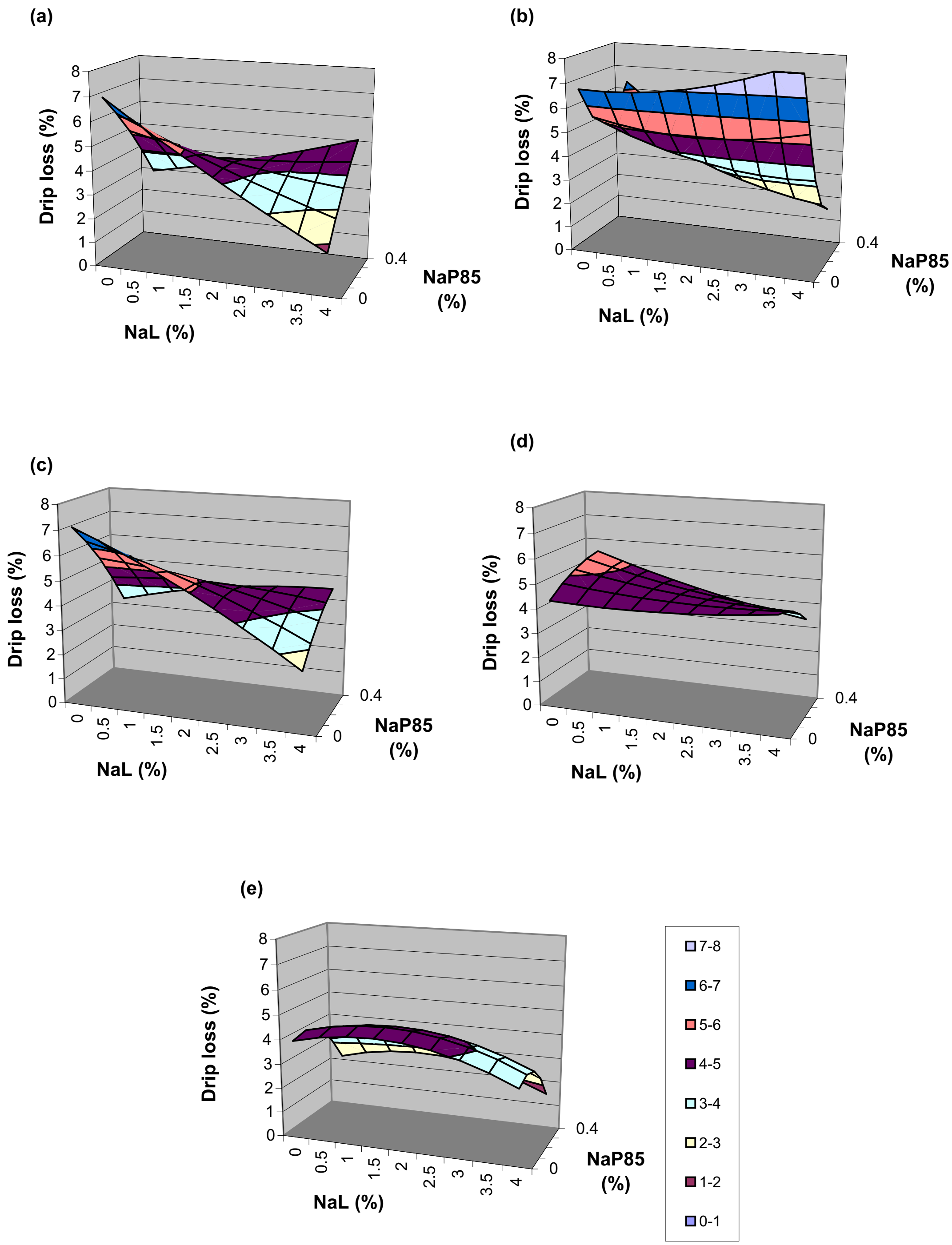

Figure 44. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the drip loss of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 3.

addition increased the cook yields in beef roasts (Papadopoulas and others 1991c). Similarly, the addition of sodium lactate alone decreased the package purge and drip loss when compared to the controls. However, the incremental addition of sodium phosphate alone increased package purge dramatically on storage days 21 and 28 when compared to control chops. It is not understood why package purge was substantially affected by sodium phosphate addition only on 21 and 28 storage days. The combination of sodium phosphate and sodium lactate also tended to increase package purge slightly after 14 d when compared to the control.

According to Figure 44, the drip loss of the pork chops decreased with the addition of sodium phosphate alone when compared to the controls. This trend was consistent across storage, except on storage day 7 where the pork chops containing 2% NaL (7.85%) had more drip loss then the controls (6.35%)(Appendix AF). Additionally, the combination of these ingredients was as beneficial at decreasing the drip loss of the pork chops as the ingredients added alone when compared to the controls on all storage days.

Treatment and storage day ($P \leq 0.05$) affected the pH of the pork loin chops (Appendixes AB and AA, respectively) (Fig. 45). Pork chop pH ranged from greater than 5.74 to less than 4.90. According to the least squares means, sodium lactate addition alone slightly increased the muscle pH (Appendix AB) when compared to the controls. In support, Evans (1992) reported an increase in muscle pH when sodium lactate was added to beef top rounds. Sodium

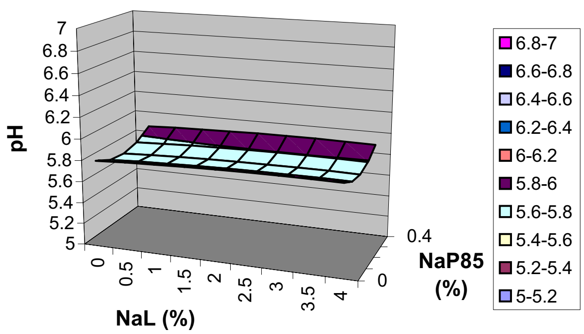

Figure 45. Response surface of sodium lactate (NaL) and sodium phosphate 85 (NaP85) levels on the pH of pork in Experiment 3.

phosphate addition alone also increased the muscle pH of the pork loin chops As expected, the pH of the brine solutions did differ (p = .0001) (Table 2). It is likely that the brine pH influenced the pH of the treated pork loin chop pH. Table 3 indicates that the pH of the pork loins did differ (p = .02) prior to injection, which indicates that there was variability among the pork loins. Day also affected the pH of the pork loin chops (Appendix AA). The pH of the pork loin chops, ranging from 5.87 on 0 d to 5.75 on 28 d, decreased with storage.

The cook time of the pork loin chops was also ($P \leq 0.05$) affected by day and ranged from 19.35 min on 0 d to 23.40 min on 21 d (Appendix AAF). At 28 d cook time dropped to 17.61 min. Other researchers studying the effects of sodium lactate and sodium phosphate on beef and pork have not reported any significant day effects on cook time (Keeton 1983, Trout and Schmidt 1986, Maca 1995, Papadopoulas and others 1991b, Evans 1992 Papadopoulas and others 1991c).

In support of the current study, Papadopoulas and others (1991b) observed higher cook yields in cook beef roasts with the addition of sodium lactate. Maca (1995) also observed that the cook yields of the control roasts were lower than roasts treated with sodium lactate. This is consistent with the current study where pork chops containing sodium lactate had slightly higher pH, and as expected, less cook loss, drip loss and package purge when compared to the control. Decreased cook loss, package purge, and drip loss are viewed as positive characteristics by the pork industry. From the current experiment, it can be concluded that pork chops should contain at least 2% NaL and .2% NaP to maximize palatability and color, and minimize discoloration, drip loss, package purge, and cook loss.

Experiment 4

Experiment 4 examined the effects of potassium lactate at 0 to 4% and sodium phosphate at 0 to .4% on pork loin chop palatability, texture, color, pH, and drip loss. Potassium lactate is commonly used as a substitute for sodium lactate because it does not contribute to the sodium content of the final product, but both ingredients are commonly used as antimicrobial agents. It has been reported that the addition of potassium lactate has antimicrobial benefits similar to sodium lactate. Results from Harris and others (1990) reported that APC values were lower for beef treated with either sodium and/or potassium lactate when compared to the control. Sodium lactate has been associated with increased salt basic taste, mouthburn, and chemical aromatics, but potassium lactate is thought to not alter the flavor of the finished product (Miller 2001). There is limited research that compares the functionality of these two ingredients; therefore, it was the objective of Experiment 3 and 4 to observe the interaction of potassium lactate and sodium lactate, respectively, in combination with sodium phosphate on pork loin chop palatability, texture, color, pH, and drip loss during vacuum-packaged refrigerated storage.

Sensory aromatics, feeling factors, and basic tastes: Similar to Experiment 3, pork loin chops in Experiment 4 had high levels of pork lean/brothy flavor aromatic and salt basic tastes. Also found in the pork chops were slightly detectable levels of pork fat and soda flavor aromatics; metallic and astringent mouthfeels; sour and bitter basic tastes; and salt, bitter, and soda aftertastes. In addition, very low intensity levels of chemical flavor; and sour, mouthburn, and metallic aftertastes were found in the pork chops. Flavors that were close to zero or barely detectable in the pork chops in Experiment 4 consisted of soapy and browned flavor aromatics; sweet basic taste; and soapy, chemical, and browned aftertastes. However, results indicate that some of these sensory attributes were affected by storage time and the addition of potassium lactate and sodium phosphate.

The interaction between treatment and storage time was significant ($P \leq 0.05$) for salt baosic taste, soda flavor, and salty aftertaste (Appendixes AH, AI, AJ, respectively) (Figs. 46 - 48, respectively). Salt basic taste intensity levels were very similar to results reported in Experiment 3. The addition of potassium lactate or sodium phosphate increased the salt basic taste of pork loin chops compared to the non-injected pork chops, and this trend was maintained across storage days. It should be noted that pork chops treated with approximately 4% NaL + .4% NaP had lower salt basic taste intensities than the injected pork chops, regardless of storage day.

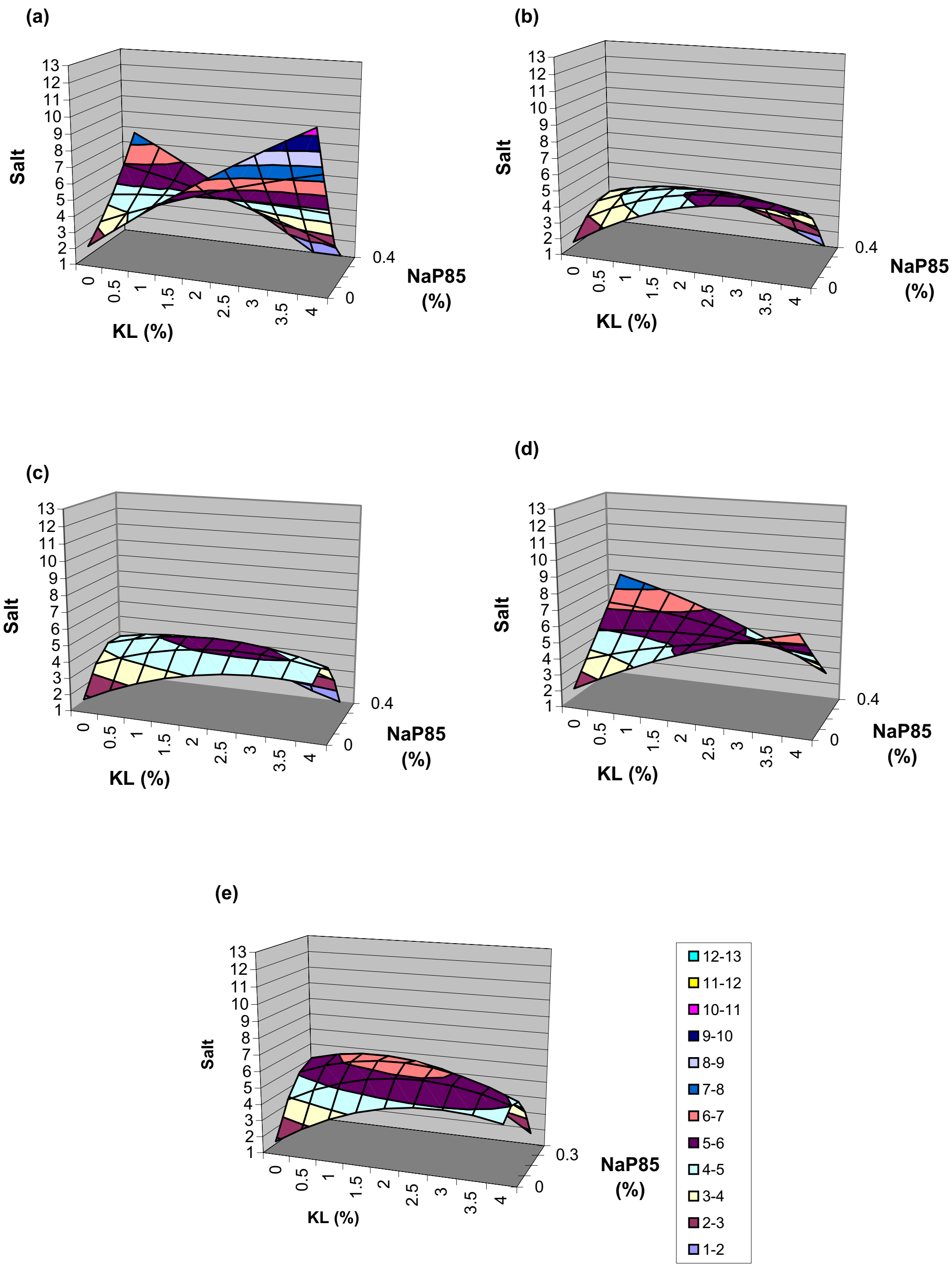

Figure 46. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the salt basic taste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 4.

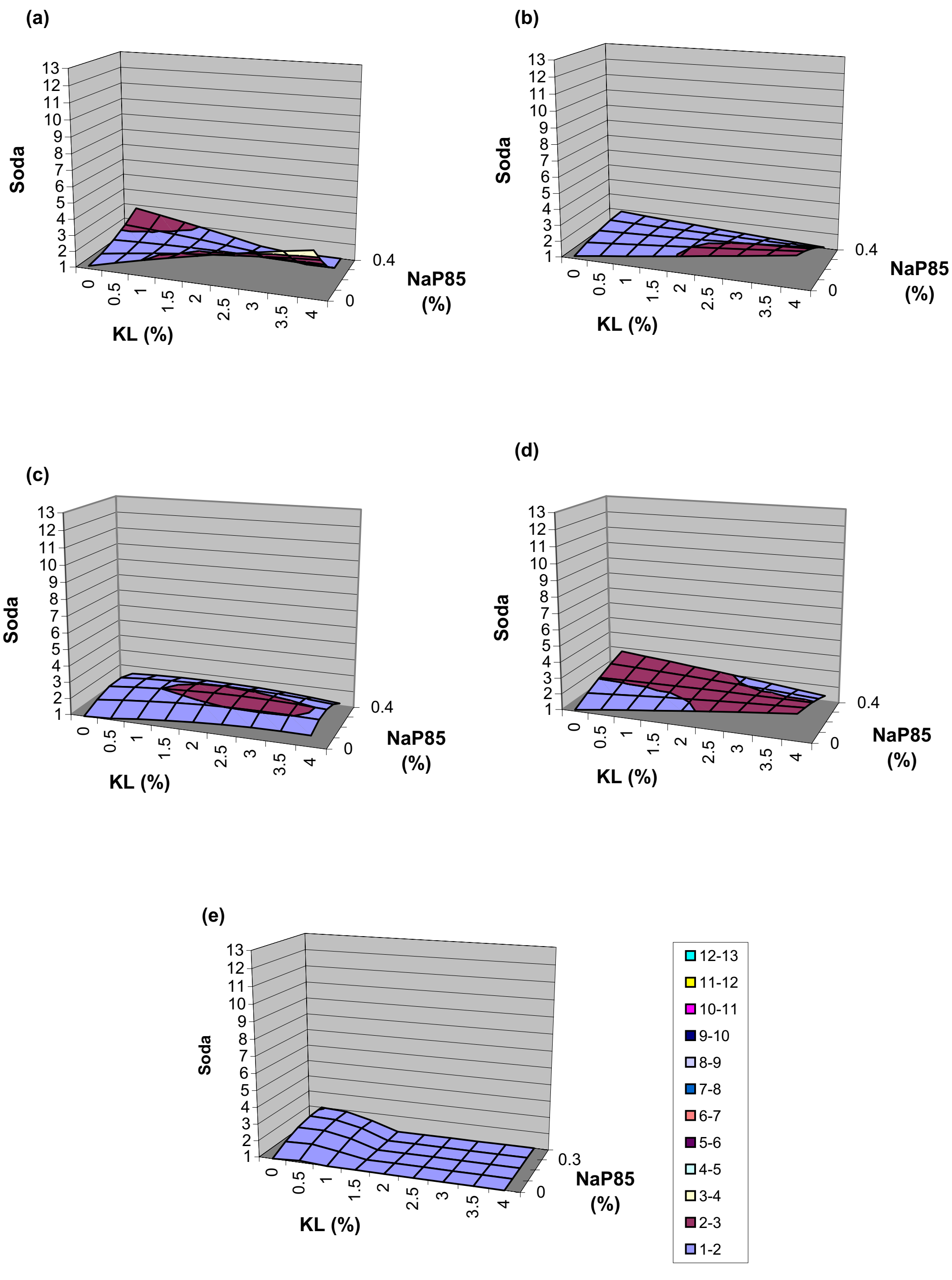

Figure 47. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the soda taste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 4.

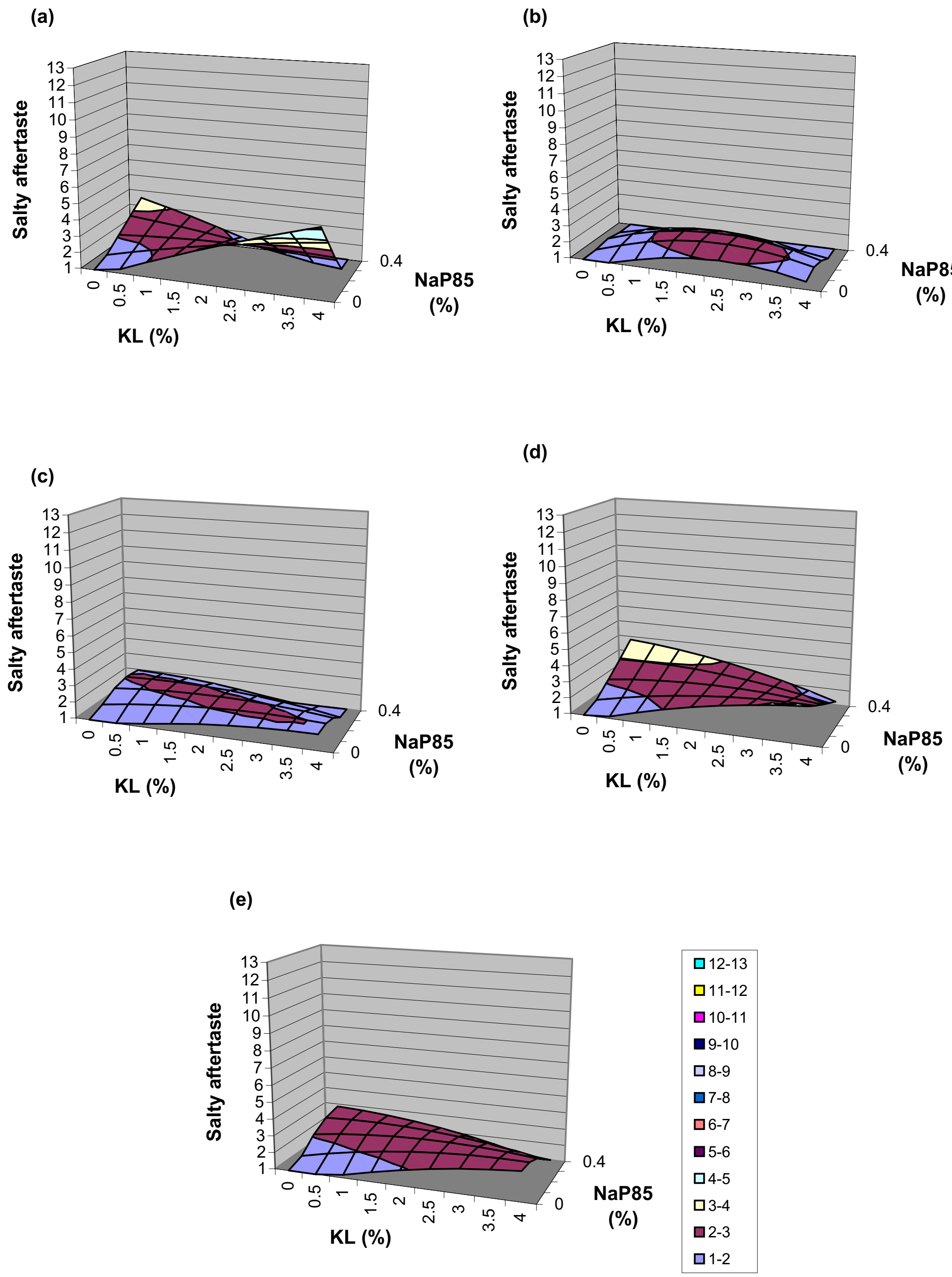

Figure 48. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the salty aftertaste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 4.

According to the least squares means in Experiment 4, soda flavor aromatic and salty aftertaste tended to be lower in control pork chops when compared to the treated chops stored for 7 to 28 d. These results are similar to other those observed in Experiment 3. According to Figures 47 and 48, the incremental addition of sodium phosphate or potassium lactate appeared to increase the soda flavor and salty aftertaste of the pork chops when compared to the control chops, regardless of storage day. In support of the current study, other research also determined that potassium lactate addition to beef steaks increased the soda flavor (Anwar 2000). However, the combination of approximately 4% KL + .4% NaP decreased these attributes when compared to other treatments. With storage time, soda flavor tended to decreased in the treated chops.

Other attributes that also had treatment x storage day interactions included pork fat, chemical, and browned flavors; sour basic tastes; and soda and bitter aftertastes; metallic and astringent mouthfeels (Appendixes AH – AK, respectively). According to the least squares means, pork fat flavor aromatic, sour basic taste, metallic and astringent mouthfeels, and soda aftertaste tended to be found at lower intensity levels in the control pork chops when compared to the treated chops. Data from Experiment 3 showed similar results. Other attributes, such as, browned flavor aromatic and bitter aftertastes were reported at higher intensity levels in controls than the treated chops regardless of storage. With storage time, pork fat flavor, sour basic taste, and soda and bitter aftertastes increased in the treated chops and decreased in the control chops. As in Experiment 3, metallic and astringent mouthfeels were reported in pork chops from all treatments in Experiment 4. However, metallic and astringent mouthfeels, and chemical taste intensity levels in treated and control chops were inconsistent, and a trend was not observed with storage time.

There was a treatment by storage day effect for sour aftertastes; however, this attribute was found at very low intensity levels, and no consistent trends were observed among the treated and non-injected controls up to 28 d of storage (Appendixes AJ).

There were no treatment or storage day main effects ($P > .05$) for bitter ($2.59 \pm .056$) and sweet ($.24 \pm .024$) basic tastes; or soapy ($.11 \pm .018$) and mouthburn ($.37 \pm .033$) aftertastes, but treatment did affect ($P \leq 0.05$) pork lean/brothy flavor aromatic. As in Experiment 3, pork lean/brothy flavor was lowest in the controls and in pork chops containing approximately .4% NaP and 4% KL (Appendix AL) (Fig. 49). However, incremental increases in the level of sodium phosphate or potassium lactate alone increased the pork lean/brothy flavor. Pagach (1992) also determined that the addition of potassium lactate increased beef/brothy flavor of precooked beef roasts. There were storage day main effects for soapy ($.158 \pm .01$) flavors; and chemical ($.072 \pm .02$), metallic ($.556 \pm .04$), and browned ($.137 \pm .02$) aftertastes (Appendix AM, respectively). However, these attributes were barely detectable and will not be discussed further.

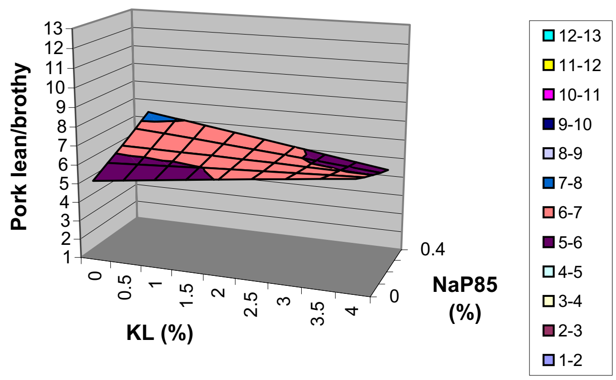

Figure 49. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the pork lean/brothy aromatic (0 = none; 15 = extremely intense) of pork loin chops in Experiment 4.

Results from Experiment 4 indicated that pork chops treated with potassium lactate were similar in flavor to pork chops containing sodium lactate. It should be noted that the addition of high levels potassium lactate or sodium lactate in combination with high levels of sodium phosphate to pork chops had a negative effect on the pork lean/brothy flavor aromatic. It is possible that the decrease in the flavor intensity is associated with the increase in package purge and cook loss when potassium lactate and sodium phosphate are added together at high levels.

Texture: The interaction between treatment and storage day was significant ($P \leq 0.05$) for muscle fiber tenderness, juiciness, and processed meat-like bite (Figs. 50 - 52, respectively) (Appendix AN). Muscle fiber tenderness, juiciness, and processed meat-like bite tended to increase in pork chops treated with incrementally higher levels of potassium lactate alone on most storage days. According to Figures 50 and 52, the addition of potassium lactate alone to the pork chops seemed to have a greater effect on increasing the pork chop muscle fiber tenderness and processed meat-like bite than sodium lactate alone. It should be noted that the addition of sodium lactate (up to 4%) tended to decrease the processed meat-like texture, while potassium lactate (up to 4%) tended to increase the processed meat-like texture. In addition, Figures 50 - 52 indicated that when the trained sensory panel scores for tenderness were high, their scores for processed meat-like bite were high, and visa versa, which was also observed in Experiment 3. In Experiment 4, generally pork chops

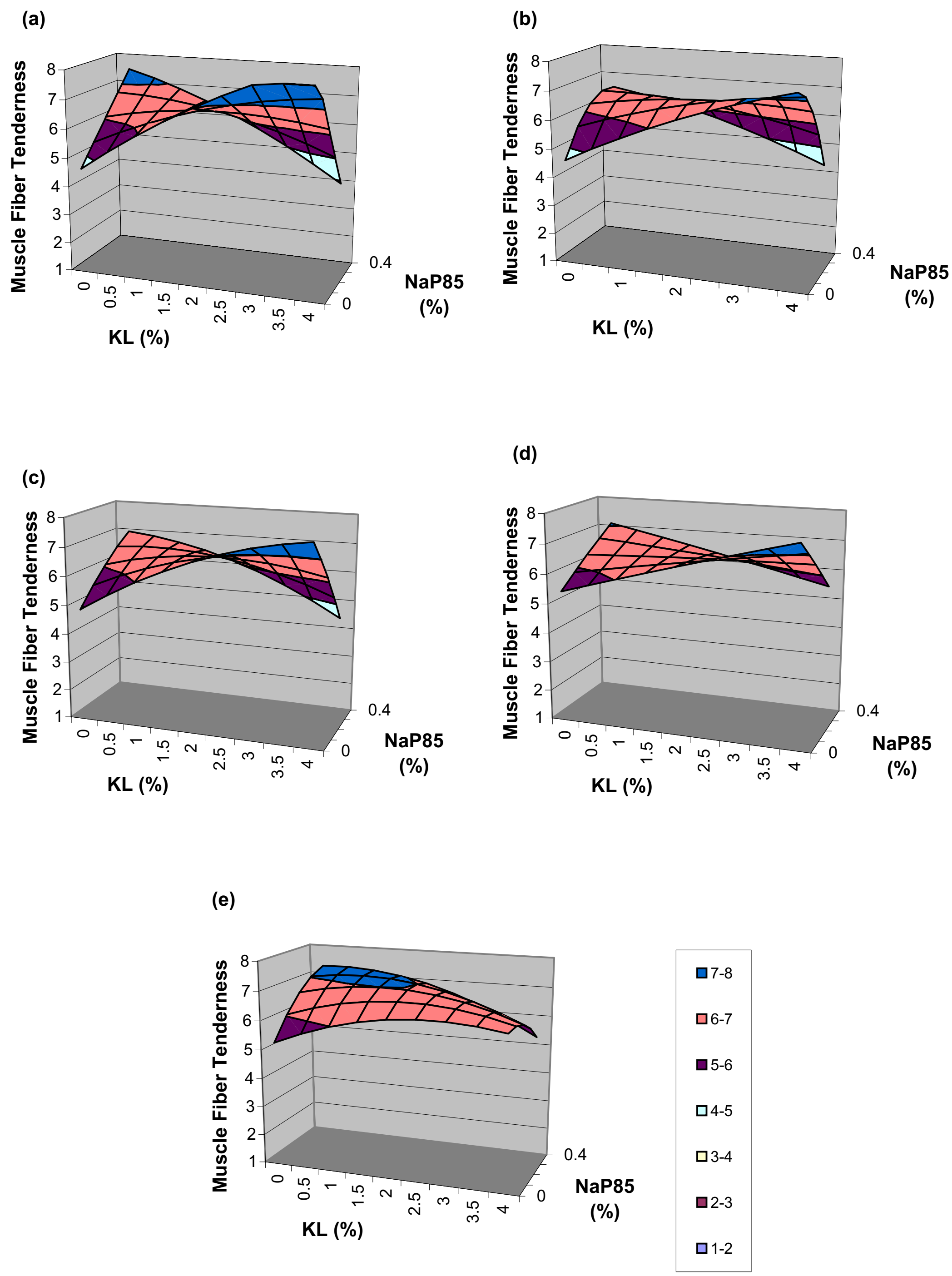

Figure 50. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the muscle fiber tenderness (0 = extremely tough; 8 = extremely tender) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 4.

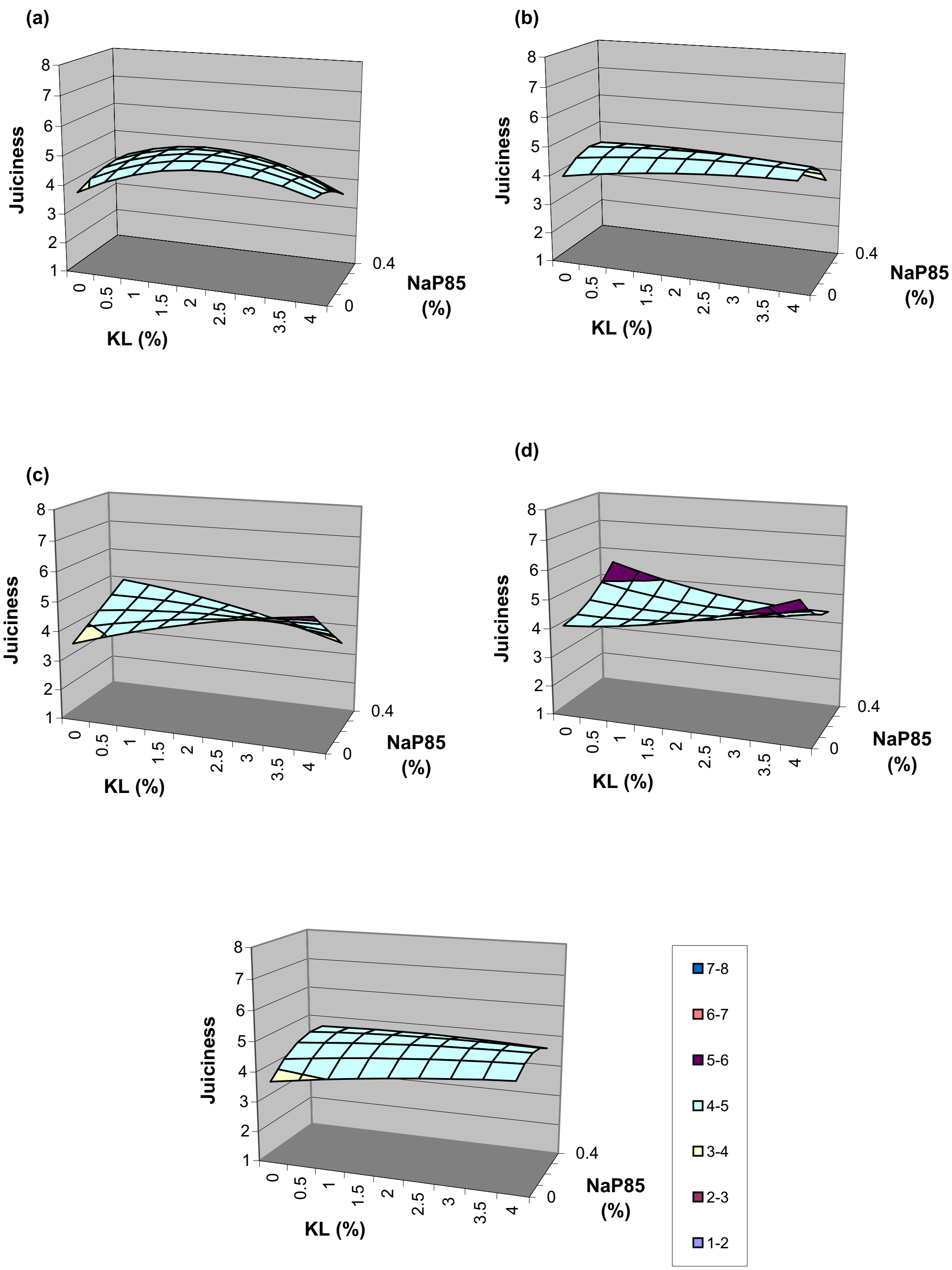

Figure 51. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the juiciness (0 = extremely dry; 15 = extremely juicy) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 4.

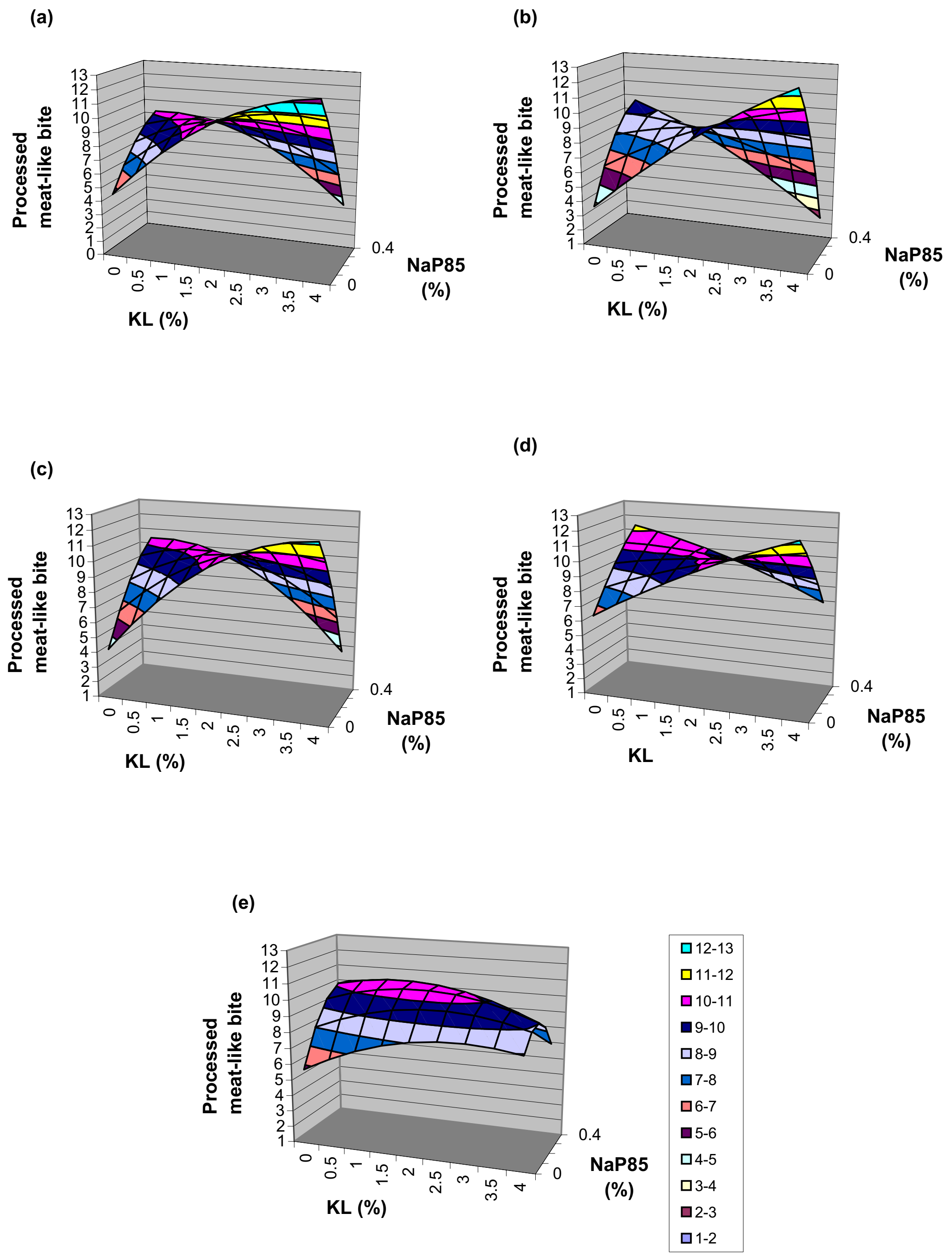

Figure 52. Response surface of sodium potassium lactate (KL) and phosphate 85 (NaP85) levels on the processed meat-like bite (0 = whole muscle or steak like; 15 = very soft and rubbery) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 4.

containing the combination of approximately 4% KL and 4% NaP were less tender, juicy, and had less processed meat-like when compared to other treated pork chops regardless of storage day. This result also was observed in Experiment 3 in pork chops containing 4% NaL + .4% NaP. As mentioned previously, these unexpected trends may be due to the high salt content of the pork chops and/or because generally in fitting models to the estimated values located on the extreme points of the response surface graphs which tend to have high standard errors and are more susceptible to either under or over-estimating. However, when compared to the controls, the addition of potassium lactate or sodium phosphate alone to the pork chops increased the perceived juiciness and tenderness up to 28 d storage. Additionally, storage day in Experiment 4 did not have much effect on the juiciness of the pork chops, but pork chops injected with high levels of potassium lactate alone (up to 4%) and stored 28 d were less tender and had more processed meat-like than the same treatments on other storage days. However, pork chops containing approximately 4% KL + .4% NaP and stored 28 d were more tender and had higher levels of processed meat-like when compared to the same treatments on other storage days. According to the Figures 50-52, incremental increases of sodium phosphate alone (up to 4%) in the pork chops increased the tenderness, juiciness, and processed meat-like bite of the pork chops, and these attributes were maintained up to 28 d storage.

Results similar to those observed in the current study were found by Anwar (2000), who reported that strip loin steaks containing 1.5 – 2% potassium lactate were more tender when compared to the control steaks, and that the addition of potassium lactate increased the processed meat-like bite of the beef steak. Improved juiciness was expected in pork chops containing sodium phosphate because of sodium phosphate's ability to increase protein swelling and increased WHC. These results are supported by the low package purge and cook loss amounts observed in pork chops containing sodium phosphate or potassium lactate alone when compared to the controls.

In summary, it is recommended that pork chops contain approximately 1% KL + .3% NaP to increase and maintain muscle fiber tenderness and juiciness during storage up to 28 d.

Color: A significant ($P \leq 0.05$) treatment by storage day interaction was observed for the pork chop color, amount of discoloration, color of discoloration (Appendix AO), and CIE b* color space values (Appendix AP) (Figs. 53, 56, 57, and 58, respectively), but not for CIE L* or a* color space values (Appendix AH). Although CIE L* and a* color space values were affected by treatment (Appendix AL)(Figs. 54 and 55, respectively), storage day did not affect these color values.

The CIE L* and a* color space values trends and sensory color intensities in the pork chops were very similar in Experiment 3 and 4. Pork chops were darker, less white, and slightly less red with increasing levels of potassium

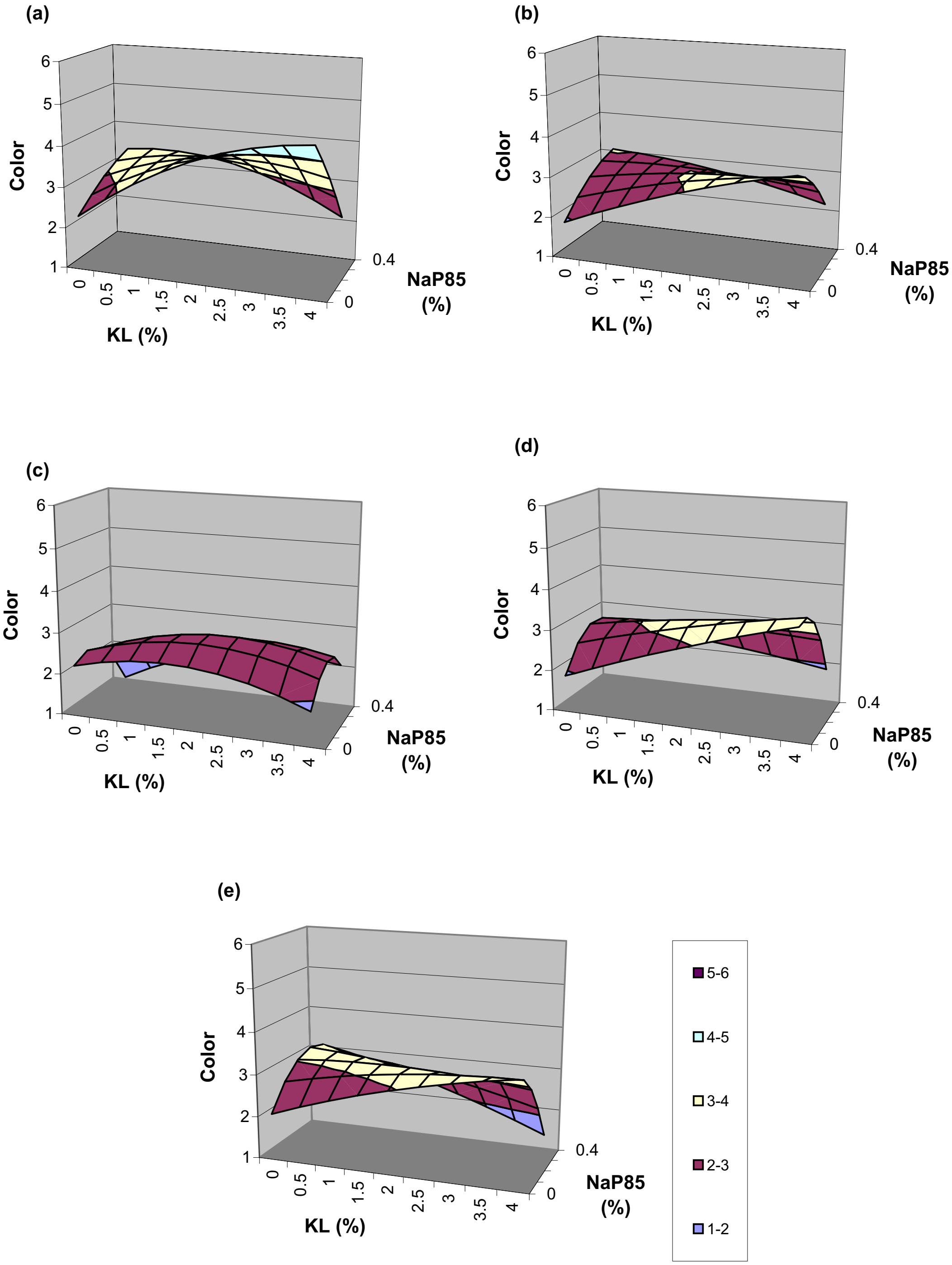

Figure 53. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the color (1 = pale pink; 6 = pinkish red) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 4.

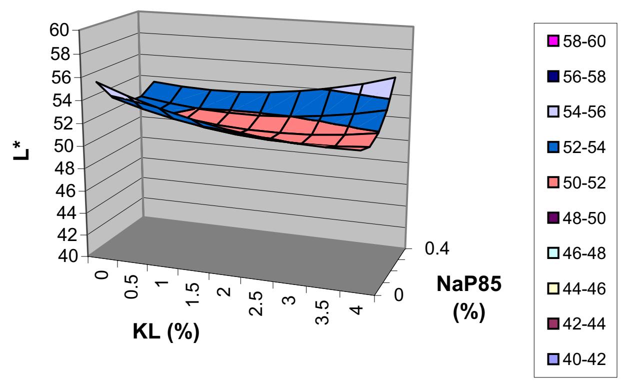

Figure 54. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the CIE L* color space values (0 = black; 100 = white) of pork loin chops in Experiment 4.

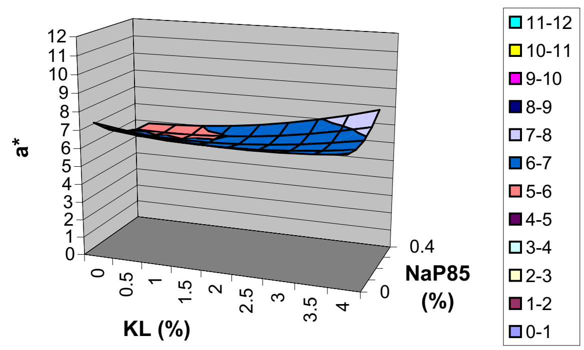

Figure 55. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the CIE a* color space values (+a = red; -a = green) of pork loin chops in Experiment 4.

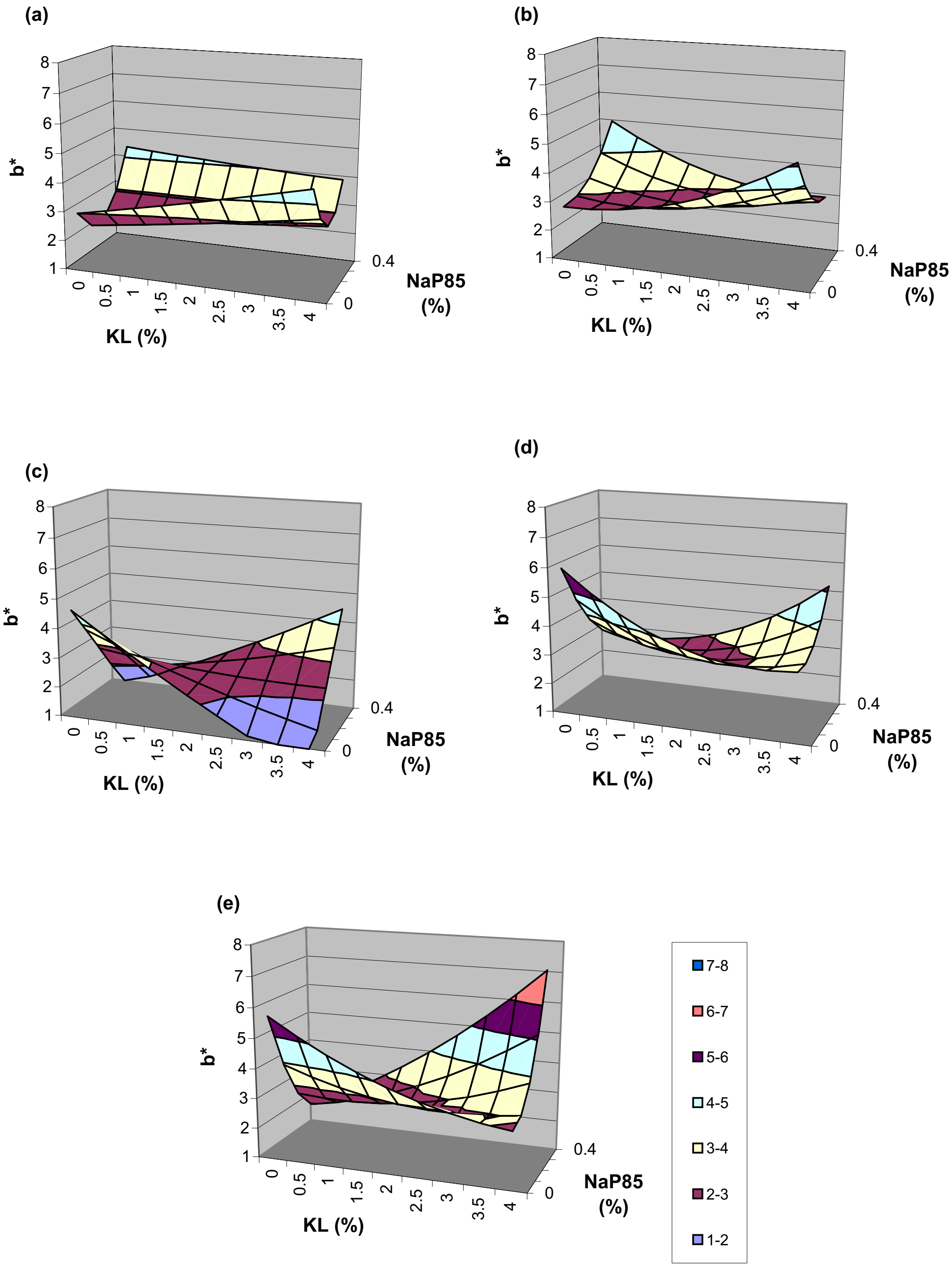

Figure 56. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the CIE b* color space value (+b = yellow; -b = blue) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 4.

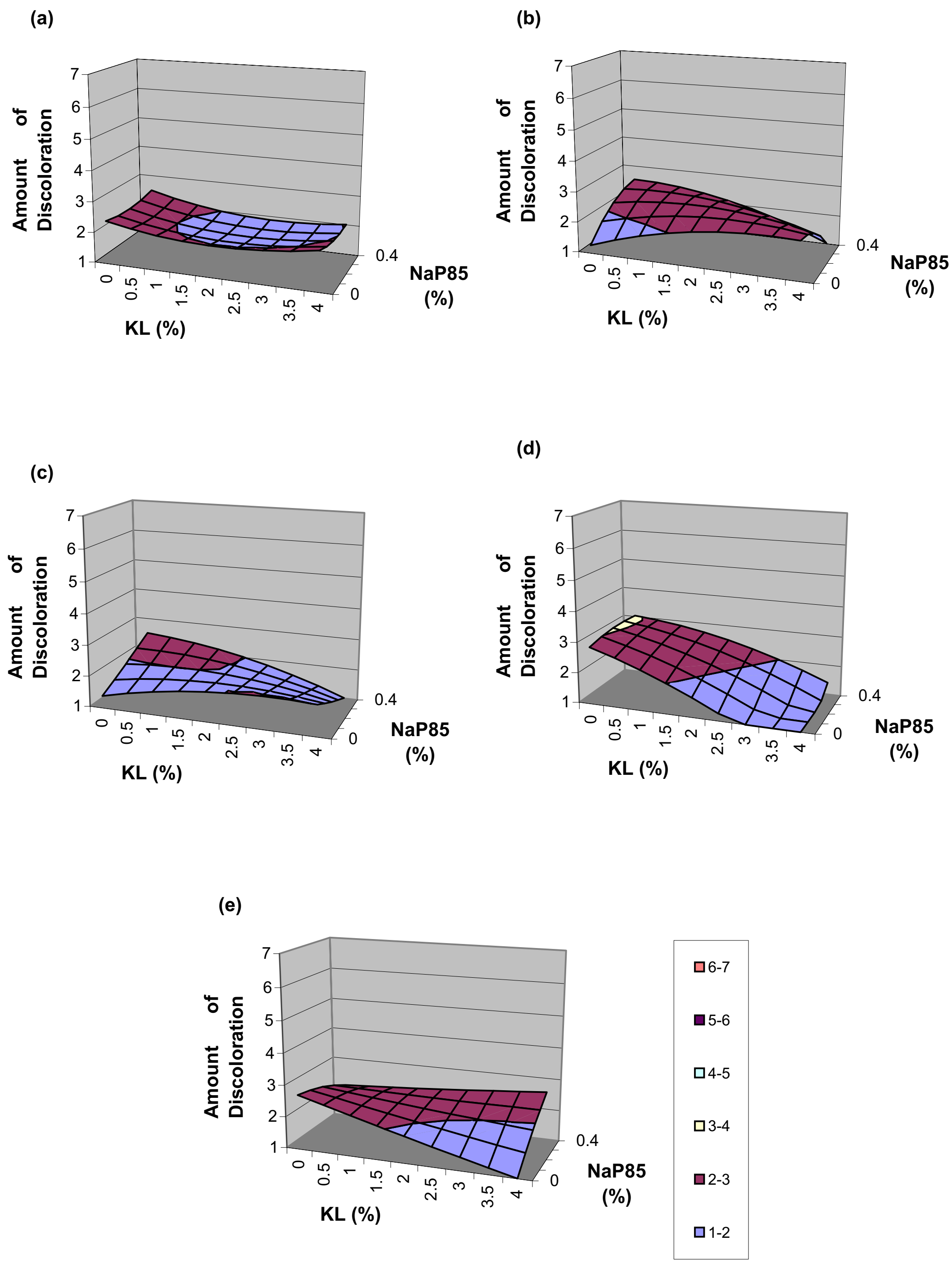

Figure 57. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the amount of discoloration (1 = 0% discoloration; 7 = 100% discoloration) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4$^{\circ C}$ in Experiment 4.

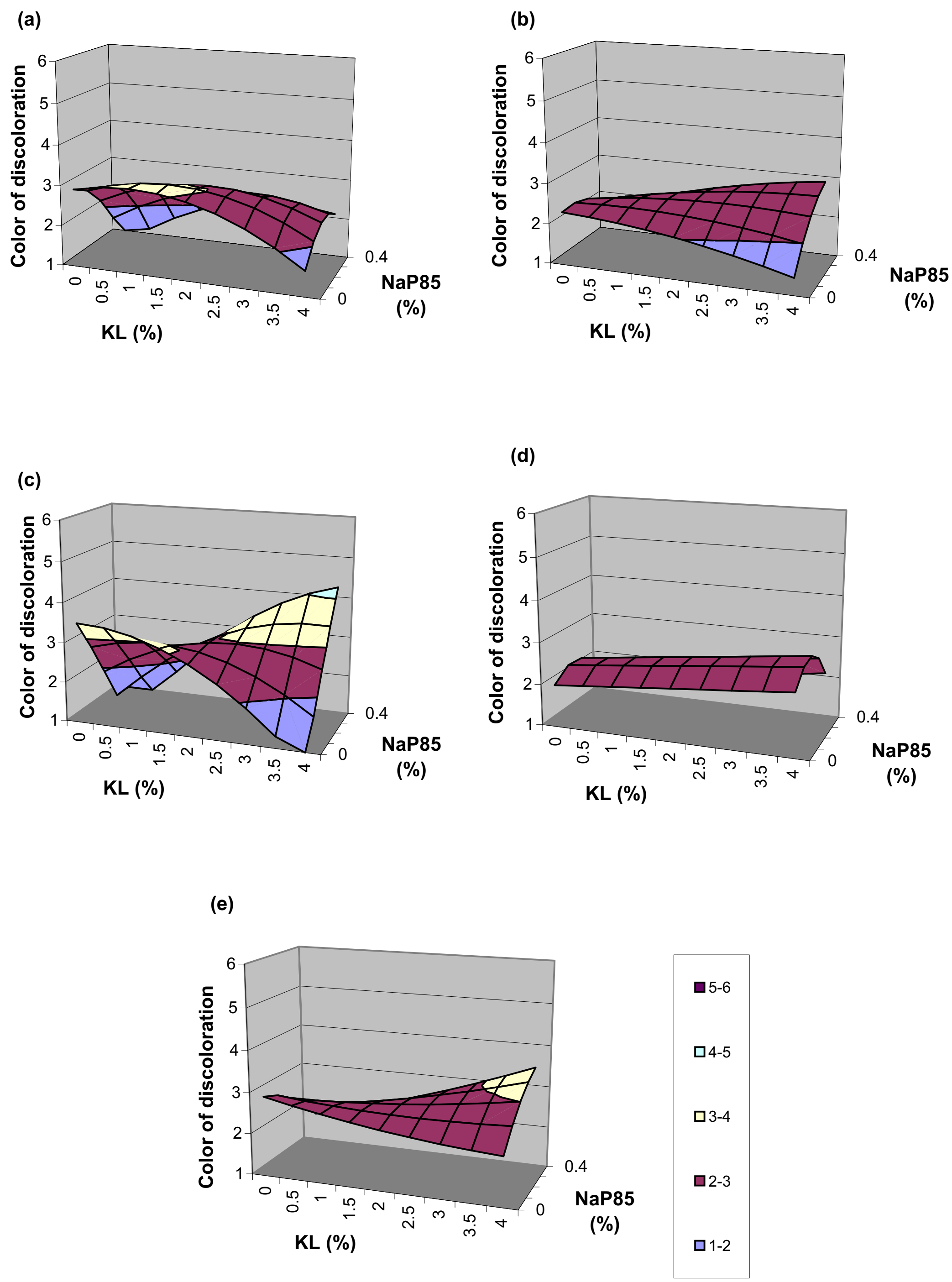

Figure 58. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the color of discoloration (0 = pinkish gray; 6 = pinkish red) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 4.

lactate or sodium phosphate alone than in the non-injected control pork chops. Similarly, darker, redder appearances were found in meat treated with sodium tripolyphosphates (Mendonca and others 1989, Molins and others 1987). Anwar (2000) also observed a darker purple color in steaks and Mendonca and others (1989) observed higher red color values in pork loins containing potassium lactate when compared to the control. The combination of potassium lactate (up to 4%) and sodium phosphate (up to .4%) at higher levels in the pork chops made them appear lighter and slightly more red, similar to the control chops. It is likely that the lighter pork chop color is a result of free water on the surface of the chop, which reflects light. These results were consistent across storage up to 28 d.

Results from Experiment 4 also indicated that pork chops containing potassium lactate (up to 4%) alone or sodium phosphate (up to .4%) alone were more yellow (CIE b* color space values) when compared to the non-injected controls stored 7 d. Over 14 d, the addition of either ingredient alone decreased the yellowness of the pork chops compared to the non-injected controls. The combination of potassium lactate and sodium phosphate increased the yellowness of the pork chops and this trend was observed up to 28 d of storage.

Potassium lactate and sodium lactate had similar effects on the amount of discoloration of the pork chops. Generally, the amount of discoloration decreased and became lighter when potassium lactate was added alone or in combination with sodium phosphate when compared to the controls stored up to

28 d (Figs. 57 and 58, respectively). However, sodium phosphate alone increased the amount of discoloration in the pork chops for both experiments, which was pale in color. It is likely that the discoloration associated with potassium lactate and sodium phosphate addition is due to increased amount of free water on the pork chops surface that reflects light. Even though there was a treatment by storage day interaction for discoloration and the color of the discoloration, changes in these attributes were minimal across storage time.

Cooking analysis, pH, and drip loss: The interaction between treatment and storage time was significant for cook time, cook loss, and package purge (Appendix AQ, respectively) (Figs. 59 - 61, respectively) but interactions of treatment and storage time for pH or drip loss (Appendix AR) were not significant. Regardless of storage time, higher cook time values were observed in pork chops containing increasing levels of sodium phosphate alone; however, the addition of potassium lactate decreased cook time slightly.

Potassium lactate or sodium phosphate addition alone appeared to affect the cook loss of the pork chops similarly; however, the trends were more dramatic in pork chops containing potassium lactate. When compared to the controls, the addition of KL (up to 4%) alone decreased the cook loss of pork chops stored 7 and 28 d, and NaP (up to .4%) alone decreased the cook loss of the pork chops stored 14 and 28 d. It should be noted that on storage day 7 and 21, sodium phosphate addition alone did not appear to affect the cook loss of the pork chops. Package purge decreased in pork chops containing

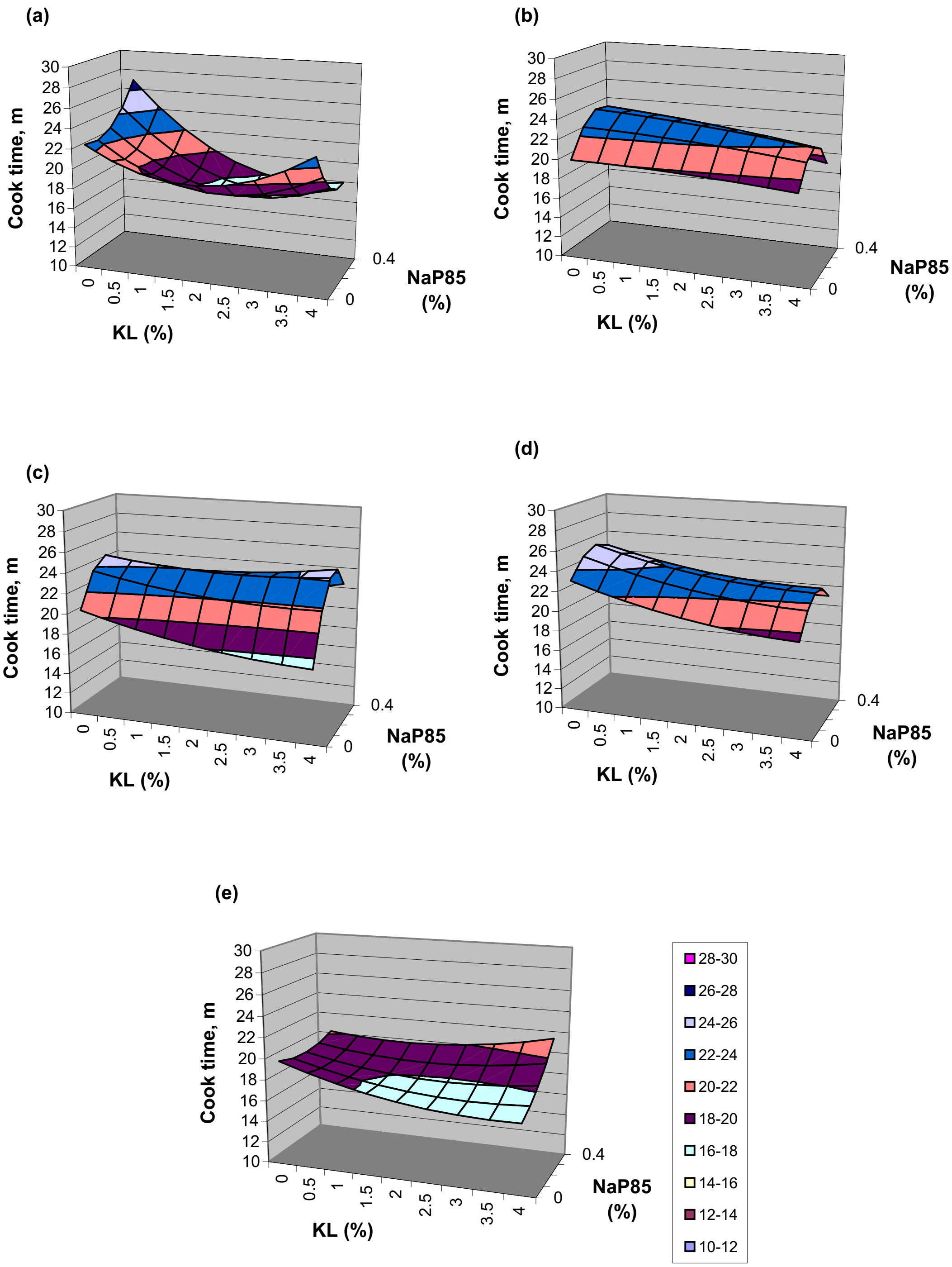

Figure 59. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the cook time of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4 °C in Experiment 4.

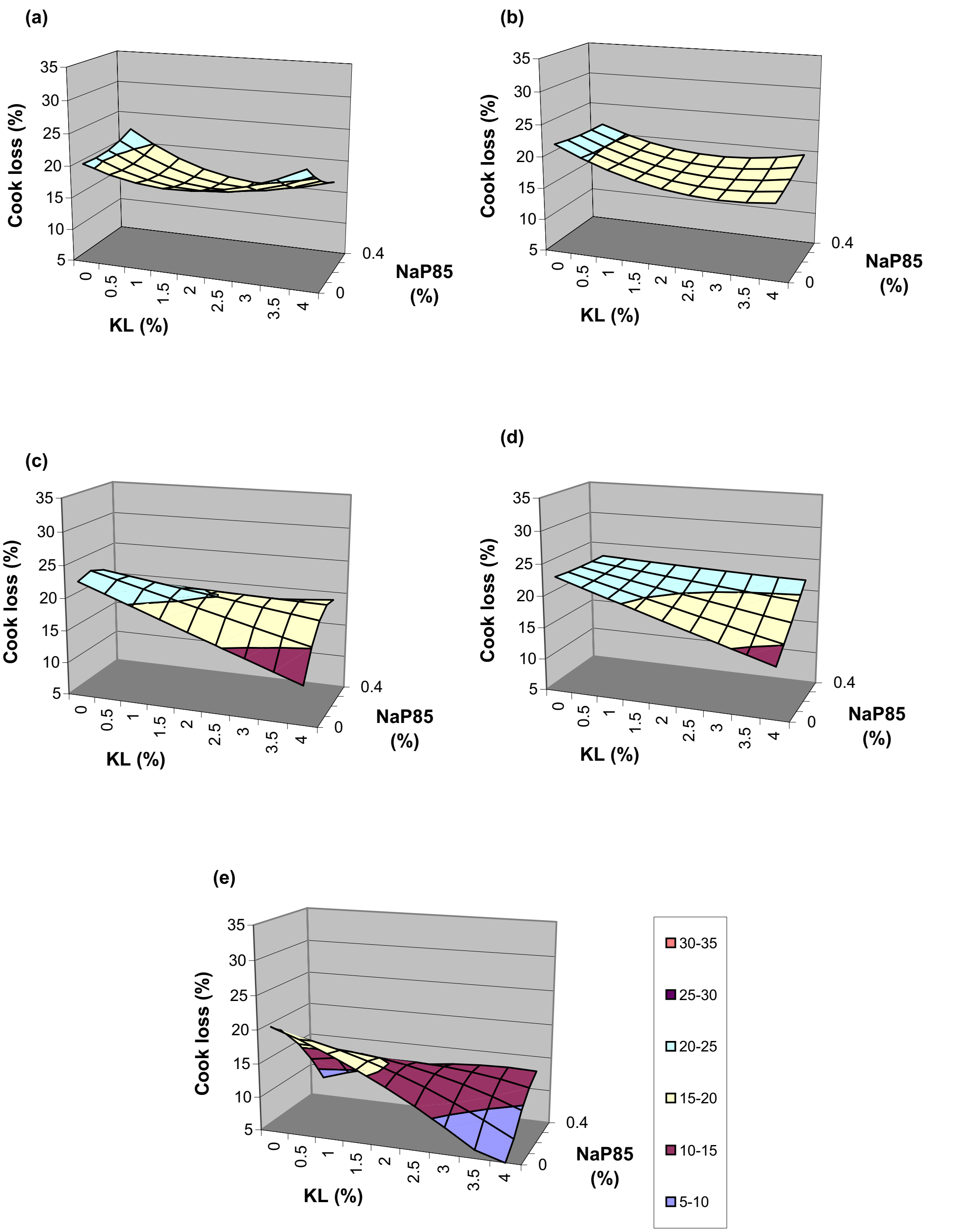

Figure 60. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the cook loss of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4˚C in Experiment 4.

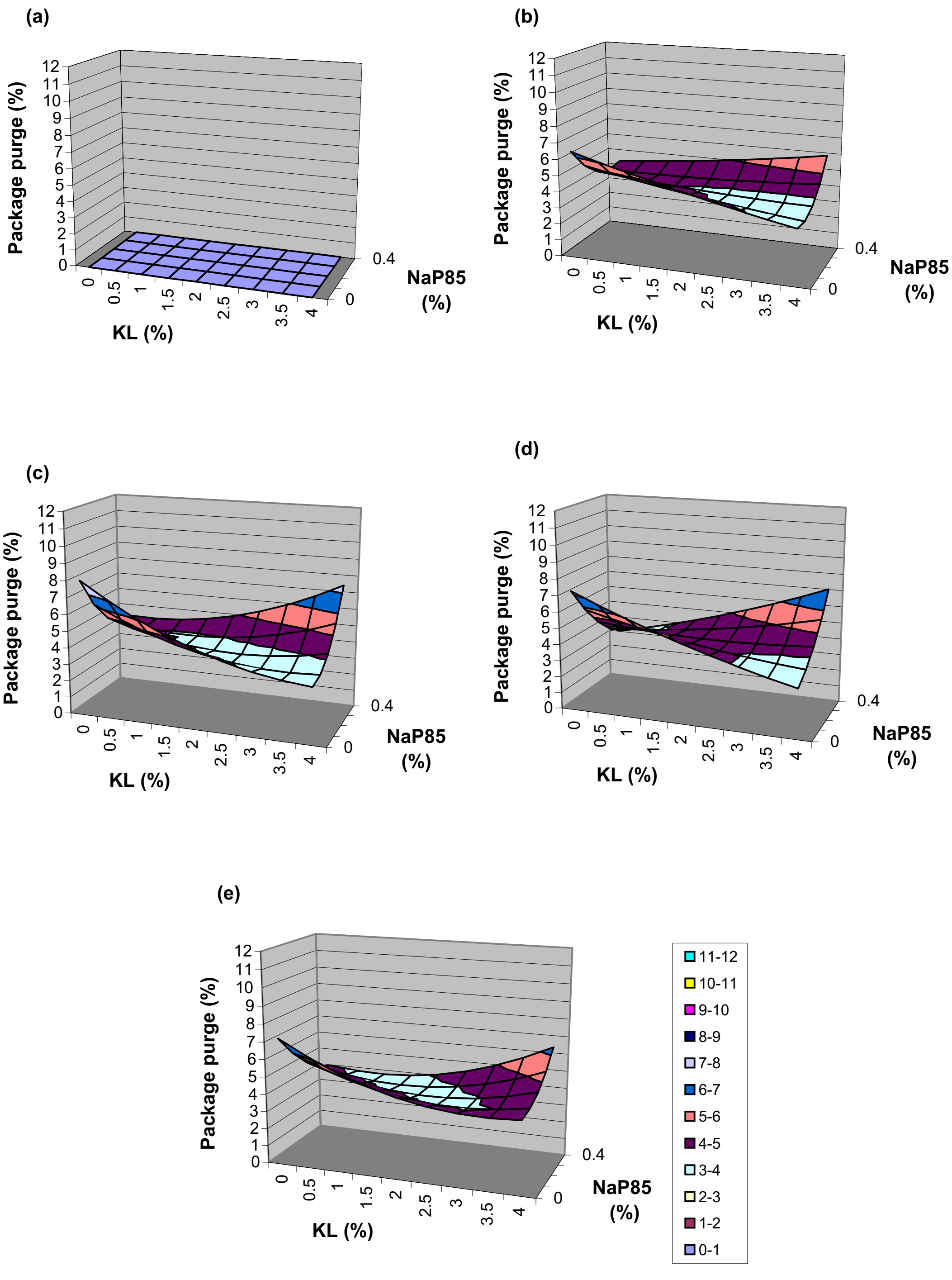

Figure 61. Response surface of potassium lactate (KL) and sodium phosphate 85 (NaP85) levels on the package purge of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 4.

potassium lactate alone or sodium phosphate alone, but, pork chops containing approximately 4% KL + .4% NaP and the control chops generally had greater amounts of cook loss and package purge when compared to other treated chops. Cook loss in the treated chops stored up to 28 d decreased slightly regardless of treatment; however, there was little change in the amount of package purge with storage time.

Table 3 indicates that the pH of the pork loins differed ($p = .03$) prior to injection. It is likely that the high variability among pork loins prior to injection could have contributed to the lack of significance among treatments and over storage time. Additionally, neither treatment nor storage day significantly ($P > 0.05$) affected the pH of the pork loin chops ($5.85 \pm .016$) (Appendix AJ). As expected, the pH of the brine solutions also significantly ($P \leq 0.05$) differed ($p = .03$) (Table 2). To understand if the pH of the pork chops were influenced by the pH of the pork loins prior to injection; analysis of variance was conducted using SAS (1999) where the preinjected loin pH was tested as a covariate. Results indicated that preinjected pH did not influence the pH of the pork chops during storage.

Drip loss was not affected ($P \geq 0.05$) by treatment, but was affected ($P \leq 0.05$) by storage day (Appendix AM). Drip loss of the pork loin chops increased with storage time, most likely due to proteolysis. The increased drip loss observed over storage time could explain the decrease in cook loss in the pork chops stored up to 28 d decreased, regardless of treatment. With less free water in the protein matrix, there is less water loss during the cooking process.

In other research, strip loin steaks containing potassium lactate had the lowest purge and the highest cook yield when compared to the control (Anwar 2000). These results are consistent with the results from the current study, which determined that the addition of potassium lactate decreased the amount of cook loss and package purge when compared to the controls. The decrease in cook loss can be attributed to the ability of potassium lactate to increase the water-binding capacity of meat proteins.

In summary, potassium lactate and sodium lactate had similar flavor and basic tastes when added to enhance pork loin chops. Unlike sodium lactate, potassium lactate alone (up to 4%) tended to increase the muscle fiber tenderness, juiciness, and processed meat-like bite up to 28 d storage. Like sodium lactate, potassium lactate addition reduced package purge and cook loss. It should be noted that the addition of high levels of potassium lactate (up to 4%) or sodium lactate (up to 4%) in combination with high levels of sodium phosphate (up to .4%) had a negative effect on color, muscle fiber tenderness, cook loss, and package purge when compared to other treated chops. Additionally, it was observed that processed meat-like bite increased with incremental additions of 0 – 4% KL alone and decreased with the incremental addition of 0 – 4% NaL alone to the chops when compared to the controls. Therefore, it is recommended that pork chops contain approximately 2% NaL or

2% KL + .2% NaP to maintain positive attributes, such as, pork lean/brothy flavor, salt basic taste, improved tenderness, and juiciness over storage time when compared to the control chops.

Experiment 5

Experiment 5 was used to examine the effects of sodium diacetate from 0 to .2% and sodium phosphate from 0 to .4% on pork loin chop palatability, texture, color, pH, and drip loss during vacuum-packaged, refrigerated storage. Sodium diacetate is a non-meat ingredient commonly used in pork products as an antimicrobial agent mainly to retard the growth of *Listeria monocytogenes* (Schlyter and others 1993). Sodium diacetate addition has minimal effects on meat color, WHC, and palatability; mainly because it is added at low levels (Anwar 2000; Grones 2000). In the current study, sodium phosphate was used in combination with sodium diacetate to examine meat color, drip loss, palatability, and antimicrobial ability in pork loin chops.

Sensory aromatics, feeling factors, and basic tastes: Overall, pork chops in Experiment 5 had high levels of pork lean/brothy flavor aromatic and salt basic tastes. Also found in the pork chops were slightly detectable levels of pork fat flavor aromatics; metallic and astringent mouthfeels; sour basic tastes; salt, bitter, and soda aftertastes. In addition, very low intensity levels of cardboardy, chemical, metallic, mature, and browned aftertastes were found in the pork chops. Vinegar flavor aromatic and chemical aftertastes close to zero or not detected in pork chops in Experiment 5. However, storage time and the level of sodium diacetate and sodium phosphate addition affected the intensity levels of some sensory attributes.

Treatment by storage time interaction was significant ($P \leq 0.05$) for pork lean/brothy aromatic, salt basic tastes, salty and soda aftertastes attributes, pork fat, and sour basic taste (Appendix AS – AU, respectively) (Figs. 62 - 67, respectively). Treatment by storage time interaction also significantly ($P \leq 0.05$) affected metallic and astringent mouthfeels, however, differences were not observed utilizing the surface response graphs (Appendix AV). Therefore, surface response graphs will not be presented.

Pork lean/brothy least squares means ranged from greater than four to less than six. At 0 d of storage, pork chops with 0% NaDi and .4% NaP had the highest pork lean/brothy flavor aromatic. With the addition of sodium phosphate to pork chops stored 0 to 28 d, pork lean/brothy aromatic increased. The combination of sodium phosphate with sodium diacetate decreased the pork lean/brothy aromatic and this trend was consistent throughout storage. As sodium diacetate increased from 0 to .2% in pork chops stored 0 to 28 d, pork lean brothy increased slightly. With storage, pork lean/brothy increased in treated pork chops from approximately five to six on the 15-point Universal Intensity scale. This is likely due to limited off-flavor development in these products. It has been shown that as off-flavor increases, lean/brothy meat flavors decreases (Sheard and others 1999, Miller 2001). Off flavor development is due to either flavor contributions from microbial growth or

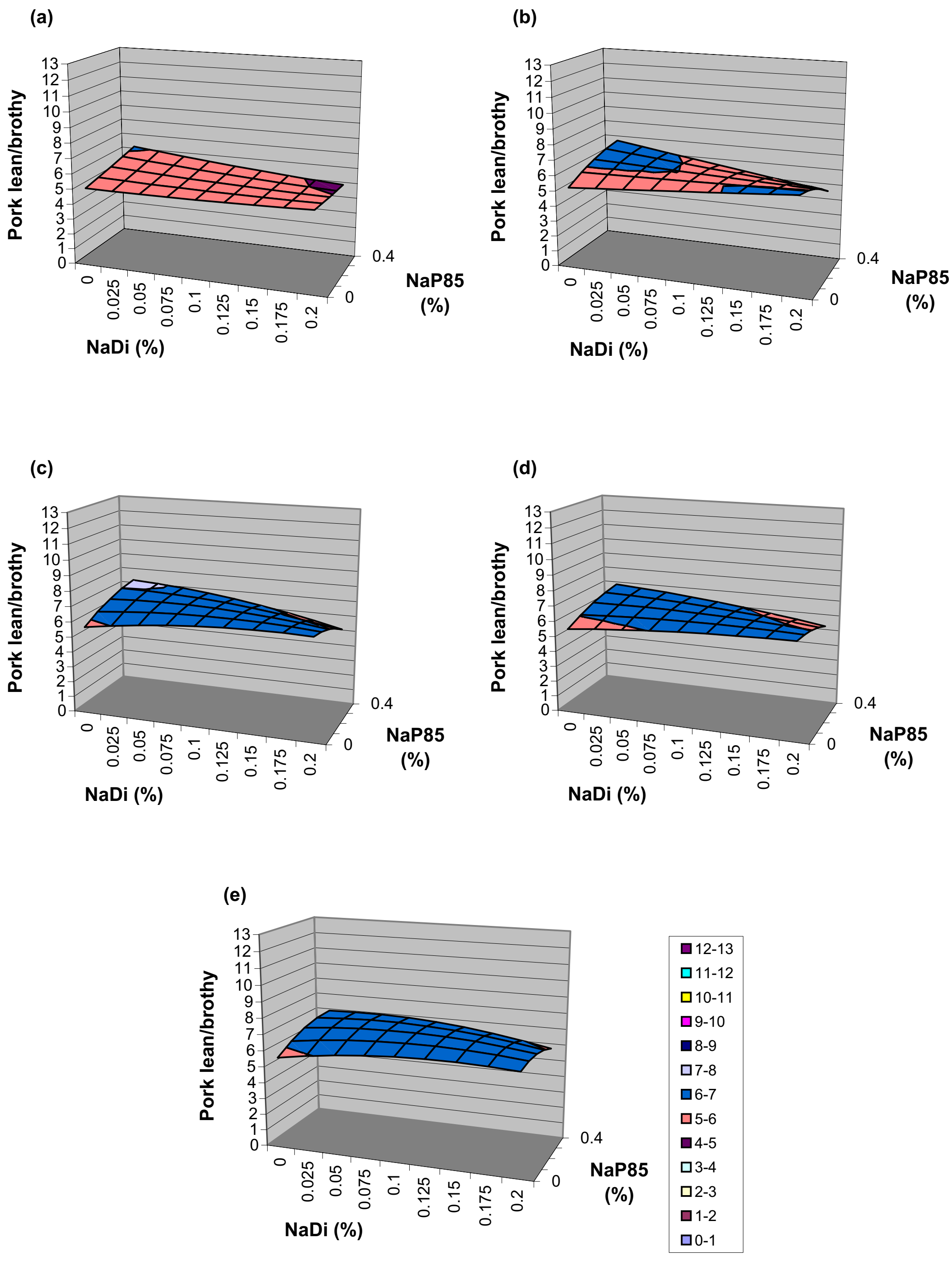

Figure 62. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) on the pork lean/brothy aromatic (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

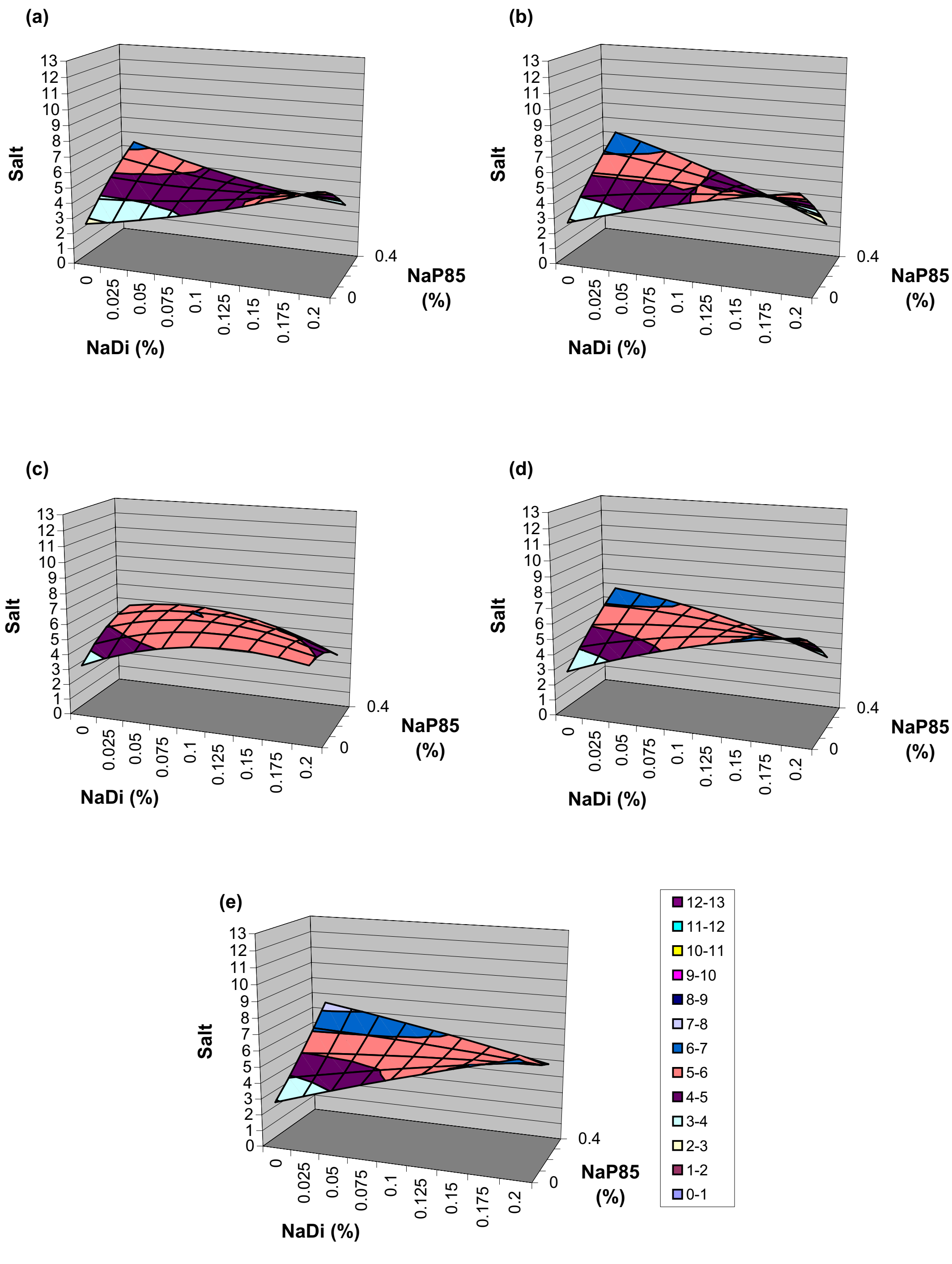

Figure 63. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) on the salt basic taste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

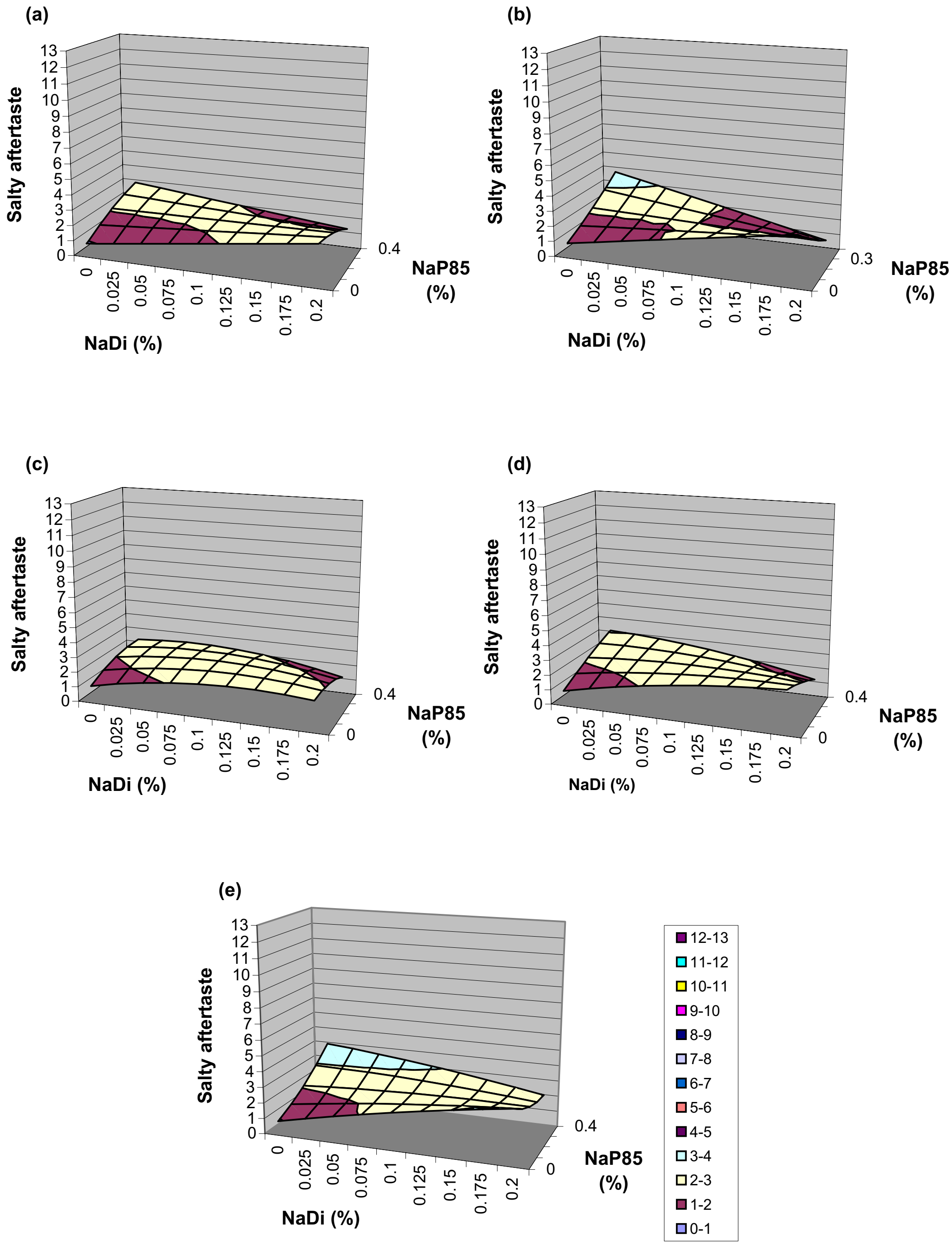

Figure 64. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) on the salty aftertaste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

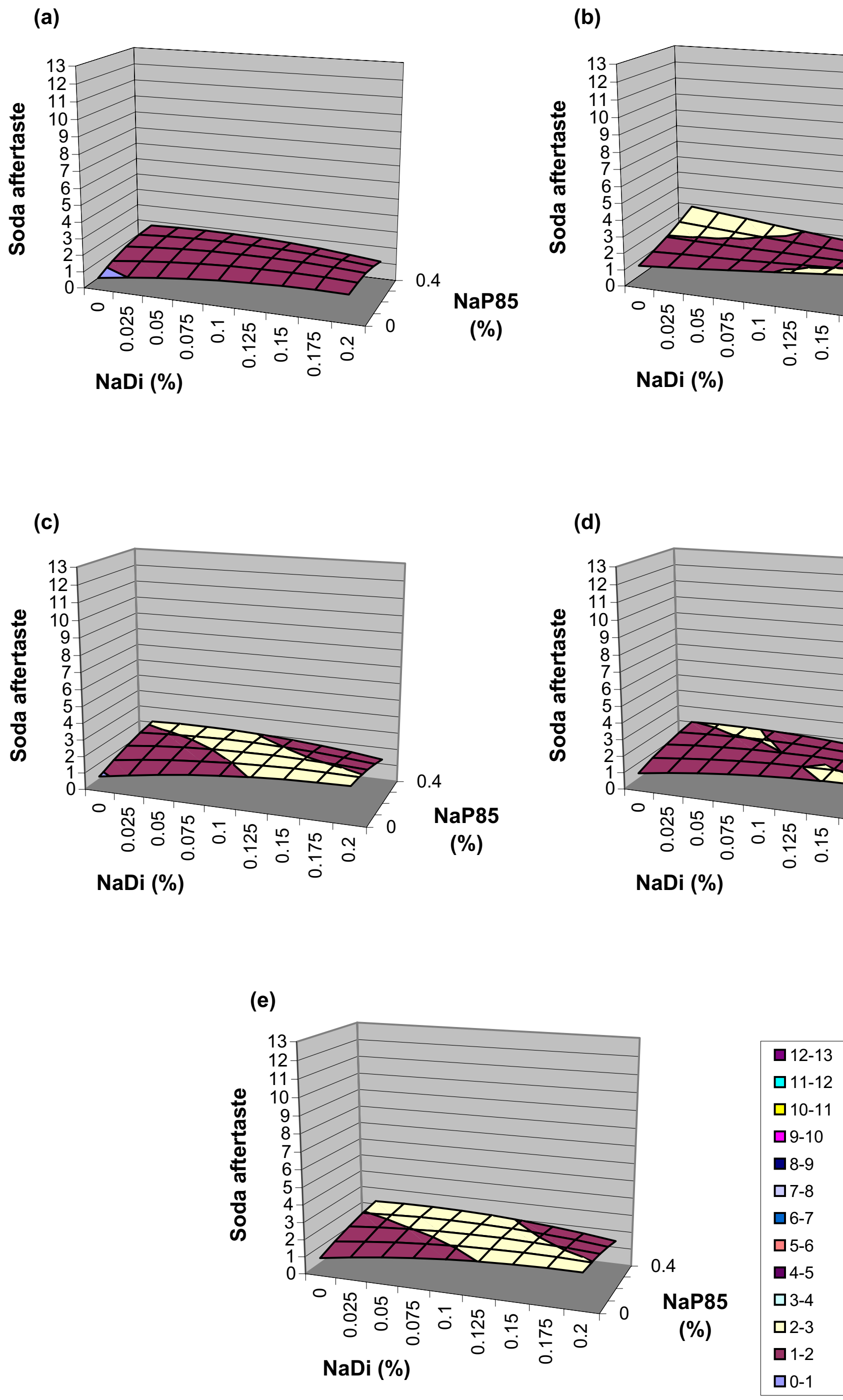

Figure 65. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) on the aftertaste soda (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

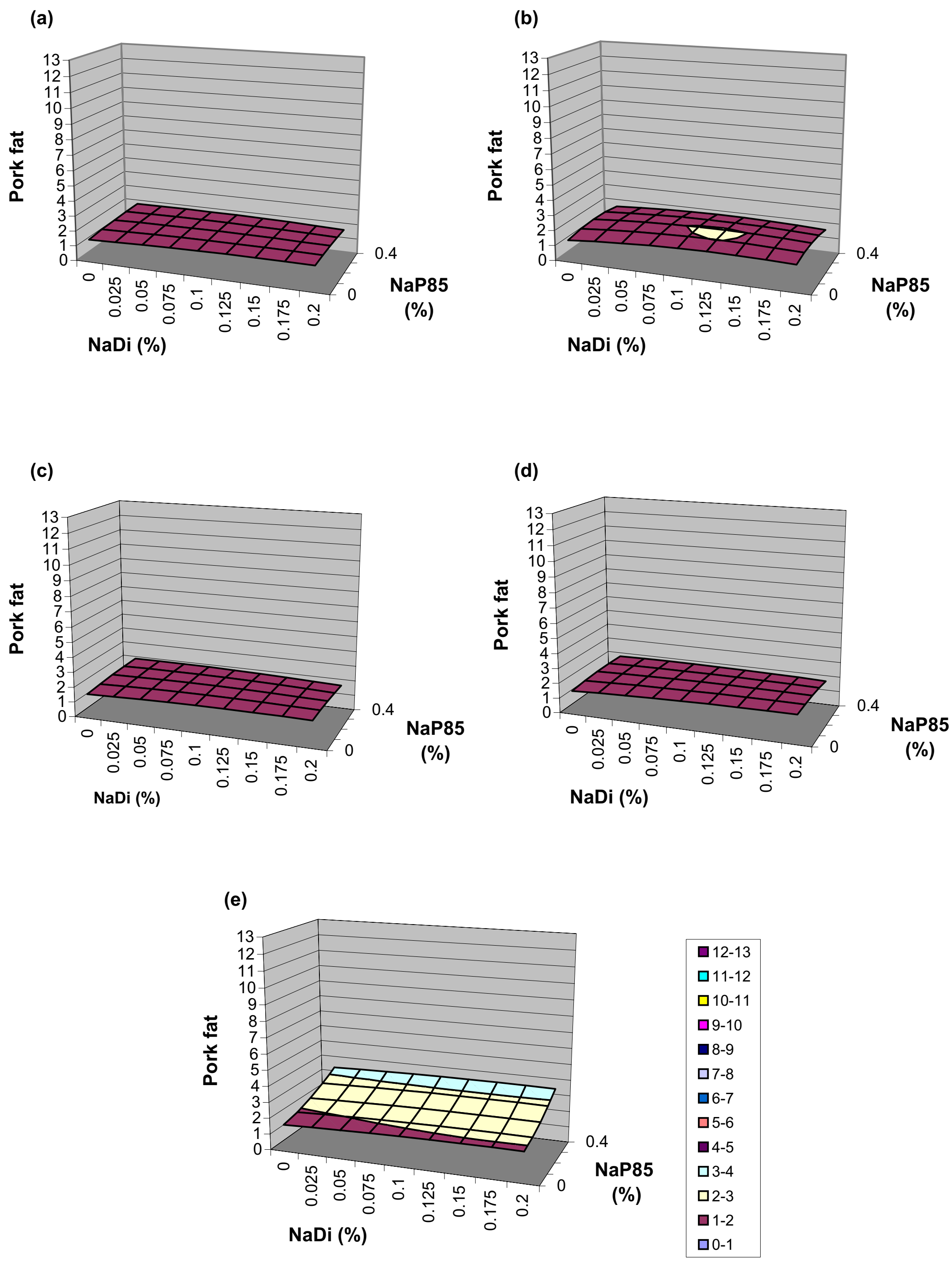

Figure 66. Response surface of ssodium diacetate (NaDi) and sodium phosphate 85 (NaP85) on the pork fat aromatic (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

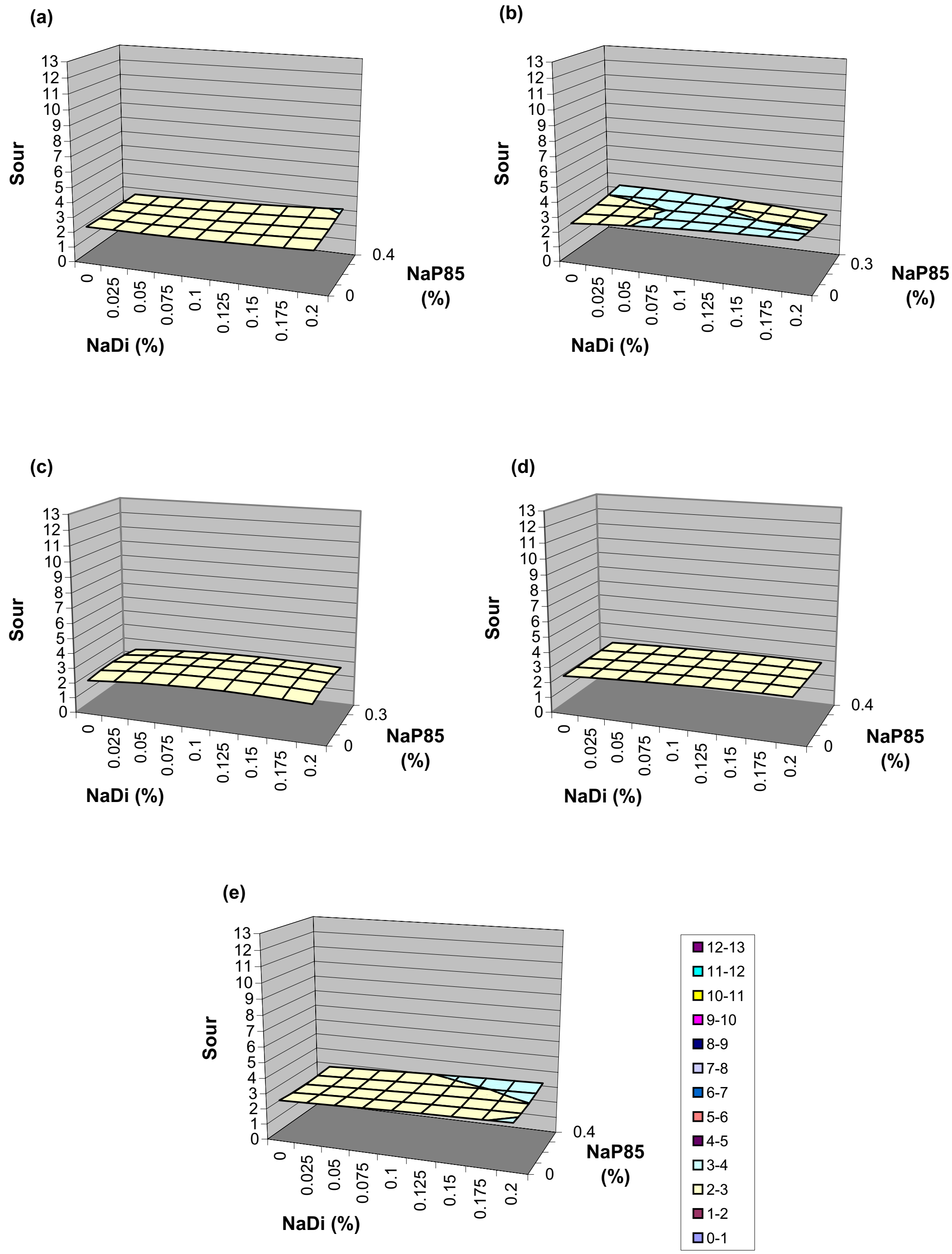

Figure 67. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) on the sour basic taste (0 = none; 15 = extremely intense) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

increased levels of volatile compounds from lipid oxidation. Sodium diacetate has not been shown to affect or limit lipid oxidation, but it has been shown to limit microbial growth (Weber 1997, Moye and Chambers 1991, Anwar 2000). This effect is most likely a result of sodium diacetate ability to limit microbial growth.

Salt basic taste ranged from greater than two to less than eight. Figure 63 indicated that the addition of NaDi from 0 to .2% or NaP from 0 to .4% to the pork chops increased the salt basic taste. This effect was consistent across storage time. This trend was expected because both ingredients contain sodium ions. However, when sodium diacetate was added in combination with sodium phosphate, salt basic taste decreased. Similar trends were observed for pork lean/brothy flavor aromatic. It is likely that the salt basic taste may have been so intense that panelists could no longer detect differences in intensities. Brewer and others (1995) observed similar results in model systems containing sodium chloride and sodium lactate.

Salty and soda aftertastes increased with increasing levels of sodium diacetate alone and sodium phosphate alone in pork chops stored 0 to 28 d. As previously mention in the salt basic taste results, salty and soda aftertastes decreased when sodium diacetate in combination with sodium phosphate was added to pork chops.

On 28 d, pork fat flavor aromatic increased with the addition of sodium phosphate. Sodium diacetate had little effect on the pork fat aromatic.

Additionally, there were no significant changes observed for the pork fat aromatic of the pork chops stored 0 to 21 d.

Surface response graphs were not generated for metallic and astringent mouthfeels because the changes were within 1-point on a 15-point Universal intensity scale in the treated and control pork chops. However, metallic and astringent mouthfeels were observed at the highest intensity in pork chops containing approximately .2% NaDi in combination with .4% NaP and this effect was stable over storage time. The data suggests mouthfeels were highest when sodium diacetate and sodium phosphate were used at their highest levels.

Sour basic tastes tended to increase with sodium diacetate addition to pork chops; however, the change in intensity was within 1 point on the 15-point Universal Intensity Scale. The combination of sodium diacetate and sodium phosphate appeared to slightly increase the sour basic taste, especially in pork chops stored 28 d. The slight increase in sour basic taste at 28 d may be associated with the growth of lactic acid-producing bacteria and not from sodium diacetate addition.

It was observed that vinegar flavor aromatics; and chemical aftertastes variables were affected ($P \leq 0.05$) by the interaction of treatment x storage day (Appendixes AS – AU, respectively), but these attributes were present at very low intensity levels and these effects will not be discussed.

Neither treatment nor storage day main effects affected ($P > 0.05$) soapy (.14 $\pm$ .014), soured (.79 $\pm$ .005), and serum/bloody (.01 $\pm$ .004) flavor aromatics;

bitter (2.94 .015) and sweet basic tastes (.33 ± .019); and aftertaste soapy (.20 ± .013). However, storage day did affect ($P < 0.05$) sour (1.19 ± .05), bitter (1.08 ± .04), and mouthburn (1.16 ± .05) aftertaste attributes (Appendix AW). At day 0, pork chops had the lowest sour, bitter, and mouthburn aftertastes. With storage up to 28 d, these flavor aromatics increased. On 28 d sour, bitter, and mouthburn aftertastes were similar as these attributes in chops stored 7d. Cardboardy (.21 ± .01), browned (.91 ± .03), and chemical (.98 ± .04) flavor aromatics; mature (.36 ± .01), browned (.43 ± .01), and metallic (.61 ± .02) aftertastes attributes were barely detectable.

In other research, flavor intensity and beefy/brothy flavors were not affected by the addition of sodium diacetate (Anwar 2000 and Grones 2000). However, the addition of sodium tripolyphosphate has been shown to improve flavor retention (Smith and others 1984). Anwar (2000) observed the lowest cooked beef/brothy scores in beef steaks with the combination of .1% NaDi + 2.0% KL + .25% sodium tripolyphosphate. This trend is consistent with the results from the current study. It is likely that the low pork lean brothy flavor aromatics, salt basic tastes; and salty and soda aftertastes found in pork chops treated with the combination of sodium phosphate and sodium diacetate are in part due to increased sour basic tastes found in the pork chops but most likely storage effects decreased the lean/brothy flavor (St. Angelo 1988). It is likely the sour basic taste could be associated with the addition of sodium diacetate, which dissociated into acetic acid when added to the brine. Other research found sour basic taste in roast beef and turkey containing sodium diacetate (Weber 1997). In contrast, Anwar (2000) did not report significant sour basic tastes or metallic or astringent mouthfeels. It is likely that the higher levels of flavor attributes in beef steaks could have masked the higher levels of sour basic tastes, metallic, and astringent mouthfeel differences. Drip loss, juiciness, and pH were lower in pork chops with higher levels of sodium diacetate and sodium phosphate, which would reduce pork chop moisture and may have contributed to the decrease in pork lean/brothy and salt attributes.

The data suggests that the predominate flavors of the pork chops in the current study were pork lean/brothy aromatic and salt basic taste which decreased with the combination of sodium diacetate and sodium phosphate. This effect may be explained by the decrease in pork chop water holding capacity, juiciness, and pH. Salty and soda aftertastes also were minimized with the addition of sodium diacetate and sodium phosphate combination. Although intensity levels were low, metallic and astringent mouthfeels, and sour basic tastes were higher in pork chops containing approximately .2% sodium diacetate in combination with approximately .4% sodium phosphate. Vacuumed-packaged pork chops in the current study did not develop any undesirable flavor aromatics such as painty, fishy, and cardboardy during the 28 d storage, therefore, it may be concluded that the addition of sodium phosphate, sodium diacetate, potassium lactate, and salt minimized this off-flavor development.

Texture: The interaction of treatment by storage day was significant ($P \leq 0.05$) for muscle fiber tenderness, juiciness, and processed meat-like bite (Figs. 68 - 70, respectively) (Appendix AX).

Pork chop muscle fiber tenderness ranged from greater than five to less than eight. The addition of up to approximately .3% NaP alone increased the pork chop muscle fiber tenderness, except on storage day 28. On 28 d, pork chop muscle fiber tenderness slightly decreased with the addition of sodium phosphate. The addition of sodium diacetate alone decreased pork chop muscle fiber tenderness. This trend also was observed throughout storage. The combination of sodium diacetate and sodium phosphate increase pork chops muscle fiber tenderness on 0, 21, and 28 d. On 7 and 14 d pork chop muscle fiber tenderness decreased slightly but only within 1 point on an 8-point scale.

It was observed that generally when muscle fiber tenderness increased, processed meat-like bite increased; and when muscle fiber tenderness decreased, processed meat-like bite decreased on most storage days. Pork chops containing sodium diacetate alone were reported to have a higher processed meat-like bite than the non-injected controls. The addition of sodium phosphate without sodium diacetate also increased the processed meat-like bite. However, pork chops containing approximately .4% NaP in combination with approximately .2% NaDi had the lowest processed meat-like bite when compared to the other treated pork chops.

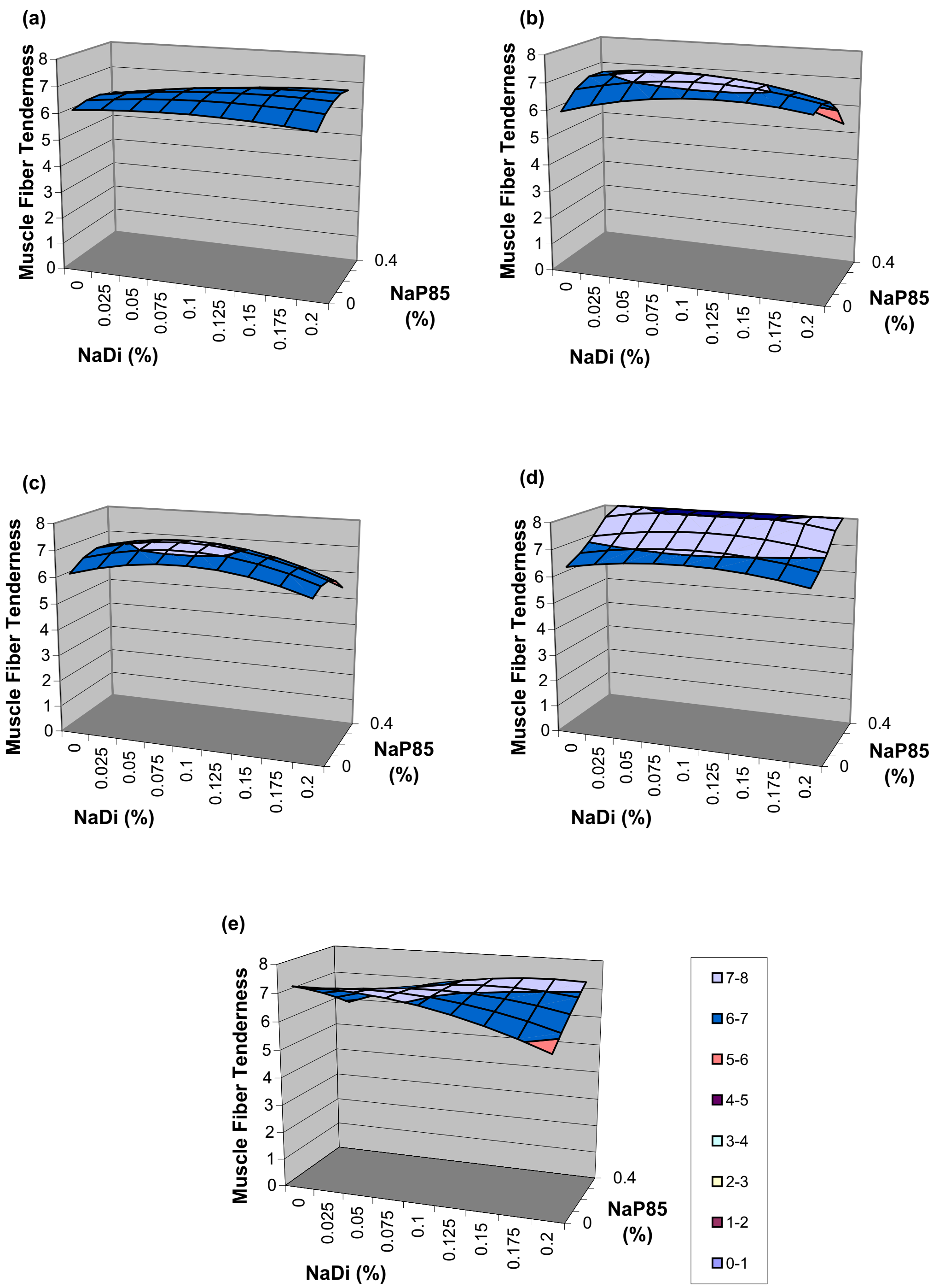

Figure 68. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) levels on the muscle fiber tenderness (0 = extremely tough; 15 = extremely tender) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

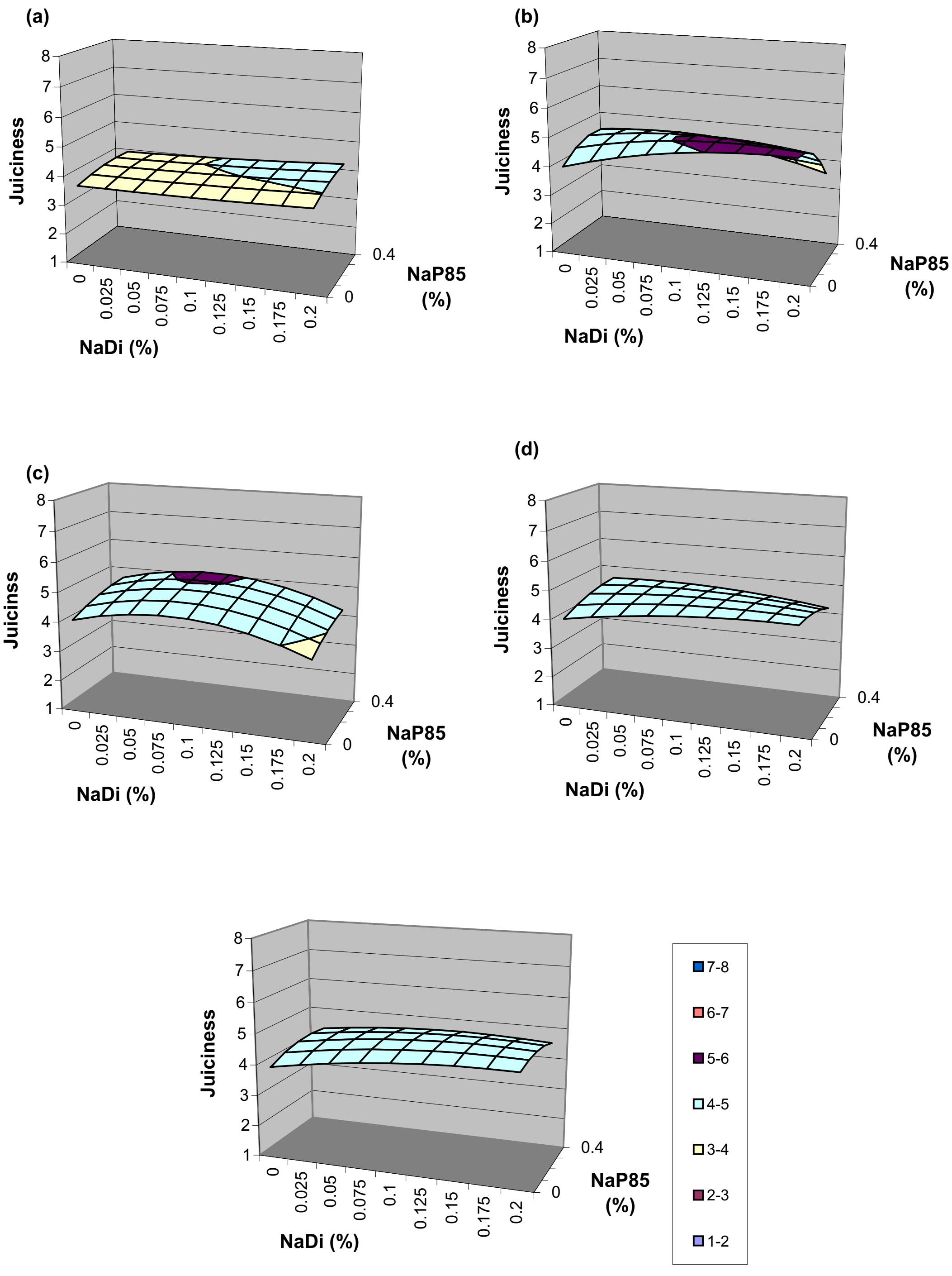

Figure 69. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) levels on the juiciness (0 = extremely dry; 15 = extremely juicy) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

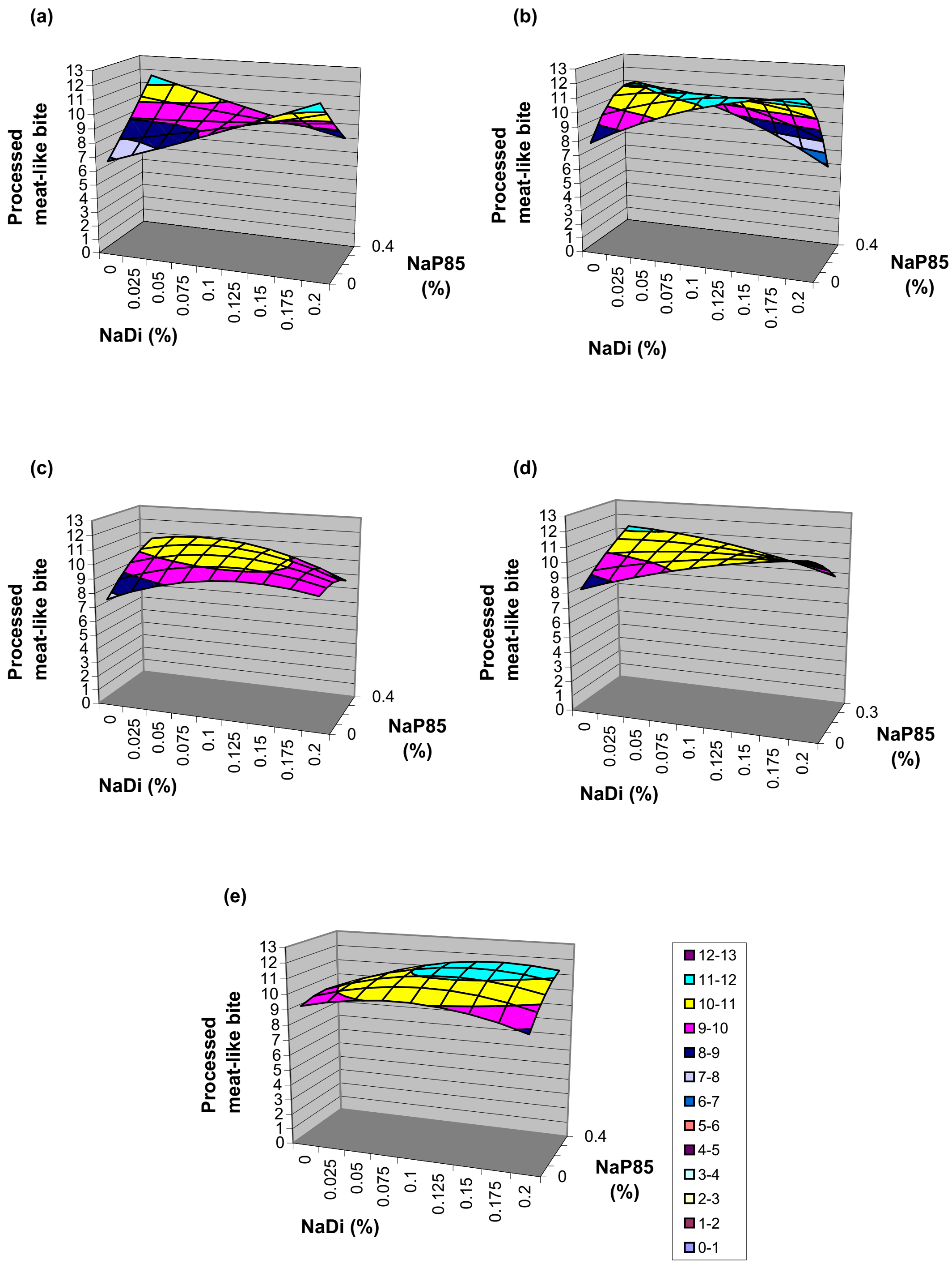

Figure 70. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) levels on the processed meat-like bite of (0 = whole muscle or steak like; 15 = very soft and rubbery) pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

Juiciness ranged from greater than three to less than six. It was observed that the addition of sodium phosphate without sodium diacetate in pork chops stored 7 to 28 d increased juiciness. After the addition of approximately .3% NaP, juiciness to pork chops tended to decrease in pork chops stored 14 d.

Pork chops treated with sodium diacetate were slightly juicier than the non-injected controls. However, pork chops containing the combination of sodium diacetate and sodium phosphate were slightly drier than other treated pork chops. With storage time, treated pork chops became juicier than the non-injected controls. It should be noted that the cook loss also decreased with storage time, which most likely contributed to the increase in the perceived juiciness reported by the trained panelists

Non-injected control beef steaks were overall less tender, had lower muscle fiber tenderness scores, and higher processed meat-like texture than those treated with .1% NaDi + 2.0% KL + .25% sodium tripolyphosphate (Anwar 2000). This is consistent with the results from the current study. Anwar (2000) found that the juiciness of beef steaks treated with sodium diacetate, sodium tripolyphosphate, and potassium lactate were not affected by treatment. Pork chops in the current study tended be drier when sodium diacetate was added which can be associated with the decrease in pH. Although results indicate that sodium phosphate increased pork chop muscle pH, it is likely that the addition of sodium diacetate minimized the positive effects of the higher pH.

These data suggests that, in general, vacuumed-packaged pork chops were more tender and juicier when the combination of .12 or .15% NaDi and .3% NaP was added compared to the non-injected control chops. Additionally, these pork chops had less processed meat-like bite when compared to pork chops with sodium diacetate or sodium phosphate alone.

Color: Sodium phosphate and sodium diacetate had the most effect on the color of the pork loin chops in relationship to color effects reported in the previous experiments. The treatment by storage day interaction was significant for color, CIE L* and b* color space values, amount of discoloration, and color of discoloration (Figs. 71 -75, respectively) (Appendix AY and AZ, respectively), but not significant ($P > 0.05$) for CIE a* color space values (Fig. 76) (Appendix AAA). Table 2 indicates that the pH of the pork loin did not differ ($p = .16$) prior to injection; therefore, the color of the pork loin chops most likely were induced by the injection treatments and the injection solutions impact on muscle pH.

Sensory color scores ranged from greater than one to less than four. As sodium phosphates levels increased, pork chop color became darker. With the addition of sodium diacetate from 0 to .2%, the pork chops became slightly lighter. However, in contrast to sensory scores, the addition of sodium diacetate alone to the pork chops decreased the CIE L* color space values indicating that the pork chops became darker in color. These differences in the sensory color scores and CIE L* color space values may be due to moisture on the surface of the pork chops that could reflect light and make them appear lighter in color to trained color panelists and to a Minolta colorimeter. Pork chops containing the

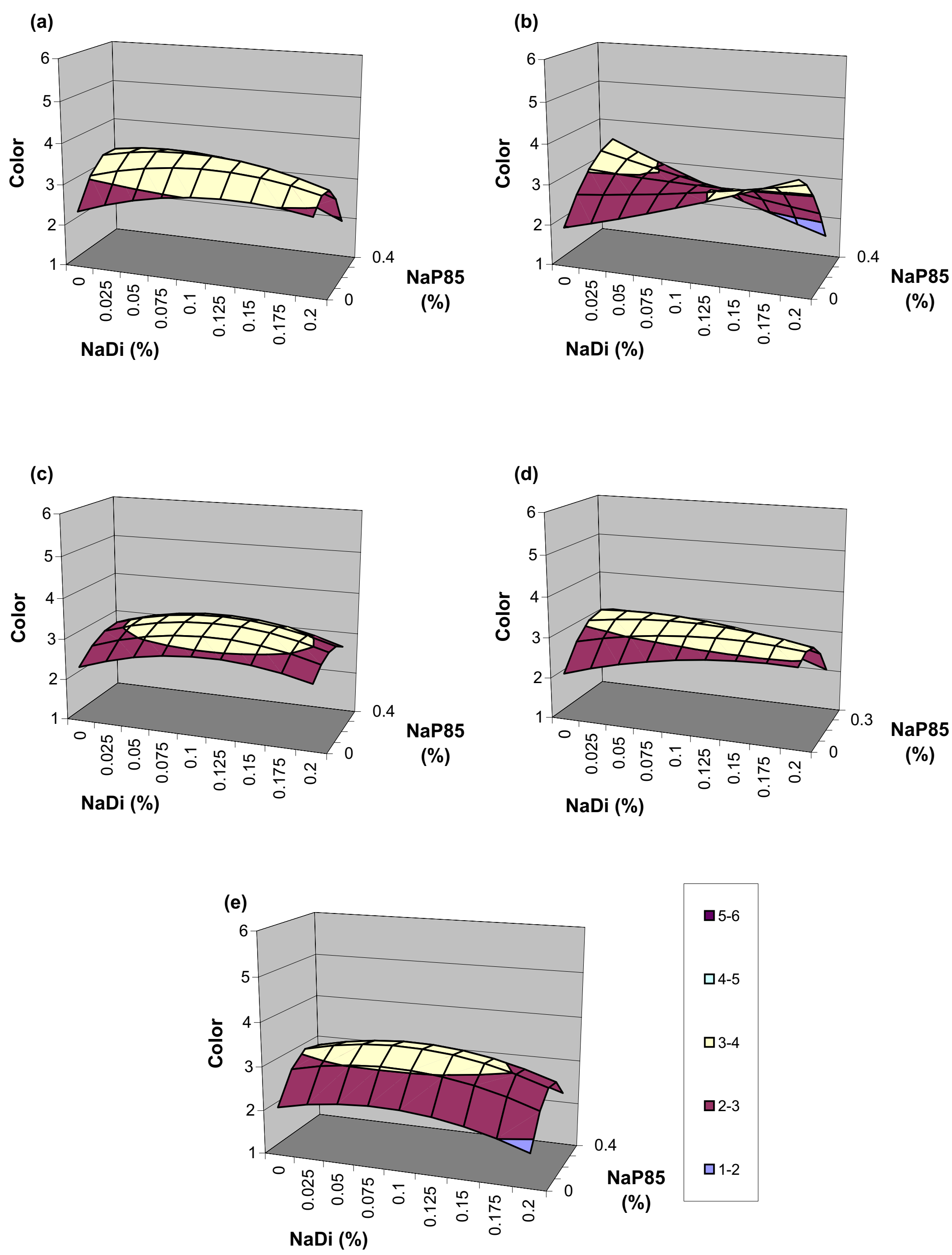

Figure 71. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) levels on the color (1 = pale pink; 6 = pinkish red) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

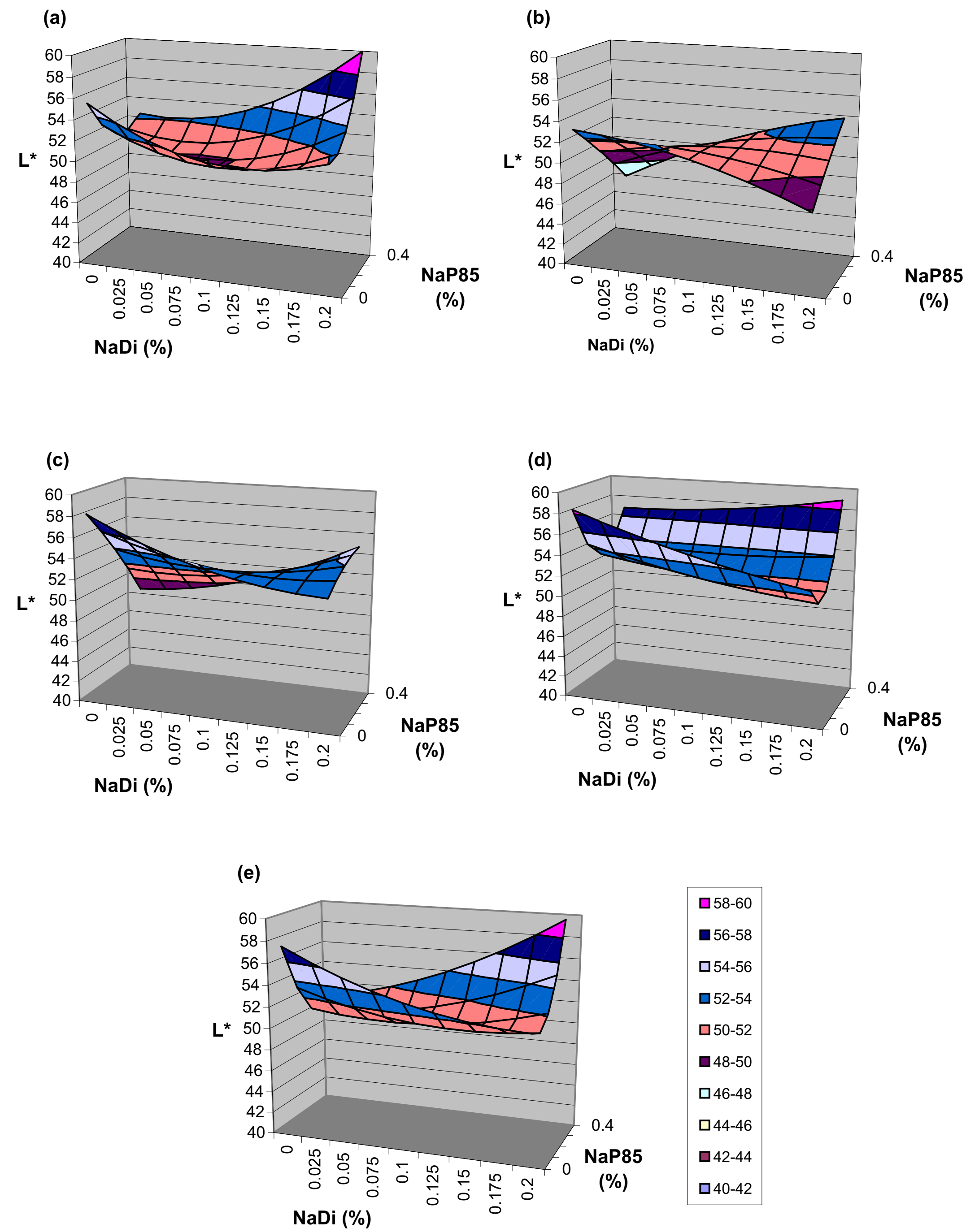

Figure 72. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) levels on the CIE L* color space value (0 = black; 100 = white)of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

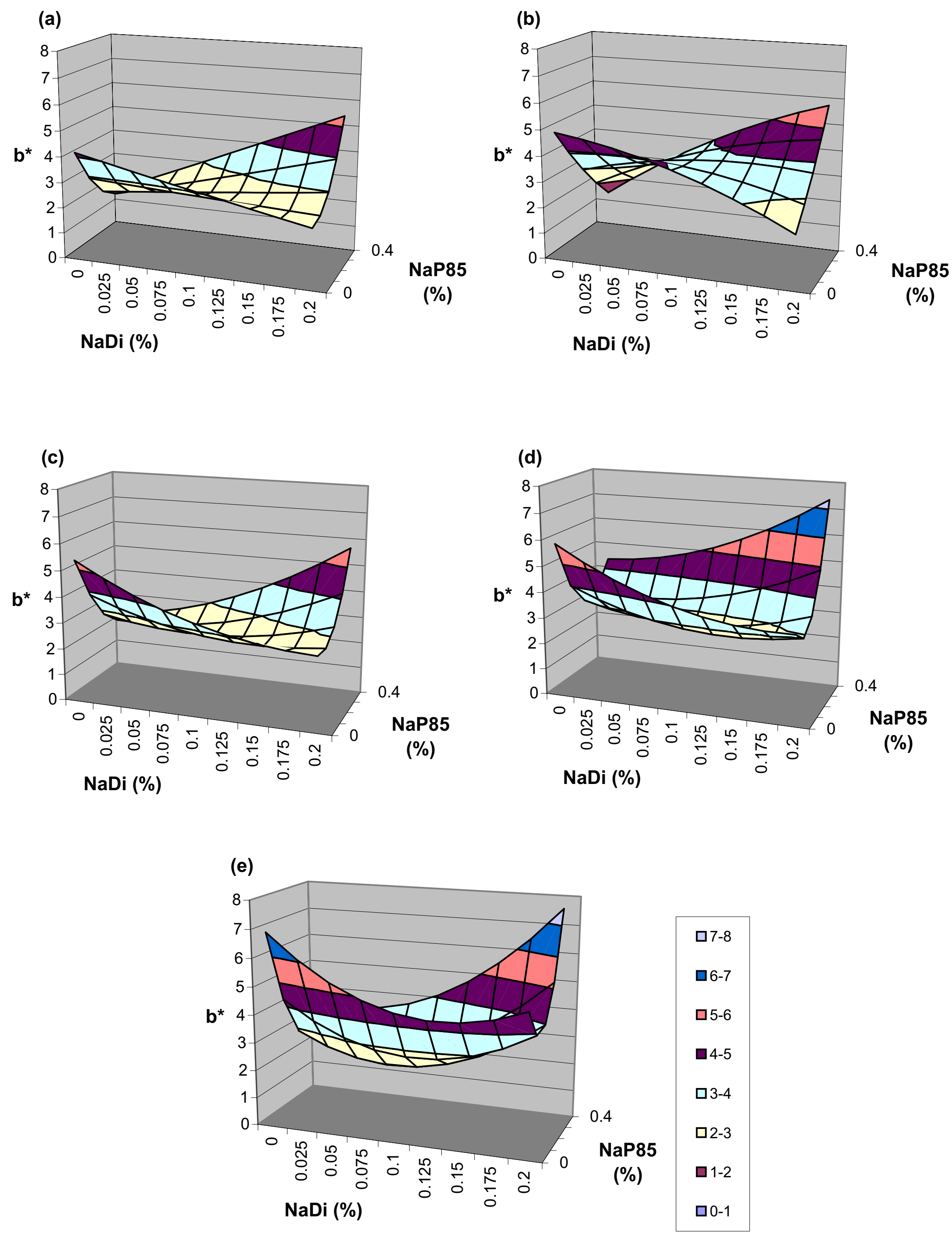

Figure 73. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) levels on the CIE b* color space value (+b = yellow; -b = blue) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

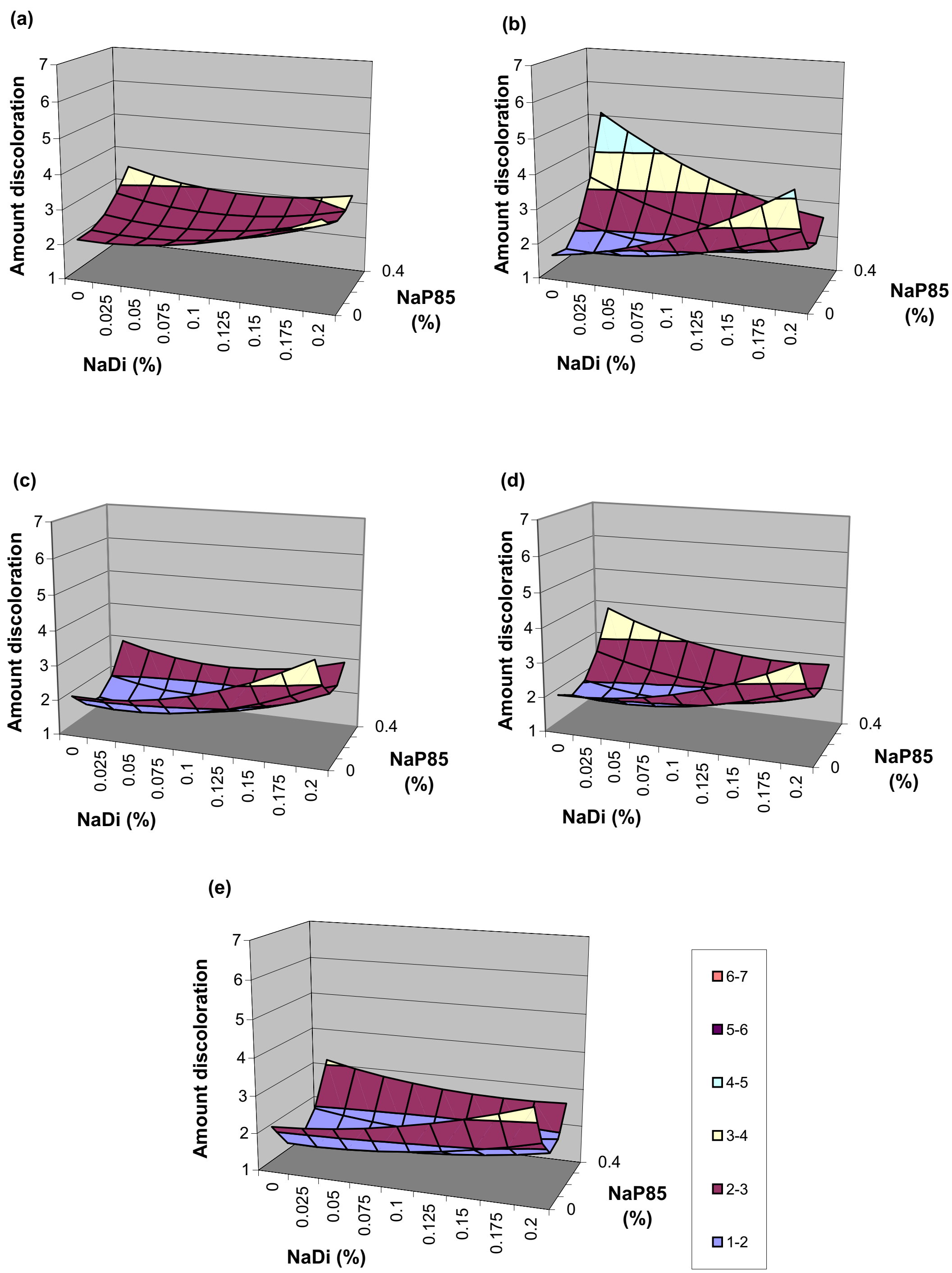

Figure 74. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) levels on the amount of discoloration (1 = 0% discoloration; 7 = 100% discoloration) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

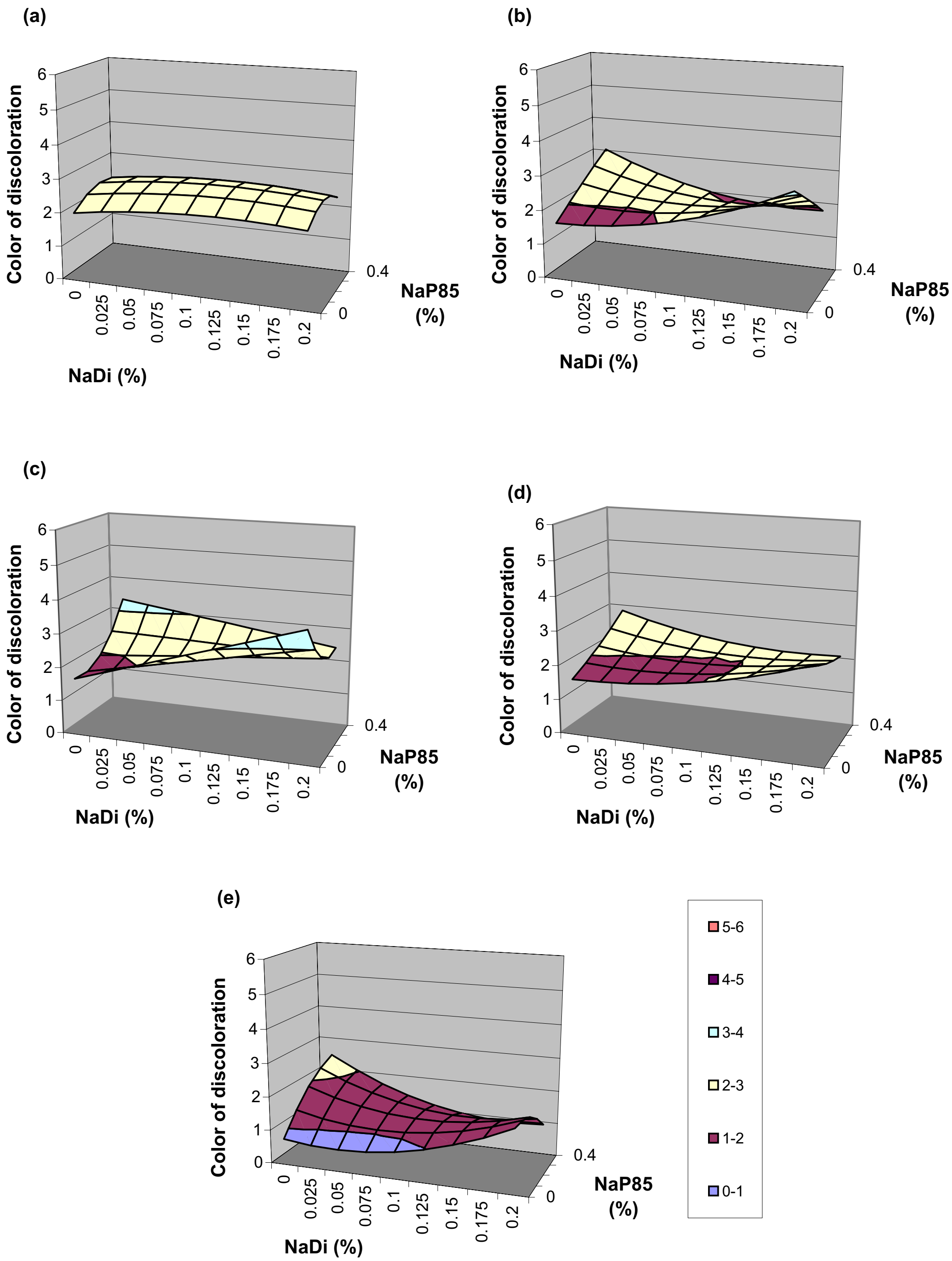

Figure 75. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) levels on the color of discoloration (0 = pinkish gray; 6 = pinkish red) of pork loin chops stored for 0 (a), 7 (b), 14 (c), 21 (d), and 28 (e) days at 4°C in Experiment 5.

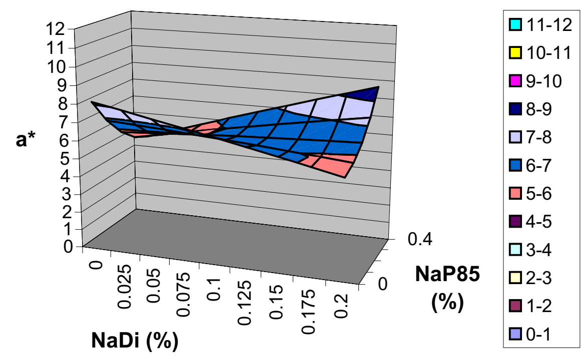

Figure 76. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) levels on the CIE a* color space value (+a = red; -a = green) of pork loin chops in Experiment 5.

combination sodium diacetate and sodium phosphate at high levels were as light as the control chops. These results are consistent with the CIE L* color space values that also indicated that the addition of sodium diacetate in combination with sodium phosphate lightened the pork chops. Color space values L* also decreased for pork chops containing sodium phosphate indicating that they became darker.

Pork chops containing increasing levels of sodium diacetate or sodium phosphate became less yellow, as indicated by lower CIE b* color space values. Pork chops became more yellow with the addition of sodium diacetate in combination with sodium phosphate. Treatment main effects did have an effect on the CIE a* color space values (Fig. 76) (Appendix AAA). It was observed that the addition of sodium diacetate or sodium phosphate decreased the redness of the pork chops and the combination of the two ingredients also increased the pork chop redness.

Considering the pH values (Fig. 77) of the treated pork chops, as pH increased, pork chops tended to be darker, less red, and less yellow as indicated by CIE L*, a*, and b* color space values. Additionally, when pH was lower, pork chops were lighter, redder, and more yellow in color. The pH was higher in pork chops containing sodium phosphate and lowest in pork chops containing sodium diacetate, especially when sodium diacetate levels are greater than .1%. Anwar (2000) did not report significant treatment effects for color, or CIE L*, a*, and b* color space values for treated beef steaks. It is

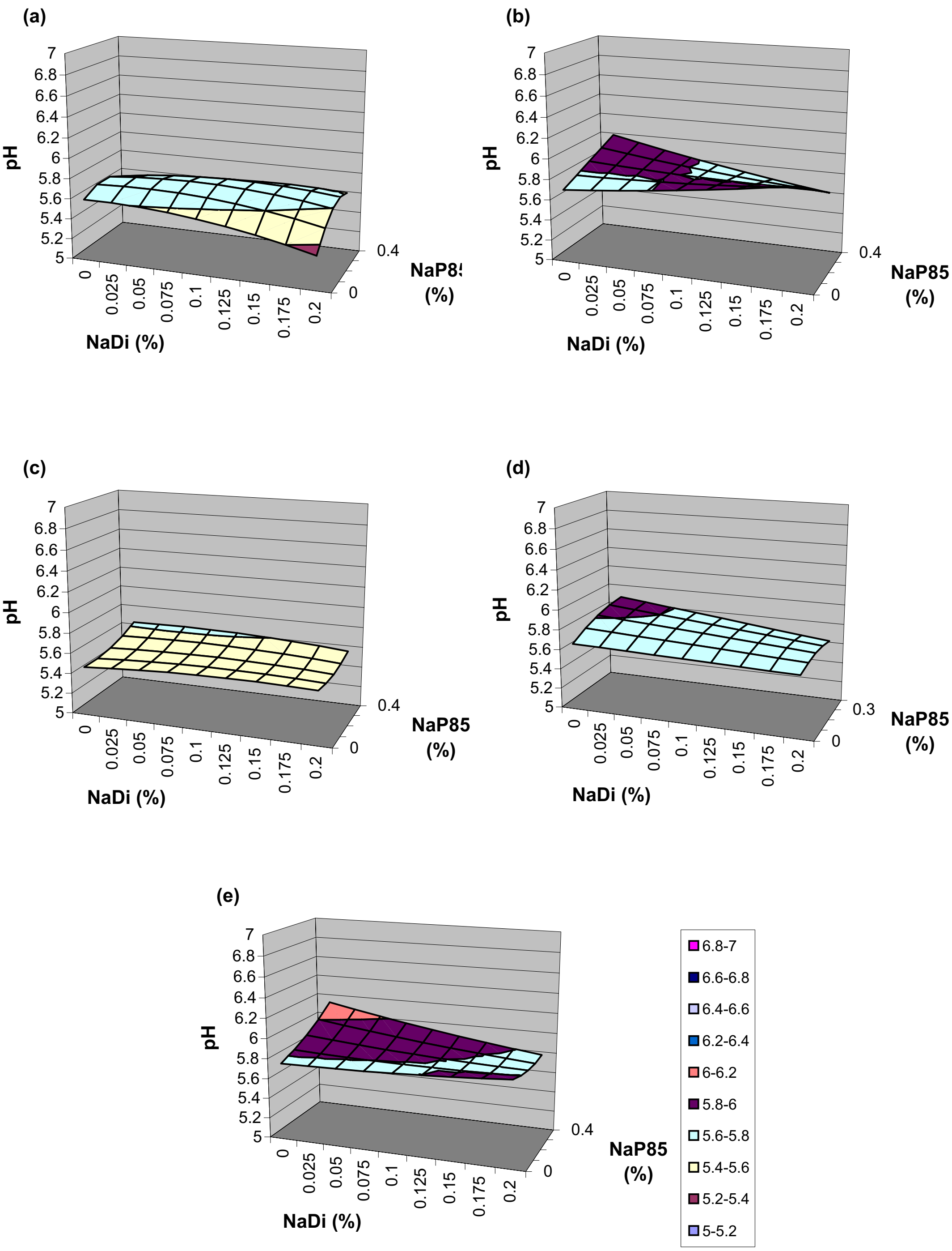

Figure 77. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) levels on the pH of pork loin chops in Experiment 5.

possible that these effects were expressed more in the current study because pork tends to be lighter overall than darker beef steaks. However, strip loin steaks containing .1% NaDi in combination with .25% NaP had lower CIE L* color space values when compared to the non-injected control steaks (Anwar 2000). Similarly, Anwar (2000) reported lower b* values in beef strip steaks containing .1% NaDi in combination with .25% sodium tripolyphosphate when compared to steaks containing .25% sodium tripolyphosphate. These results are consistent with data from the current study. In contrast, other research has reported that the addition of sodium diacetate has not been shown to affect the color of the meat system (Grones 2000; Weber 1997). These consistencies may be attributed to differences in color scales, products, and ingredient combinations.

The amount of discoloration observed in the pork chops increased with the addition of sodium phosphate or sodium diacetate. However, the amount of discoloration decreased when the two ingredients were combined together and added to the pork chops for up to 21 d. Adding .2% NaP, regardless of sodium diacetate addition, decreased the amount of discoloration from 0 to 28 d storage. The color of the discoloration became darker in pork chops containing increasing levels of sodium phosphate or sodium diacetate. The combination of sodium diacetate and sodium phosphate tended to lighten the color of the pork chop discoloration. These trends were apparent throughout storage time. It was reported that two-toning color decreased with the addition of sodium diacetate in combination with potassium lactate to beef steaks (Anwar 2000). The color of the two-toning was not evaluated in the current study. It should be noted that the amount of discoloration decreased in treated pork chops and increased in control chops. It can be concluded that the addition of sodium diacetate and sodium phosphate decreased the amount of discoloration over time when compared to non-injected controls.

Data suggests that the color of the pork chops treated with sodium phosphate in combination with sodium diacetate were lighter, redder, and more yellow in color when compared to other treated pork chops and the non-injected controls. Additionally, these pork chops were slightly more discolored when compared to non-injected control chops during storage.

Cooking analysis, pH, and drip loss: Treatment by storage day interaction did significantly ($P \leq 0.05$) affect pH (Fig. 77) (Appendix AAC). There was no significant ($P \geq 0.05$) treatment by storage day interactions for cook time, cook loss, package purge, and drip loss (Appendixes AAB and AAC, respectively).

Neither treatment nor storage day significantly ($P > 0.05$) affected cook time ($20.78 \pm .372$) or package purge ($5.70 \pm .081$). Therefore, these attributes will not be discussed further. There were treatment main effects for drip loss (Appendix AAA) (Fig. 78). Drip loss decreased in pork chops containing sodium phosphate or sodium diacetate. The addition of high levels of sodium diacetate in combination with high levels of sodium phosphate increased pork chop drip

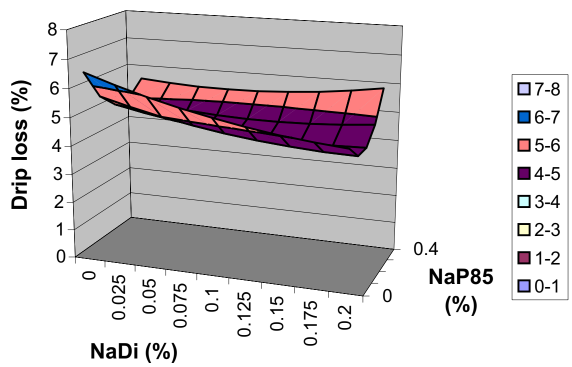

Figure 78. Response surface of sodium diacetate (NaDi) and sodium phosphate 85 (NaP85) levels on the drip loss of pork loin chops in Experiment 5.

loss. It has been well documented that the addition of sodium phosphate increased the ability of meat proteins to hold water, which can be measure by drip loss (Molins and others 1987; Keeton 1983; Jones and others 1987; and Vote and others 2000). It is not understood completely how sodium diacetate decreased drip loss in pork chops.

Storage day significantly ($P \leq 0.05$) affected pork chop cook loss. Cook loss ranged from 20.82 on 0 d to 17.46 on 28 d and cook loss tended to decreased with storage time. These results followed the same trends as results reported by trained panelists on the perceived juiciness of the pork chops. It was observed that when juiciness scores decreased, cook loss scores increased and visa versa. In contrast, Anwar (2000) did not report any differences in cook yield of beef steaks. It is possible that the addition of other ingredient combinations and the use of beef masked differences observed among treated steaks in Anwar (2000).

Table 3 indicates that the pH of the pork loins did not differ ($p = .16$) prior to injection; therefore, initial pork loin variability was low. As expected, the pH of the brine solutions differed ($p = .0001$) (Table 2). The preinjected loin pH was tested as a covariate and results indicated that preinjected loin pH did not significantly influence the pH of the post-injected pork chops during storage. Treatment x storage day interaction effects were close to the significance level ($p = .0521$), therefore, a graph was generated to examine this relationship (Fig. 77). As expected, muscle pH increased with the subsequent addition of sodium phosphate to the pork loin chops. On 0 to 28 d storage, muscle pH decreased with the addition of sodium diacetate. The combination of these ingredients decreased the muscle pH of the pork chops. Other research has reported higher pH in pork chops treated with .1% NaDi + 2.0% KL + .25% sodium tripolyphosphate when compared to non-injected control steaks. In addition, beef steaks containing the combination of .1% NaDi + .25% sodium tripolyphosphate had the lowest pH when compared to the other treatments and controls (Anwar 2000). This is consistent with the current study, which reported lower muscle pH in pork chops containing NaDi. Storage day also influenced pork chop pH; pH increased with storage time and ranged from 5.64 on 0 d to 5.83 on 28 d. It is not certain why pH increased with storage time. Anwar (2000) reported that pH decreased with storage from 0 to 35 d. However, the differences observed may be due to the addition of other ingredients to beef steaks.

In summary, pork chops treated with the maximum levels of sodium diacetate (.2%) in combination with sodium phosphate (.4%) were less flavorful, drier, and lighter in color than the other treated pork chops. Drip loss, the measurement of water holding capacity, was higher and pH was lower in the aforementioned pork chops, which most likely contributed to the lack of flavor and dryness of the pork chops. However, sensory panelists reported that the high levels of sodium diacetate and sodium phosphate combination improved tenderness and decreased the processed meat-like bite. Therefore, it would be recommended that pork chops contain the combination of approximately .1% NaDi + .2% NaP to maximize desirable characteristics like pork lean/brothy flavor attribute, juiciness, tenderness, and color and minimize processed meat like-bite when compared to the control chops.

CHAPTER V

SUMMARY AND CONCLUSIONS

Results from this study indicated that sodium chloride in combination with sodium phosphate (Brifisol® 512 or Brifisol® 85) resulted in high pork lean/brothy aromatics and minimal salt basic taste, increased muscle fiber tenderness and juiciness, minimal processed meat-like bite, improved lean color, and decreased package purge and cook loss when compared to the control chops. The addition of sodium phosphate alone or sodium chloride alone positively affected the texture attributes in Experiment 2, but this was not the case in Experiment 1. However, the combination of sodium phosphate and sodium chloride did consistently improve the texture attributes in both Experiments. The synergistic effect observed when sodium phosphate and sodium chloride are used together may be due to the small increase in pH, ionic strength, and NaCl induced protein swelling (Keeton 1983, Offer and Knight 1988). Based on the results from Experiments 1and 2, it is recommended that pork chops contain at least .2% NaP and at least .75% NaCl.

Sodium lactate and potassium lactate addition improved flavor aromatics, such as, pork lean/brothy and decreased package purge and cook loss when compared to the control chops. However, it was observed that processed meat-like bite increased with incremental additions of 0 – 4% KL alone and decreased with the incremental addition of 0 – 4% NaL alone to the chops when compared to the controls. Therefore, it is recommended that pork chops contain approximately 2% NaL or 2% KL + .2% NaP to maintain positive attributes, such as, pork lean/brothy flavor, salt basic taste, improved tenderness, juiciness, and color over storage time when compared to the control chops.

Results from Experiment 5 indicated that the addition of approximately .2% NaDi and .4% NaP to pork chops had a negative affect on the flavor, color, and water holding capacity when compared to the control chops; however, texture was improved. Therefore, it is recommended that pork chops contain approximately .1% NaDi + .2% NaP to maximize desirable characteristics like pork lean/brothy flavor aromatic, juiciness, tenderness, and color; and minimize processed meat-like bite when compared to the control chops.

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APPENDIX A

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR AROMATICS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 1

(n = 885)

	Storage Time, days				
Treatment	0	7	14	21	28
Pork lean/brothy[a]	.0001[b]	1.640[c]			
0.1% NaP512[1] + 0.375% NaCl[2]	6.67	6.08	5.77	5.74	5.57
0.1% NaP512 + 1.125% NaCl	6.40	4.92	6.33	6.30	6.21
0.2% NaP512 + 0% NaCl	6.04	5.54	5.49	4.42	4.52
0.2% NaP512 + 0.75% NaCl	6.83	5.46	6.05	5.99	6.12
0.2% NaP512 + 1.5% NaCl	6.74	5.15	6.05	6.49	5.94
0.3% NaP512 + 0.375% NaCl	7.40	5.23	5.77	6.24	5.67
0.3% NaP512 + 1.125% NaCl	7.17	5.39	6.88	6.17	5.92
0.4% NaP512 + 0.75% NaCl	7.54	5.00	5.83	5.92	5.63
0% NaP512 + 0.75% NaCl	6.72	5.69	6.38	6.05	5.94
Control (no injection)	6.63	5.15	5.49	4.61	5.15
Pork fat	.0001	0.547			
0.1% NaP512 + 0.375% NaCl	1.70	1.78	1.52	1.87	1.62
0.1% NaP512 + 1.125% NaCl	1.70	1.28	1.85	1.87	1.98
0.2% NaP512 + 0% NaCl	1.61	1.35	1.74	1.37	1.37
0.2% NaP512 + 0.75% NaCl	2.15	1.35	1.74	1.87	1.77
0.2% NaP512 + 1.5% NaCl	1.82	1.43	1.91	1.94	1.88
0.3% NaP512 + 0.375% NaCl	1.93	1.59	1.80	1.81	1.62
0.3% NaP512 + 1.125% NaCl	2.15	1.43	2.07	1.94	1.92
0.4% NaP512 + 0.75% NaCl	2.11	1.28	2.07	1.94	1.93
0% NaP512 + 0.75% NaCl	1.88	1.66	1.85	1.87	1.93
Control (no injection)	1.65	1.35	1.85	1.75	1.30
Cardboardy	.0189	0.338			
0.1% NaP512 + 0.375% NaCl	0.09	0.00	0.01	0.00	0.42
0.1% NaP512 + 1.125% NaCl	0.05	0.08	0.01	0.00	0.23
0.2% NaP512 + 0% NaCl	0.09	0.00	0.01	0.07	0.47
0.2% NaP512 + 0.75% NaCl	0.00	0.00	0.01	0.00	0.11
0.2% NaP512 + 1.5% NaCl	0.04	0.00	0.01	0.00	0.02
0.3% NaP512 + 0.375% NaCl	0.00	0.00	0.01	0.07	0.02
0.3% NaP512 + 1.125% NaCl	0.09	0.00	0.07	0.00	0.17
0.4% NaP512 + 0.75% NaCl	0.00	0.00	0.07	0.07	0.12
0% NaP512 + 0.75% NaCl	0.09	0.00	0.01	0.00	0.12
Control (no injection)	0.05	0.00	0.07	0.07	0.18

Treatment	Storage Time, days				
	0	7	14	21	28
Soapy[a]	.1329[b]	0.657[c]			
0.1% NaP512[1] + 0.375% NaCl[2]	0.41	0.82	0.67	0.49	0.28
0.1% NaP512 + 1.125% NaCl	0.54	0.54	0.61	0.49	0.63
0.2% NaP512 + 0% NaCl	0.68	0.47	0.61	0.43	0.43
0.2% NaP512 + 0.75% NaCl	0.79	0.85	0.78	0.74	0.33
0.2% NaP512 + 1.5% NaCl	0.58	0.39	0.78	0.43	0.47
0.3% NaP512 + 0.375% NaCl	0.59	0.77	0.78	0.49	0.38
0.3% NaP512 + 1.125% NaCl	0.59	0.31	0.89	0.87	0.43
0.4% NaP512 + 0.75% NaCl	0.82	0.54	0.84	0.31	0.47
0% NaP512 + 0.75% NaCl	0.59	0.7	0.39	0.62	0.42
Control (no injection)	0.73	0.39	0.73	0.31	0.32
Soda	.0001	0.834			
0.1% NaP512 + 0.375% NaCl	0.34	0.95	0.88	0.95	1.51
0.1% NaP512 + 1.125% NaCl	0.8	0.71	1.32	1.13	1.61
0.2% NaP512 + 0% NaCl	1.02	0.40	1.10	0.76	1.06
0.2% NaP512 + 0.75% NaCl	1.22	0.86	1.21	1.26	1.46
0.2% NaP512 + 1.5% NaCl	0.85	0.94	1.16	1.07	1.61
0.3% NaP512 + 0.375% NaCl	1.11	0.63	1.10	1.13	1.41
0.3% NaP512 + 1.125% NaCl	1.16	0.94	1.55	1.51	1.66
0.4% NaP512 + 0.75% NaCl	1.3	0.94	1.38	0.88	1.40
0% NaP512 + 0.75% NaCl	1.07	1.09	1.16	1.01	1.45
Control (no injection)	0.93	0.86	1.05	1.01	0.92
Chemical	.0001	0.541			
0.1% NaP512[1] + 0.375% NaCl	0.44	0.23	0.17	0.20	0.76
0.1% NaP512 + 1.125% NaCl	0.49	0.15	0.22	0.32	0.53
0.2% NaP512 + 0% NaCl	0.39	0.31	0.28	0.38	0.71
0.2% NaP512 + 0.75% NaCl	0.34	0.23	0.22	0.51	0.55
0.2% NaP512 + 1.5% NaCl	0.58	0.15	0.17	0.57	0.38
0.3% NaP512 + 0.375% NaCl	0.22	0.15	0.17	0.45	0.33
0.3% NaP512 + 1.125% NaCl	0.08	0.24	0.11	0.20	0.53
0.4% NaP512 + 0.75% NaCl	0.44	0.15	0.06	0.38	0.83
0% NaP512 + 0.75% NaCl	0.44	0.31	0.33	0.32	0.50
Control (no injection)	0.62	0.23	0.33	0.20	0.50

Treatment		Storage Time, days			
	0	7	14	21	28
Nutty[a]	.6314[b]	0.120[c]			
0.1% NaP512[1] + 0.375% NaCl[2]	0.00	0.00	0.00	0.00	0.00
0.1% NaP512 + 1.125% NaCl	0.05	0.00	0.00	0.00	0.00
0.2% NaP512 + 0% NaCl	0.00	0.00	0.00	0.00	0.10
0.2% NaP512 + 0.75% NaCl	0.12	0.00	0.00	0.00	0.00
0.2% NaP512 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.10
0.3% NaP512 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP512 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.4% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.00
Acidic	.7058	0.068			
0.1% NaP512 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.1% NaP512 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP512 + 0% NaCl	0.00	0.00	0.00	0.00	0.10
0.2% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP512 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP512 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP512 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.4% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.00
Burnt	.2808	0.101			
0.1% NaP512 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.1% NaP512 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP512 + 0% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP512 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP512 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP512 + 1.125% NaCl	0.00	0.00	0.00	0.19	0.00
0.4% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.00

Treatment	Storage Time, days 0	7	14	21	28
Mature[a]	.3535[b]		0.101[c]		
0.1% NaP512[1] + 0.375% NaCl[2]	0.00	0.00	0.00	0.00	0.00
0.1% NaP512 + 1.125% NaCl	0.00	0.00	0.00	0.13	0.00
0.2% NaP512 + 0% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.13	0.00
0.2% NaP512 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP512 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP512 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.4% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.06	0.00
0% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.00
Other	.7849		0.233		
0.1% NaP512 + 0.375% NaCl	-0.01	0.03	0.00	0.03	0.00
0.1% NaP512 + 1.125% NaCl	-0.01	0.03	0.00	0.03	0.16
0.2% NaP512 + 0% NaCl	-0.01	0.03	0.00	0.03	0.10
0.2% NaP512 + 0.75% NaCl	0.00	0.03	0.00	0.03	0.10
0.2% NaP512 + 1.5% NaCl	-0.01	0.03	0.00	0.03	0.00
0.3% NaP512 + 0.375% NaCl	-0.01	0.03	0.00	0.03	0.00
0.3% NaP512 + 1.125% NaCl	0.13	0.03	0.00	0.03	0.00
0.4% NaP512 + 0.75% NaCl	-0.01	0.03	0.17	0.03	0.00
0% NaP512 + 0.75% NaCl	-0.01	0.03	0.00	0.03	0.21
Control (no injection)	-0.01	0.03	0.00	0.03	0.00

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaP512: sodium phosphate 512, [2]NaCl: sodium chloride

APPENDIX B

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR BASIC TASTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 1

(n = 885)

	Storage Time, days				
Treatment	0	7	14	21	28
Sour[a]	.0001[b]	0.584[c]			
0.1% NaP512[1] + 0.375% NaCl[2]	1.31	1.54	1.58	1.70	1.88
0.1% NaP512 + 1.125% NaCl	1.99	1.53	1.91	2.01	2.17
0.2% NaP512 + 0% NaCl	1.54	1.45	1.58	1.45	1.78
0.2% NaP512 + 0.75% NaCl	1.83	1.45	1.58	1.82	1.93
0.2% NaP512 + 1.5% NaCl	1.61	1.99	1.63	1.89	2.07
0.3% NaP512 + 0.375% NaCl	1.81	1.30	1.63	1.89	2.03
0.3% NaP512 + 1.125% NaCl	1.95	1.53	1.69	1.82	1.83
0.4% NaP512 + 0.75% NaCl	1.49	1.91	1.91	1.76	2.44
0% NaP512 + 0.75% NaCl	1.77	1.53	1.63	1.82	1.91
Control (no injection)	1.68	1.53	1.69	1.76	1.65
Bitter	.0001	0.605			
0.1% NaP512 + 0.375% NaCl	1.58	1.74	1.69	1.83	2.17
0.1% NaP512 + 1.125% NaCl	1.76	1.63	1.97	2.15	2.28
0.2% NaP512 + 0% NaCl	1.58	1.55	1.75	1.90	2.37
0.2% NaP512 + 0.75% NaCl	1.59	1.55	1.75	2.02	2.07
0.2% NaP512 + 1.5% NaCl	1.65	1.55	1.75	1.90	2.28
0.3% NaP512 + 0.375% NaCl	1.48	1.78	1.75	2.08	1.92
0.3% NaP512 + 1.125% NaCl	1.67	1.63	1.75	2.15	2.17
0.4% NaP512 + 0.75% NaCl	1.53	1.40	1.91	1.83	2.12
0% NaP512 + 0.75% NaCl	1.71	1.55	1.69	1.96	2.22
Control (no injection)	1.58	1.55	1.91	2.15	2.59
Sweet	.0001	0.736			
0.1% NaP512 + 0.375% NaCl	1.14	0.96	0.63	0.69	-0.02
0.1% NaP512 + 1.125% NaCl	0.96	0.68	0.85	0.63	0.25
0.2% NaP512 + 0% NaCl	1.09	0.83	0.74	0.44	-0.17
0.2% NaP512 + 0.75% NaCl	1.35	0.75	0.80	0.69	0.38
0.2% NaP512 + 1.5% NaCl	1.05	0.91	0.96	0.44	0.25
0.3% NaP512 + 0.375% NaCl	1.18	0.91	0.96	0.19	0.38
0.3% NaP512 + 1.125% NaCl	1.18	0.75	0.96	0.44	0.68
0.4% NaP512 + 0.75% NaCl	1.05	0.83	0.52	0.38	0.25
0% NaP512 + 0.75% NaCl	1.09	0.98	1.24	0.63	0.25
Control (no injection)	1.14	1.06	0.52	0.13	-0.06

Treatment		Storage Time, days				
		0	7	14	21	28
Salt[a]	(n = 883)	.0001[b]	1.464[c]			
0.1% NaP512[1] + 0.375% NaCl[2]		2.01	2.96	2.53	2.42	2.43
0.1% NaP512 + 1.125% NaCl		2.92	3.10	3.86	4.42	4.73
0.2% NaP512 + 0% NaCl		2.83	2.64	1.92	1.73	1.78
0.2% NaP512 + 0.75% NaCl		3.96	2.48	4.70	3.86	3.53
0.2% NaP512 + 1.5% NaCl		3.04	3.56	3.98	4.67	4.29
0.3% NaP512 + 0.375% NaCl		3.24	1.87	2.81	2.73	2.33
0.3% NaP512 + 1.125% NaCl		3.92	3.33	4.25	4.27	4.13
0.4% NaP512 + 0.75% NaCl		3.51	3.56	3.14	3.73	3.73
0% NaP512 + 0.75% NaCl		3.29	3.71	3.25	3.42	3.31
Control (no injection)		2.38	1.64	1.86	1.86	1.84

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaP512: sodium phosphate 512, [2]NaCl: sodium chloride

APPENDIX C

LEAST SQUARES MEANS FOR DESCRIPTIVE ATTRIBUTE FLAVOR AFTERTASTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 1 (n = 885)

	Storage Time, days				
Treatment	0	7	14	21	28
Sour[a]	.0002[b]		0.565[c]		
0.1% NaP512[1] + 0.375% NaCl[2]	-0.07	0.20	0.10	0.23	0.42
0.1% NaP512 + 1.125% NaCl	0.07	0.20	0.54	0.23	0.39
0.2% NaP512 + 0% NaCl	0.07	0.05	0.15	0.36	0.47
0.2% NaP512 + 0.75% NaCl	0.12	0.05	0.21	0.23	0.27
0.2% NaP512 + 1.5% NaCl	0.16	0.43	0.27	0.42	0.39
0.3% NaP512 + 0.375% NaCl	0.21	0.05	0.43	0.23	0.57
0.3% NaP512 + 1.125% NaCl	-0.07	0.05	0.21	0.17	0.17
0.4% NaP512 + 0.75% NaCl	0.21	0.43	0.38	0.61	0.60
0% NaP512 + 0.75% NaCl	-0.07	0.05	0.10	0.11	0.54
Control (no injection)	-0.02	0.13	0.54	0.48	0.33
Salty	.0001		0.945		
0.1% NaP512 + 0.375% NaCl	-0.02	0.63	0.18	0.22	0.05
0.1% NaP512 + 1.125% NaCl	0.52	0.27	1.07	1.03	1.14
0.2% NaP512 + 0% NaCl	0.80	0.27	-0.10	-0.03	-0.20
0.2% NaP512 + 0.75% NaCl	0.60	0.11	1.07	0.97	0.70
0.2% NaP512 + 1.5% NaCl	0.69	0.73	1.24	1.47	1.61
0.3% NaP512 + 0.375% NaCl	0.66	0.04	0.24	0.22	0.05
0.3% NaP512 + 1.125% NaCl	0.98	0.42	1.07	0.78	1.25
0.4% NaP512 + 0.75% NaCl	0.75	0.80	0.62	0.72	0.67
0% NaP512 + 0.75% NaCl	1.02	0.65	0.51	0.40	0.30
Control (no injection)	0.30	0.11	0.24	-0.10	-0.18
Bitter	.0001		0.890		
0.1% NaP512 + 0.375% NaCl	0.02	0.47	0.90	0.96	1.24
0.1% NaP512 + 1.125% NaCl	0.24	0.18	1.01	0.77	0.90
0.2% NaP512 + 0% NaCl	0.02	0.34	0.67	0.96	1.34
0.2% NaP512 + 0.75% NaCl	0.17	0.18	1.01	1.02	0.99
0.2% NaP512 + 1.5% NaCl	0.39	0.26	0.67	0.77	1.11
0.3% NaP512 + 0.375% NaCl	0.24	0.80	0.73	1.15	0.79
0.3% NaP512 + 1.125% NaCl	0.24	0.57	0.73	0.84	0.54
0.4% NaP512 + 0.75% NaCl	0.24	0.34	0.90	0.59	0.79
0% NaP512 + 0.75% NaCl	0.34	0.26	0.73	1.21	1.11
Control (no injection)	0.79	0.49	1.01	1.15	1.27

Treatment	Storage Time, days				
	0	7	14	21	28
Soapy[a]	.0796[b]	0.682[c]			
0.1% NaP512[1] + 0.375% NaCl[2]	0.72	0.56	0.85	0.52	0.49
0.1% NaP512 + 1.125% NaCl	0.86	0.70	0.74	0.65	0.69
0.2% NaP512 + 0% NaCl	0.81	0.63	0.63	0.59	0.64
0.2% NaP512 + 0.75% NaCl	1.12	0.70	0.96	0.77	0.34
0.2% NaP512 + 1.5% NaCl	0.76	0.78	0.74	0.59	0.53
0.3% NaP512 + 0.375% NaCl	0.68	0.86	0.79	0.46	0.39
0.3% NaP512 + 1.125% NaCl	0.63	0.47	1.01	0.77	0.39
0.4% NaP512 + 0.75% NaCl	1.04	0.63	0.96	0.40	0.53
0% NaP512 + 0.75% NaCl	0.90	0.86	0.57	0.65	0.43
Control (no injection)	0.63	0.47	0.74	0.46	0.43
Mouthburn	.6980	0.202			
0.1% NaP512 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.1% NaP512 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP512 + 0% NaCl	0.09	0.00	0.00	0.13	0.10
0.2% NaP512 + 0.75% NaCl	0.01	0.00	0.00	0.13	0.10
0.2% NaP512 + 1.5% NaCl	0.00	0.00	0.00	0.13	0.00
0.3% NaP512 + 0.375% NaCl	0.00	0.00	0.00	0.13	0.00
0.3% NaP512 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.4% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.13	0.00
0% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.13	0.05
Control (no injection)	0.00	0.00	0.00	0.00	0.00
Soda	.0072	0.699			
0.1% NaP512 + 0.375% NaCl	0.24	0.30	0.02	0.22	0.25
0.1% NaP512 + 1.125% NaCl	0.42	0.27	0.41	0.66	0.63
0.2% NaP512 + 0% NaCl	0.47	0.04	-0.03	0.35	0.30
0.2% NaP512 + 0.75% NaCl	0.37	0.27	0.41	0.35	0.10
0.2% NaP512 + 1.5% NaCl	0.35	0.19	0.30	0.60	0.79
0.3% NaP512 + 0.375% NaCl	0.65	0.19	0.19	0.79	0.55
0.3% NaP512 + 1.125% NaCl	0.60	0.65	0.74	0.60	0.65
0.4% NaP512 + 0.75% NaCl	0.38	0.42	0.41	0.16	0.57
0% NaP512 + 0.75% NaCl	0.65	0.42	0.13	0.60	0.47
Control (no injection)	0.47	0.04	0.24	0.54	0.15

Treatment	Storage Time, days 0	7	14	21	28
Chemical[a]	.3024[b]		0.346[c]		
0.1% NaP512[1] + 0.375% NaCl[2]	0.04	0.03	0.01	0.05	0.11
0.1% NaP512 + 1.125% NaCl	0.13	0.03	0.01	0.05	0.01
0.2% NaP512 + 0% NaCl	0.00	0.03	0.01	0.11	0.11
0.2% NaP512 + 0.75% NaCl	0.11	0.03	0.01	0.17	0.11
0.2% NaP512 + 1.5% NaCl	0.10	0.03	0.01	0.05	0.01
0.3% NaP512 + 0.375% NaCl	0.22	0.03	0.01	0.05	0.01
0.3% NaP512 + 1.125% NaCl	0.18	0.03	0.01	0.05	0.16
0.4% NaP512 + 0.75% NaCl	0.41	0.03	0.12	0.17	0.27
0% NaP512 + 0.75% NaCl	0.13	0.03	0.01	0.05	0.17
Control (no injection)	0.18	0.03	0.12	0.05	0.17
Metallic	.0180		0.495		
0.1% NaP512 + 0.375% NaCl	0.15	0.09	0.27	0.24	0.60
0.1% NaP512 + 1.125% NaCl	0.15	0.10	0.16	0.24	0.21
0.2% NaP512 + 0% NaCl	-0.04	0.10	0.27	0.12	0.60
0.2% NaP512 + 0.75% NaCl	0.35	0.10	0.11	0.24	0.20
0.2% NaP512 + 1.5% NaCl	0.03	0.10	0.11	0.24	0.32
0.3% NaP512 + 0.375% NaCl	0.05	0.18	0.22	0.31	0.50
0.3% NaP512 + 1.125% NaCl	0.19	0.10	0.22	0.24	0.30
0.4% NaP512 + 0.75% NaCl	-0.04	0.10	0.11	0.24	0.26
0% NaP512 + 0.75% NaCl	0.19	0.10	0.11	0.24	0.37
Control (no injection)	0.15	0.25	0.22	0.43	0.47
Mature	.0037		0.263		
0.1% NaP512 + 0.375% NaCl	0.14	0.16	0.00	-0.01	0.09
0.1% NaP512 + 1.125% NaCl	0.00	-0.01	0.00	-0.01	-0.01
0.2% NaP512 + 0% NaCl	0.00	-0.01	0.00	0.37	-0.01
0.2% NaP512 + 0.75% NaCl	0.01	-0.01	0.00	-0.01	-0.01
0.2% NaP512 + 1.5% NaCl	0.00	-0.01	0.00	-0.01	-0.01
0.3% NaP512 + 0.375% NaCl	0.09	-0.01	0.00	0.12	-0.01
0.3% NaP512 + 1.125% NaCl	0.09	-0.01	0.00	0.12	-0.01
0.4% NaP512 + 0.75% NaCl	0.00	-0.01	0.00	0.37	-0.01
0% NaP512 + 0.75% NaCl	0.00	-0.01	0.00	-0.01	0.04
Control (no injection)	0.00	0.07	0.00	0.12	0.10

Treatment	Storage Time, days				
	0	7	14	21	28
Musty[a]	.0832[b]		0.195[c]		
0.1% NaP512[1] + 0.375% NaCl[2]	0.00	0.00	0.00	0.00	0.25
0.1% NaP512 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.11
0.2% NaP512 + 0% NaCl	0.00	0.23	0.00	0.00	0.00
0.2% NaP512 + 0.75% NaCl	0.00	0.08	0.00	0.00	0.00
0.2% NaP512 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP512 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP512 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.4% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.11
0% NaP512 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.11

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaP512: sodium phosphate 512, [2]NaCl: sodium chloride

APPENDIX D

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE MOUTHFEELS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 1

(n = 885)

	Storage Time, days				
Treatment	0	7	14	21	28
Metallic[a]	.5783[b]	0.264[c]			
	0	7	14	21	28
0.1% NaP512[1] + 0.375% NaCl[2]	0.10	0.23	0.01	0.00	0.01
0.1% NaP512 + 1.125% NaCl	0.01	-0.01	0.01	0.00	0.12
0.2% NaP512 + 0% NaCl	0.01	-0.01	0.12	0.00	0.11
0.2% NaP512 + 0.75% NaCl	0.01	-0.01	0.01	0.13	0.01
0.2% NaP512 + 1.5% NaCl	0.01	-0.01	0.01	0.00	0.01
0.3% NaP512 + 0.375% NaCl	0.05	-0.01	0.01	0.00	0.11
0.3% NaP512 + 1.125% NaCl	0.01	-0.01	0.06	0.00	0.16
0.4% NaP512 + 0.75% NaCl	0.01	-0.01	0.01	0.00	0.01
0% NaP512 + 0.75% NaCl	0.10	-0.01	0.01	0.00	0.01
Control (no injection)	0.01	0.14	0.01	0.25	0.12

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaP512: sodium phosphate 512, [2]NaCl: sodium chloride

APPENDIX E

LEAST SQUARES MEANS FOR SENSORY ATTRIBUTES, COLOR, AND FROM STORAGE DAY ANALYSIS FOR EXPERIMENT 1

Storage Day			
Mature		(n = 930)	.0138[a]
0	0.00		
7	0.00		
14	0.00		
21	0.03		
28	0.00		
Aftertaste soapy		(n = 930)	<.0001
0	0.82		
7	0.49		
14	0.73		
21	0.50		
28	0.41		
Aftertaste mouthburn		(n = 930)	.0038
0	0.01		
7	0.00		
14	0.00		
21	0.07		
28	0.03		
Aftertaste chemical		(n = 850)	.0002
0	0.15		
7	0.00		
14	0.02		
21	0.03		
28	0.10		
Aftertaste mature		(n = 930)	.0025
0	0.03		
7	0.02		
14	0.00		
21	0.11		
28	0.03		

Storage Day			
*a**		(n = 139)	.0066
0	6.96		
7	6.31		
14	7.24		
21	7.65		
28	7.00		
*b**		(n = 139)	<.0001
0	3.20		
7	2.54		
14	3.67		
21	3.99		
28	3.87		
Cook time		(n = 149)	.0018
0	25.51		
7	21.17		
14	21.00		
21	23.00		
28	20.97		
Cook loss		(n = 150)	.0346
0	25.73		
7	20.27		
14	20.70		
21	21.56		
28	19.46		

[a] P- value from Analysis of Variance table of SAS (1999)

APPENDIX F

LEAST SQUARES MEANS FOR SENSORY MEAT DESCRIPTIVE TEXTURE ATTRIBUTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 1 (n = 885)

	Storage Time, days				
Treatment	0	7	14	21	28
Muscle fiber tenderness[a]	.0001[b]		2.403[c]		
0.1% NaP512[1] + 0.375% NaCl[2]	8.04	9.00	10.46	10.76	10.42
0.1% NaP512 + 1.125% NaCl	8.85	10.23	11.73	11.26	12.00
0.2% NaP512 + 0% NaCl	8.90	10.08	9.90	9.20	9.32
0.2% NaP512 + 0.75% NaCl	10.07	9.08	11.62	11.70	11.07
0.2% NaP512 + 1.5% NaCl	9.54	9.61	10.73	11.83	11.21
0.3% NaP512 + 0.375% NaCl	10.99	9.54	11.07	11.08	10.87
0.3% NaP512 + 1.125% NaCl	10.81	9.15	11.73	11.58	11.32
0.4% NaP512 + 0.75% NaCl	10.63	9.69	11.12	11.08	11.21
0% NaP512 + 0.75% NaCl	9.99	9.77	10.62	10.26	10.52
Control (no injection)	9.63	8.54	11.01	10.89	9.73
Juiciness	.0005		1.120		
0.1% NaP512 + 0.375% NaCl	2.91	2.87	3.35	3.43	3.41
0.1% NaP512 + 1.125% NaCl	3.50	3.71	3.96	3.68	4.08
0.2% NaP512 + 0% NaCl	3.46	3.64	2.96	2.87	2.66
0.2% NaP512 + 0.75% NaCl	3.97	3.41	3.63	3.50	3.36
0.2% NaP512 + 1.5% NaCl	3.54	3.56	3.46	3.68	3.81
0.3% NaP512 + 0.375% NaCl	3.78	3.64	3.19	3.37	3.11
0.3% NaP512 + 1.125% NaCl	4.05	3.71	3.80	3.56	3.61
0.4% NaP512 + 0.75% NaCl	3.96	3.33	3.96	3.81	3.50
0% NaP512 + 0.75% NaCl	3.18	3.71	3.19	3.18	3.34
Control (no injection)	3.09	3.25	3.63	3.31	2.50
Processed meat- like bite	.0001		1.931		
0.1% NaP512 + 0.375% NaCl	0.73	1.47	2.60	4.00	3.26
0.1% NaP512 + 1.125% NaCl	1.41	2.73	3.27	4.50	5.05
0.2% NaP512 + 0% NaCl	1.32	2.11	2.49	3.44	3.41
0.2% NaP512 + 0.75% NaCl	2.51	2.42	3.88	4.50	4.26
0.2% NaP512 + 1.5% NaCl	1.06	3.27	3.16	4.62	4.36
0.3% NaP512 + 0.375% NaCl	1.64	3.11	2.94	4.19	4.06
0.3% NaP512 + 1.125% NaCl	1.59	2.96	3.94	5.00	4.31
0.4% NaP512 + 0.75% NaCl	2.09	2.88	3.38	5.19	5.05
0% NaP512 + 0.75% NaCl	1.09	2.19	2.22	3.81	4.47
Control (no injection)	1.05	2.11	2.55	4.06	2.73

[a] Sample evaluation on a 15-point scale for 0 = extremely tough, dry, not processed and 15 = extremely tender, juicy, processed.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaP512: sodium phosphate 512, [2]NaCl: sodium chloride

APPENDIX G

LEAST SQUARES MEANS FOR SUBJECTIVE COLOR FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 1

Treatment		Storage Time, days				
		0	7	14	21	28
Color[a]	(n = 920)	.0001[b]	0.804[c]			
0.1% NaP512[1] + 0.375% NaCl[2]		3.22	2.20	2.38	2.98	2.35
0.1% NaP512 + 1.125% NaCl		2.36	2.50	2.66	2.42	2.51
0.2% NaP512 + 0% NaCl		2.59	2.03	2.16	2.67	1.98
0.2% NaP512 + 0.75% NaCl		3.61	2.79	3.49	3.04	3.30
0.2% NaP512 + 1.5% NaCl		3.30	2.79	2.77	2.92	2.88
0.3% NaP512 + 0.375% NaCl		2.31	2.73	2.88	3.17	2.77
0.3% NaP512 + 1.125% NaCl		3.36	2.62	3.05	3.04	2.77
0.4% NaP512 + 0.75% NaCl		3.22	2.44	2.60	3.29	2.56
0% NaP512 + 0.75% NaCl		2.59	2.61	2.32	2.17	2.14
Control (no injection)		2.54	2.56	2.27	2.61	1.82
Amount of Discoloration[d]	(n = 919)	.0001	0.761			
0.1% NaP512 + 0.375% NaCl		2.20	2.01	1.62	1.55	1.28
0.1% NaP512 + 1.125% NaCl		2.52	1.96	1.62	1.92	1.49
0.2% NaP512 + 0% NaCl		2.15	1.65	1.62	2.05	1.22
0.2% NaP512 + 0.75% NaCl		2.36	1.54	1.23	1.17	1.38
0.2% NaP512 + 1.5% NaCl		2.16	1.77	1.51	1.74	1.43
0.3% NaP512 + 0.375% NaCl		2.43	1.77	1.29	1.42	1.75
0.3% NaP512 + 1.125% NaCl		2.34	1.89	1.84	1.74	1.65
0.4% NaP512 + 0.75% NaCl		2.47	2.01	1.73	1.55	1.96
0% NaP512 + 0.75% NaCl		2.25	1.75	1.57	1.49	1.28
Control (no injection)		2.43	1.95	1.46	1.67	1.59
Color of Discoloration	(n = 460)	.0161	1.028			
0.1% NaP512 + 0.375% NaCl		3.00	2.35	2.37	2.72	2.88
0.1% NaP512 + 1.125% NaCl		2.81	3.12	3.24	3.22	3.19
0.2% NaP512 + 0% NaCl		2.99	2.09	2.13	2.08	3.11
0.2% NaP512 + 0.75% NaCl		3.69	3.02	2.17	.	2.59
0.2% NaP512 + 1.5% NaCl		3.11	2.70	3.11	2.53	2.86
0.3% NaP512 + 0.375% NaCl		2.47	2.12	2.33	2.66	2.32
0.3% NaP512 + 1.125% NaCl		2.99	3.07	2.88	2.83	2.66
0.4% NaP512 + 0.75% NaCl		3.63	2.33	2.80	2.61	2.56
0% NaP512 + 0.75% NaCl		3.01	3.10	2.75	2.99	3.15
Control (no injection)		2.77	2.88	2.22	2.91	1.80

[a] Sample evaluation for Color and Color of Discoloration on a 6-point National Pork Board color scale for 1=extremely light and 6=extremely dark.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[d] Sample evaluation for Amount of Discoloration on a 7-point scale, 1 = no discoloration and 7 = 100% discoloration
[1] NaP512: sodium phosphate 512, [2] NaCl: sodium chloride

APPENDIX H

LEAST SQUARES MEANS FOR OBJECTIVE COLOR FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 1 (n = 139)

	Storage Time, days				
Treatment	0	7	14	21	28
*L**	.0132[a]		2.705[b]		
0.1% NaP512[1] + 0.375% NaCl[2]	51.25	54.72	54.37	54.72	56.23
0.1% NaP512 + 1.125% NaCl	53.18	52.86	52.61	52.69	52.92
0.2% NaP512 + 0% NaCl	53.42	54.80	52.91	54.10	56.47
0.2% NaP512 + 0.75% NaCl	49.69	50.13	50.22	49.56	52.41
0.2% NaP512 + 1.5% NaCl	50.62	52.10	51.05	51.25	52.43
0.3% NaP512 + 0.375% NaCl	50.63	51.07	51.86	52.89	55.60
0.3% NaP512 + 1.125% NaCl	50.39	49.99	50.58	48.93	53.57
0.4% NaP512 + 0.75% NaCl	49.09	49.64	54.14	53.07	54.75
0% NaP512 + 0.75% NaCl	54.45	54.52	54.76	56.31	57.53
Control (no injection)	53.47	53.50	54.01	55.15	55.78
*a**	.2530		1.243		
0.1% NaP512 + 0.375% NaCl	6.54	5.95	7.95	7.99	7.62
0.1% NaP512 + 1.125% NaCl	6.39	5.86	6.87	6.64	5.95
0.2% NaP512 + 0% NaCl	6.44	6.16	7.33	8.06	6.61
0.2% NaP512 + 0.75% NaCl	8.68	6.97	7.61	8.52	8.25
0.2% NaP512 + 1.5% NaCl	7.66	5.75	7.40	7.36	7.53
0.3% NaP512 + 0.375% NaCl	7.61	7.87	8.22	7.88	7.62
0.3% NaP512 + 1.125% NaCl	6.13	5.49	6.03	7.42	6.35
0.4% NaP512 + 0.75% NaCl	7.40	6.08	7.27	8.34	7.06
0% NaP512 + 0.75% NaCl	6.00	6.62	7.42	6.93	6.72
Control (no injection)	6.78	6.36	6.29	7.32	6.29
*b**	.5920		0.966		
0.1% NaP512 + 0.375% NaCl	3.30	2.88	4.21	4.57	3.96
0.1% NaP512 + 1.125% NaCl	3.46	2.38	3.82	4.00	3.01
0.2% NaP512 + 0% NaCl	2.94	2.96	3.25	4.20	3.92
0.2% NaP512 + 0.75% NaCl	3.79	2.54	3.29	3.52	4.28
0.2% NaP512 + 1.5% NaCl	3.43	2.37	3.52	3.45	3.82
0.3% NaP512 + 0.375% NaCl	3.14	2.75	4.18	3.91	3.88
0.3% NaP512 + 1.125% NaCl	2.63	1.65	2.41	3.59	3.40
0.4% NaP512 + 0.75% NaCl	2.64	2.00	4.42	4.47	4.13
0% NaP512 + 0.75% NaCl	3.56	3.38	4.37	4.05	4.13
Control (no injection)	3.06	2.46	3.24	4.18	4.15

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaP512: sodium phosphate 512, [2]NaCl: sodium chloride

APPENDIX I

LEAST SQUARES MEANS AND REGRESSION EQUATIONS FOR COOK LOSS AND CIE A* COLOR SPACE VALUES FROM TREATMENT ANALYSIS FOR EXPERIMENT 1

Treatment		Least Squares Means		Regression Equation
*a**	(n = 139)	.0066[a]	1.243[b]	
0.1% NaP512 + 0.375% NaCl		7.21		
0.1% NaP512 +1.125% NaCl		6.35		
0.2% NaP512 + 0% NaCl		6.92		
0.2% NaP512 + 0.75% NaCl		8.00		
0.2% NaP512 + 1.5% NaCl		7.14		
0.3% NaP512 + 0.375% NaCl		7.84		
0.3% NaP512 + 1.125% NaCl		6.29		
0.4% NaP512 + 0.75% NaCl		7.23		
0% NaP85 + 0.75% NaCl		6.74		
Control (no injection)		6.61		
Intercept				6.48
Sodium chloride (NaCl)				0.85
Sodium phosphates (NaP)				6.60
NaCl x NaCl				-1.21
P512 x P512				-11.51
R2				36.61
Cook loss	(n = 150)	.0095[a]	8.177[b]	
0.1% NaP512[1] + 0.375% Na[2]		23.92		
0.1% NaP512 +1.125% NaCl		20.64		
0.2% NaP512 + 0% NaCl		28.07		
0.2% NaP512 + 0.75% NaCl		19.02		
0.2% NaP512 + 1.5% NaCl		18.98		
0.3% NaP512 + 0.375% NaCl		24.40		
0.3% NaP512 + 1.125% NaCl		17.58		
0.4% NaP512 + 0.75% NaCl		17.93		
0% NaP85 + 0.75% NaCl		23.71		
Control (no injection)		21.18		
Intercept				22.14
Sodium chloride (NaCl)				-2.84
Sodium phosphates (NaP)				28.29
NaCl x NaCl				4.52
P512 x S				-49.05
P512 x P512				-4.21
R^2				89.71

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaP: sodium phosphate 512, [2]Na: sodium chloride

APPENDIX J

LEAST SQUARES MEANS FOR COOK TIME, COOK LOSS, AND PACKAGE PURGE FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 1 (n = 150)

	Storage Time, days				
Treatment	0	7	14	21	28
Cook time	.1728[a]		6.244[b]		
0.1% NaP512[1] + 0.375% NaCl[2]	28.67	19.33	20.33	26.00	18.67
0.1% NaP512 + 1.125% NaCl	23.67	20.67	20.82	25.00	22.67
0.2% NaP512 + 0% NaCl	22.67	22.33	19.34	25.00	23.33
0.2% NaP512 + 0.75% NaCl	18.00	24.00	21.67	21.67	18.33
0.2% NaP512 + 1.5% NaCl	29.33	18.33	20.09	24.33	18.00
0.3% NaP512 + 0.375% NaCl	27.33	19.00	23.67	23.00	22.00
0.3% NaP512 + 1.125% NaCl	15.00	18.67	20.32	18.67	19.00
0.4% NaP512 + 0.75% NaCl	22.67	23.33	18.67	23.33	22.00
0% NaP512 + 0.75% NaCl	29.00	25.33	22.33	5.67	20.67
Control (no injection)	30.67	20.67	23.00	22.00	25.00
Cook loss	.3055		8.177		
0.1% NaP512 + 0.375% NaCl	30.24	21.98	23.43	23.83	20.10
0.1% NaP512 + 1.125% NaCl	23.73	22.53	20.16	20.21	16.55
0.2% NaP512 + 0% NaCl	44.78	26.17	19.54	26.37	23.54
0.2% NaP512 + 0.75% NaCl	20.51	18.37	17.76	20.94	17.52
0.2% NaP512 + 1.5% NaCl	24.18	16.23	22.35	18.39	13.74
0.3% NaP512 + 0.375% NaCl	29.54	19.53	23.75	24.17	25.01
0.3% NaP512 + 1.125% NaCl	16.79	16.89	16.36	20.91	16.96
0.4% NaP512 + 0.75% NaCl	19.97	17.47	15.07	18.03	19.08
0% NaP512 + 0.75% NaCl	28.55	20.88	28.51	20.59	20.00
Control (no injection)	18.96	22.61	20.10	22.14	22.11
Package purge (n = 120)	.0001		0.776		
0.1% NaP512 + 0.375% NaCl	0.00	5.08	5.53	6.01	6.20
0.1% NaP512 + 1.125% NaCl	0.00	4.48	4.04	5.13	4.60
0.2% NaP512 + 0% NaCl	0.00	5.68	5.52	7.33	5.79
0.2% NaP512 + 0.75% NaCl	0.00	4.35	4.64	4.81	5.24
0.2% NaP512 + 1.5% NaCl	0.00	3.89	4.79	3.85	4.22
0.3% NaP512 + 0.375% NaCl	0.00	4.60	5.34	5.56	6.10
0.3% NaP512 + 1.125% NaCl	0.00	4.98	4.71	5.34	5.48
0.4% NaP512 + 0.75% NaCl	0.00	4.30	4.55	4.44	5.02
0% NaP512 + 0.75% NaCl	0.00	3.66	4.88	4.87	5.46
Control (no injection)	0.00	5.35	5.70	5.88	5.96

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaP512: sodium phosphate 512, [2]NaCl: sodium chloride

APPENDIX K

LEAST SQUARES MEANS FOR PH AND DRIP LOSS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 1 (n = 150)

		Storage Time, days				
Treatment		0	7	14	21	28
pH	(n = 150)	.2464	0.335			
0.1% NaP512[1] + 0.375% NaCl[2]		5.69	5.82	5.86	5.80	5.85
0.1% NaP512 + 1.125% NaCl		5.73	5.91	5.79	4.91	5.76
0.2% NaP512 + 0% NaCl		5.91	5.94	6.01	6.12	5.03
0.2% NaP512 + 0.75% NaCl		5.82	5.94	5.82	5.91	5.77
0.2% NaP512 + 1.5% NaCl		5.84	5.79	5.83	5.85	5.80
0.3% NaP512 + 0.375% NaCl		5.89	5.87	5.95	5.79	5.82
0.3% NaP512 + 1.125% NaCl		6.05	6.09	6.08	6.07	6.08
0.4% NaP512 + 0.75% NaCl		5.91	5.93	6.03	5.89	5.78
0% NaP512 + 0.75% NaCl		5.91	5.79	5.94	5.82	5.74
Control (no injection)		5.96	5.84	6.05	5.80	5.80
Drip loss	(n = 150)	.0034	1.090			
0.1% NaP512 + 0.375% NaCl		5.00	4.50	2.50	3.15	3.15
0.1% NaP512 + 1.125% NaCl		4.50	3.50	2.60	2.85	2.50
0.2% NaP512 + 0% NaCl		5.15	4.50	3.20	3.00	3.00
0.2% NaP512 + 0.75% NaCl		4.50	3.00	2.50	2.85	2.65
0.2% NaP512 + 1.5% NaCl		4.00	2.65	3.70	2.85	3.85
0.3% NaP512 + 0.375% NaCl		5.00	3.50	3.50	2.85	2.50
0.3% NaP512 + 1.125% NaCl		4.50	2.85	2.60	3.00	1.15
0.4% NaP512 + 0.75% NaCl		4.15	3.00	3.15	3.15	2.35
0% NaP512 + 0.75% NaCl		4.15	3.35	3.50	2.65	2.35
Control (no injection)		5.50	4.00	2.85	3.15	3.15

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaP512: sodium phosphate 512, [2]NaCl: sodium chloride

APPENDIX L

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR AROMATICS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 2

(n = 850)

	Storage Time, days				
Treatment	0	7	14	21	28
Pork lean/brothy[a]	.0001[b]	0.982[c]			
0.1% NaP85[1] + 0.375% NaCl[2]	6.02	6.31	6.01	5.93	5.97
0.1% NaP85 + 1.125% NaCl	6.97	6.62	5.90	6.09	6.13
0.2% NaP85 + 0% NaCl	6.45	4.87	4.90	5.67	5.30
0.2% NaP85 + 0.75% NaCl	6.16	6.25	5.78	5.93	5.80
0.2% NaP85 + 1.5% NaCl	7.07	6.44	6.25	6.25	6.47
0.3% NaP85 + 0.375% NaCl	6.69	5.81	6.01	6.2	5.80
0.3% NaP85 + 1.125% NaCl	6.69	6.12	6.37	6.41	6.47
0.4% NaP85 + 0.75% NaCl	6.54	6.56	6.19	5.99	6.22
0% NaP85 + 0.75% NaCl	6.18	6.62	6.25	6.07	6.38
Control (no injection)	5.59	5.87	4.96	5.15	4.80
Pork fat	.0005	0.496			
0.1% NaP85 + 0.375% NaCl	1.88	2.32	1.84	1.69	1.85
0.1% NaP85 + 1.125% NaCl	2.16	2.13	2.02	2.00	1.77
0.2% NaP85 + 0% NaCl	2.21	1.82	1.84	1.90	1.68
0.2% NaP85 + 0.75% NaCl	1.83	1.95	1.84	1.74	1.85
0.2% NaP85 + 1.5% NaCl	2.16	2.13	1.90	2.16	2.10
0.3% NaP85 + 0.375% NaCl	2.16	1.88	1.90	2.27	2.02
0.3% NaP85 + 1.125% NaCl	2.02	1.88	2.02	2.00	2.02
0.4% NaP85 + 0.75% NaCl	1.88	2.01	1.96	1.95	2.02
0% NaP85 + 0.75% NaCl	1.83	1.88	1.96	2.06	1.85
Control (no injection)	1.78	1.70	1.78	1.74	1.52
Cardboardy	.4355	0.233			
0.1% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.04	0.00
0.1% NaP85 + 1.125% NaCl	0.04	0.00	0.00	-0.01	0.17
0.2% NaP85 + 0% NaCl	0.04	0.06	0.00	-0.01	0.34
0.2% NaP85 + 0.75% NaCl	0.04	0.00	0.00	0.04	0.00
0.2% NaP85 + 1.5% NaCl	0.00	0.00	0.00	0.10	0.00
0.3% NaP85 + 0.375% NaCl	0.09	0.00	0.00	0.04	0.00
0.3% NaP85 + 1.125% NaCl	0.04	0.00	0.00	0.10	0.00
0.4% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.04	0.00
0% NaP85 + 0.75% NaCl	0.04	0.00	0.00	0.10	0.00
Control (no injection)	0.04	0.06	0.17	0.10	0.09

Treatment	Storage Time, days 0	7	14	21	28
Soapy[a]	.0501[b]	0.223[c]			
0.1% NaP85[1] + 0.375% NaCl[2]	0.23	0.12	0.20	0.14	0.14
0.1% NaP85 + 1.125% NaCl	0.28	0.18	0.14	0.09	0.14
0.2% NaP85 + 0% NaCl	0.14	0.30	0.02	0.14	0.14
0.2% NaP85 + 0.75% NaCl	0.14	0.12	0.14	0.09	0.14
0.2% NaP85 + 1.5% NaCl	0.23	0.12	0.08	0.19	0.22
0.3% NaP85 + 0.375% NaCl	0.23	0.12	0.14	0.14	0.05
0.3% NaP85 + 1.125% NaCl	0.23	0.24	0.14	0.14	0.14
0.4% NaP85 + 0.75% NaCl	0.23	0.12	0.14	0.14	0.22
0% NaP85 + 0.75% NaCl	0.14	0.12	0.14	0.14	0.14
Control (no injection)	0.14	0.12	0.08	0.03	-0.03
Beefy	.5228	0.097			
0.1% NaP85 + 0.375% NaCl	0.00[b]	0.00	0.00	0.00	0.00
0.1% NaP85 + 1.125% NaCl	0.00	0.00	0.12	0.00	0.00
0.2% NaP85 + 0% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 1.125% NaCl	0.00	0.00	0.12	0.00	0.00
0.4% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.00
Soda	.0001	0.710			
0.1% NaP85 + 0.375% NaCl	0.97	0.75	1.01	1.56	1.26
0.1% NaP85 + 1.125% NaCl	1.44	1.44	1.60	1.82	1.76
0.2% NaP85 + 0% NaCl	0.87	0.87	0.89	1.19	1.09
0.2% NaP85 + 0.75% NaCl	1.01	1.37	1.48	1.19	1.76
0.2% NaP85 + 1.5% NaCl	1.2	1.44	1.31	1.72	1.76
0.3% NaP85 + 0.375% NaCl	1.16	1.37	1.19	1.19	1.26
0.3% NaP85 + 1.125% NaCl	1.54	1.81	1.54	1.51	1.76
0.4% NaP85 + 0.75% NaCl	1.16	1.81	1.19	1.61	1.59
0% NaP85 + 0.75% NaCl	0.88	1.56	1.37	1.58	1.68
Control (no injection)	0.87	0.69	1.01	1.09	0.84

Treatment	Storage Time, days 0	7	14	21	28
Chemical[a]	.0007[b]		0.495[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	0.17	0.11	0.34	0.22	0.45
0.1% NaP85 + 1.125% NaCl	0.22	0.3	0.17	0.33	0.53
0.2% NaP85 + 0% NaCl	0.22	0.55	0.58	0.43	0.95
0.2% NaP85 + 0.75% NaCl	0.12	0.3	0.46	0.33	0.53
0.2% NaP85 + 1.5% NaCl	0.12	0.24	0.29	0.22	0.70
0.3% NaP85 + 0.375% NaCl	0.22	0.24	0.4	0.22	0.37
0.3% NaP85 + 1.125% NaCl	0.17	0.17	0.17	0.33	0.20
0.4% NaP85 + 0.75% NaCl	0.32	0.11	0.29	0.17	0.70
0% NaP85 + 0.75% NaCl	0.26	0.11	0.23	0.22	0.12
Control (no injection)	0.32	0.17	0.52	0.43	0.53
Browned	.0034		0.511		
0.1% NaP85 + 0.375% NaCl	0.24	0.29	0.31	0.35	0.43
0.1% NaP85 + 1.125% NaCl	0.52	0.35	0.31	0.45	0.27
0.2% NaP85 + 0% NaCl	0.57	0.23	0.37	0.51	0.27
0.2% NaP85 + 0.75% NaCl	0.33	0.23	0.31	0.35	0.27
0.2% NaP85 + 1.5% NaCl	0.38	0.60	0.54	0.51	0.35
0.3% NaP85 + 0.375% NaCl	0.24	0.35	0.43	0.40	0.60
0.3% NaP85 + 1.125% NaCl	0.24	0.23	0.6	0.82	0.27
0.4% NaP85 + 0.75% NaCl	0.24	0.29	0.25	0.35	0.35
0% NaP85 + 0.75% NaCl	0.56	0.54	0.72	0.40	0.35
Control (no injection)	0.24	0.48	0.37	0.82	0.77
Musty	.0088		0.464		
0.1% NaP85 + 0.375% NaCl	0.15	0.35	0.10	0.04	0.15
0.1% NaP85 + 1.125% NaCl	0.05	0.04	0.04	-0.01	-0.02
0.2% NaP85 + 0% NaCl	0.34	0.10	0.33	0.30	0.56
0.2% NaP85 + 0.75% NaCl	0.01	0.04	0.10	-0.01	-0.02
0.2% NaP85 + 1.5% NaCl	0.24	0.29	-0.02	-0.01	-0.02
0.3% NaP85 + 0.375% NaCl	0.01	-0.02	0.10	0.20	-0.02
0.3% NaP85 + 1.125% NaCl	0.24	-0.02	0.10	0.09	-0.02
0.4% NaP85 + 0.75% NaCl	0.10	-0.02	-0.02	0.09	0.65
0% NaP85 + 0.75% NaCl	0.19	-0.02	0.10	0.04	-0.02
Control (no injection)	0.20	-0.02	0.04	0.09	-0.02

Treatment	Storage Time, days				
	0	7	14	21	28
Serum/bloody[a]	.0009[b]		0.395[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	0.08	-0.01	0.00	0.21	0.18
0.1% NaP85 + 1.125% NaCl	-0.01	-0.01	0.24	0.11	0.01
0.2% NaP85 + 0% NaCl	-0.01	0.12	0.18	0.32	0.01
0.2% NaP85 + 0.75% NaCl	-0.01	-0.01	0.36	0.11	0.18
0.2% NaP85 + 1.5% NaCl	-0.01	0.18	0.00	0.00	0.01
0.3% NaP85 + 0.375% NaCl	0.08	0.12	0.18	0.11	0.01
0.3% NaP85 + 1.125% NaCl	-0.01	0.06	0.06	0.00	0.18
0.4% NaP85 + 0.75% NaCl	-0.01	0.12	0.53	0.00	0.01
0% NaP85 + 0.75% NaCl	-0.01	0.06	0.00	0.11	0.01
Control (no injection)	-0.01	0.12	0.18	0.00	0.60
Nutty	.4665		0.256		
0.1% NaP85 + 0.375% NaCl	0.23	0.11	0.11	0.15	0.00
0.1% NaP85 + 1.125% NaCl	0.08	-0.02	-0.01	-0.01	0.00
0.2% NaP85 + 0% NaCl	-0.01	0.17	-0.01	-0.01	0.00
0.2% NaP85 + 0.75% NaCl	-0.01	-0.02	-0.01	0.04	0.00
0.2% NaP85 + 1.5% NaCl	0.08	0.11	0.05	0.15	0.00
0.3% NaP85 + 0.375% NaCl	-0.01	-0.02	-0.01	-0.01	0.00
0.3% NaP85 + 1.125% NaCl	-0.01	0.11	-0.01	-0.01	0.00
0.4% NaP85 + 0.75% NaCl	0.08	-0.02	-0.01	-0.01	0.00
0% NaP85 + 0.75% NaCl	-0.01	-0.02	-0.01	-0.01	0.00
Control (no injection)	0.08	-0.02	-0.01	-0.01	0.00
Poultry	.5117		0.290		
0.1% NaP85[1] + 0.375% NaCl	-0.01	0.00	0.11	0.10	-0.01
0.1% NaP85 + 1.125% NaCl	-0.01	0.00	0.11	-0.01	-0.01
0.2% NaP85 + 0% NaCl	-0.01	0.00	0.11	0.26	-0.01
0.2% NaP85 + 0.75% NaCl	-0.01	0.00	0.11	-0.01	0.16
0.2% NaP85 + 1.5% NaCl	-0.01	0.13	0.11	-0.01	-0.01
0.3% NaP85 + 0.375% NaCl	-0.01	0.00	0.11	-0.01	-0.01
0.3% NaP85 + 1.125% NaCl	-0.01	0.00	0.22	-0.01	-0.01
0.4% NaP85 + 0.75% NaCl	-0.01	0.00	0.11	0.10	0.16
0% NaP85 + 0.75% NaCl	-0.02	0.00	0.11	0.12	-0.01
Control (no injection)	-0.01	0.00	-0.01	-0.01	0.16

Treatment	Storage Time, days				
	0	7	14	21	28
Liver[a]	.0243[b]		0.033[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	0.00[b]	0.00	0.00	0.00	0.00
0.1% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.4% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.08
Vinegar	.0521		0.204		
0.1% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.1% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.10	0.00
0.2% NaP85 + 0% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.10	0.00
0.2% NaP85 + 1.5% NaCl	0.00	0.00	0.00	0.10	0.00
0.3% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.08
0.3% NaP85 + 1.125% NaCl	0.00	0.00	0.12	0.00	0.16
0.4% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.33
0% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.25
Acidic	.0846		0.255		
0.1% NaP85 + 0.375% NaCl	-0.01	-0.01	-0.01	-0.01	-0.01
0.1% NaP85 + 1.125% NaCl	-0.01	-0.01	-0.01	0.31	-0.01
0.2% NaP85 + 0% NaCl	-0.01	-0.01	-0.01	0.10	-0.01
0.2% NaP85 + 0.75% NaCl	-0.01	0.18	-0.01	-0.01	-0.01
0.2% NaP85 + 1.5% NaCl	-0.01	-0.01	-0.01	0.10	-0.01
0.3% NaP85 + 0.375% NaCl	-0.01	0.12	-0.01	-0.01	-0.01
0.3% NaP85 + 1.125% NaCl	-0.01	-0.01	-0.01	-0.01	-0.01
0.4% NaP85 + 0.75% NaCl	-0.01	-0.01	-0.01	0.10	-0.01
0% NaP85 + 0.75% NaCl	-0.01	-0.01	-0.01	-0.01	-0.01
Control (no injection)	-0.01	0.18	0.11	0.20	-0.01

Treatment	Storage Time, days 0	7	14	21	28
Burnt[a]	.3634[b]	0.069[c]			
0.1% NaP85[1] + 0.375% NaCl[2]	0.00	0.00	0.00	0.00	0.00
0.1% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.4% NaP85 + 0.75% NaCl	0.00	0.12	0.00	0.00	0.00
0% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.00
Mature	.6185	0.106			
0.1% NaP85 + 0.375% NaCl	0.01	0.15	0.08	0.02	0.03
0.1% NaP85 + 1.125% NaCl	0.01	0.08	0.02	0.02	0.03
0.2% NaP85 + 0% NaCl	0.01	0.02	0.02	0.02	0.03
0.2% NaP85 + 0.75% NaCl	0.01	0.02	0.02	0.02	0.03
0.2% NaP85 + 1.5% NaCl	0.01	0.02	0.02	0.02	0.03
0.3% NaP85 + 0.375% NaCl	0.01	0.02	0.02	0.02	0.03
0.3% NaP85 + 1.125% NaCl	0.01	0.02	0.02	0.02	0.03
0.4% NaP85 + 0.75% NaCl	0.01	0.02	0.02	0.02	0.03
0% NaP85 + 0.75% NaCl	0.10	0.02	0.02	0.02	0.03
Control (no injection)	0.01	0.02	0.02	0.02	0.03
Canned meat	.7514	0.181			
0.1% NaP85 + 0.375% NaCl	0.00	-0.01	0.00	0.00	0.00
0.1% NaP85 + 1.125% NaCl	0.00	-0.01	0.12	0.10	0.00
0.2% NaP85 + 0% NaCl	0.00	-0.01	0.00	0.00	0.00
0.2% NaP85 + 0.75% NaCl	0.00	-0.01	0.00	0.00	0.00
0.2% NaP85 + 1.5% NaCl	0.00	-0.01	0.00	0.10	0.00
0.3% NaP85 + 0.375% NaCl	0.00	-0.01	0.12	0.00	0.00
0.3% NaP85 + 1.125% NaCl	0.00	-0.01	0.12	0.00	0.00
0.4% NaP85 + 0.75% NaCl	0.00	-0.01	0.12	0.10	0.00
0% NaP85 + 0.75% NaCl	0.00	-0.01	0.00	0.00	0.00
Control (no injection)	0.00	-0.01	0.00	0.00	0.00

Treatment	Storage Time, days				
	0	7	14	21	28
Other[a]	.1994[b]		0.096[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	0.00	0.00	0.00	0.00	0.00
0.1% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0% NaCl	0.00	0.00	0.00	0.11	0.00
0.2% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.17
0.3% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.4% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.00

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaP85: sodium phosphate 85, [2]NaCl: sodium chloride

APPENDIX M

LEAST SQUARES MEANS FOR DESCRIPTIVE ATTRIBUTE FLAVOR BASIC TASTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 2 (n = 850)

	Storage Time, days				
Treatment	0	7	14	21	28
Sour[a]	.0001[b]		0.524c		
0.1% NaP85[1] + 0.375% NaCl[2]	2.37	2.16	2.45	2.50	2.58
0.1% NaP85 + 1.125% NaCl	2.42	2.41	2.63	2.61	2.58
0.2% NaP85 + 0% NaCl	2.42	2.53	2.75	2.87	2.83
0.2% NaP85 + 0.75% NaCl	2.37	2.59	2.80	2.55	2.50
0.2% NaP85 + 1.5% NaCl	2.23	2.16	2.39	2.45	2.58
0.3% NaP85 + 0.375% NaCl	2.28	2.47	2.69	2.40	2.50
0.3% NaP85 + 1.125% NaCl	2.37	2.34	2.63	2.40	2.41
0.4% NaP85 + 0.75% NaCl	2.42	2.16	2.45	2.40	3.00
0% NaP85 + 0.75% NaCl	2.37	2.34	2.45	2.46	2.50
Control (no injection)	2.56	2.53	2.80	2.76	3.08
Bitter	.0001		0.47		
0.1% NaP85 + 0.375% NaCl	1.91	1.85	2.26	2.52	2.09
0.1% NaP85 + 1.125% NaCl	2.25	2.28	2.61	2.41	2.51
0.2% NaP85 + 0% NaCl	2.20	2.35	2.20	2.31	2.43
0.2% NaP85 + 0.75% NaCl	2.34	2.66	2.67	2.57	2.68
0.2% NaP85 + 1.5% NaCl	2.20	2.41	2.37	2.25	2.34
0.3% NaP85 + 0.375% NaCl	2.29	2.22	2.37	2.10	2.43
0.3% NaP85 + 1.125% NaCl	2.15	2.66	2.31	2.15	2.43
0.4% NaP85 + 0.75% NaCl	2.29	2.35	2.43	2.52	2.34
0% NaP85 + 0.75% NaCl	2.10	2.41	2.37	2.43	2.26
Control (no injection)	2.29	2.60	2.61	2.52	2.51
Sweet	.0011		0.538		
0.1% NaP85 + 0.375% NaCl	0.17[b]	0.70	0.23	0.27	0.02
0.1% NaP85 + 1.125% NaCl	0.27	0.32	0.05	0.06	-0.06
0.2% NaP85 + 0% NaCl	0.51	0.14	0.40	0.22	0.10
0.2% NaP85 + 0.75% NaCl	0.13	0.26	0.11	0.17	0.02
0.2% NaP85 + 1.5% NaCl	0.75	0.26	0.11	0.32	0.35
0.3% NaP85 + 0.375% NaCl	0.51	0.07	0.23	0.32	0.52
0.3% NaP85 + 1.125% NaCl	0.41	0.07	0.05	0.11	0.35
0.4% NaP85 + 0.75% NaCl	0.27	0.32	0.23	0.27	0.19
0% NaP85 + 0.75% NaCl	0.39	0.26	0.17	0.23	0.02
Control (no injection)	0.17	0.01	0.05	0.11	-0.06

Treatment	Storage Time, days				
	0	7	14	21	28
Salt[a]	.0001[b]		0.942[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	2.43	2.47	2.40	2.28	2.62
0.1% NaP85 + 1.125% NaCl	3.71	3.60	3.87	3.75	3.70
0.2% NaP85 + 0% NaCl	2.38	2.03	2.11	2.28	2.12
0.2% NaP85 + 0.75% NaCl	2.95	3.16	3.11	3.07	3.20
0.2% NaP85 + 1.5% NaCl	4.24	3.60	4.17	4.44	4.28
0.3% NaP85 + 0.375% NaCl	2.85	2.60	2.40	2.44	2.37
0.3% NaP85 + 1.125% NaCl	4.14	3.85	3.99	3.54	4.28
0.4% NaP85 + 0.75% NaCl	3.81	4.03	3.70	4.07	2.95
0% NaP85 + 0.75% NaCl	2.88	3.10	3.40	3.16	3.37
Control (no injection)	2.14	1.97	2.11	2.17	1.95

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaP85: sodium phosphate 85, [2]NaCl: sodium chloride

APPENDIX N

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR AFTERTASTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 2

(n = 850)

	Storage Time, days				
Treatment	0	7	14	21	28
Sour[a]	.0078[b]		0.884[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	0.61	0.46	0.86	1.11	0.78
0.1% NaP85 + 1.125% NaCl	0.75	0.84	1.39	1.01	1.20
0.2% NaP85 + 0% NaCl	0.32	1.02	0.92	0.95	0.87
0.2% NaP85 + 0.75% NaCl	0.84	0.96	1.15	1.53	1.53
0.2% NaP85 + 1.5% NaCl	0.75	1.15	0.98	1.01	0.70
0.3% NaP85 + 0.375% NaCl	0.61	1.09	0.86	0.69	0.62
0.3% NaP85 + 1.125% NaCl	0.56	1.27	0.74	1.06	0.95
0.4% NaP85 + 0.75% NaCl	0.70	0.77	0.98	0.90	0.78
0% NaP85 + 0.75% NaCl	0.42	0.71	0.80	0.81	1.03
Control (no injection)	0.51	1.34	1.33	0.95	0.87
Salty	.0001		0.932		
0.1% NaP85 + 0.375% NaCl	0.36	0.13	0.45	0.17	0.47
0.1% NaP85 + 1.125% NaCl	1.02	1.51	1.22	1.39	1.06
0.2% NaP85 + 0% NaCl	0.21	0.26	0.16	0.17	0.14
0.2% NaP85 + 0.75% NaCl	0.64	0.76	0.98	0.81	0.97
0.2% NaP85 + 1.5% NaCl	1.26	1.32	1.33	1.75	1.56
0.3% NaP85 + 0.375% NaCl	0.50	0.13	0.27	0.17	0.22
0.3% NaP85 + 1.125% NaCl	1.12	1.13	1.51	0.96	1.31
0.4% NaP85 + 0.75% NaCl	1.02	1.32	1.22	1.12	0.47
0% NaP85 + 0.75% NaCl	0.37	0.63	1.04	0.81	0.81
Control (no injection)	0.07	0.20	0.22	0.33	0.14
Bitter	.0001		0.853		
0.1% NaP85 + 0.375% NaCl	0.93	1.08	1.56	1.70	1.59
0.1% NaP85 + 1.125% NaCl	1.21	1.14	1.33	1.49	1.17
0.2% NaP85 + 0% NaCl	1.21	1.83	1.86	1.75	1.59
0.2% NaP85 + 0.75% NaCl	0.98	1.39	1.38	1.54	1.75
0.2% NaP85 + 1.5% NaCl	0.79	1.01	1.15	1.44	1.34
0.3% NaP85 + 0.375% NaCl	0.83	1.39	1.38	1.60	1.34
0.3% NaP85 + 1.125% NaCl	0.88	1.20	1.27	1.54	1.25
0.4% NaP85 + 0.75% NaCl	0.79	1.14	0.91	1.12	1.59
0% NaP85 + 0.75% NaCl	0.96	1.14	1.15	1.65	1.50
Control (no injection)	1.12	1.20	1.86	1.49	1.59

Treatment	Storage Time, days				
	0	7	14	21	28
Soapy[a]	.9492[b]		0.283[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	0.27	0.11	0.18	0.13	0.28
0.1% NaP85 + 1.125% NaCl	0.13	0.17	0.24	0.13	0.11
0.2% NaP85 + 0% NaCl	0.13	0.23	0.12	0.19	0.19
0.2% NaP85 + 0.75% NaCl	0.13	0.11	0.24	0.13	0.11
0.2% NaP85 + 1.5% NaCl	0.23	0.11	0.06	0.13	0.19
0.3% NaP85 + 0.375% NaCl	0.18	0.11	0.18	0.13	0.03
0.3% NaP85 + 1.125% NaCl	0.18	0.17	0.24	0.19	0.11
0.4% NaP85 + 0.75% NaCl	0.13	0.11	0.30	0.13	0.19
0% NaP85 + 0.75% NaCl	0.12	0.11	0.24	0.14	0.11
Control (no injection)	0.13	0.11	0.06	0.13	0.11
Mouthburn	.3196		0.316		
0.1% NaP85 + 0.375% NaCl	0.01	0.03	0.01	0.12	0.20
0.1% NaP85 + 1.125% NaCl	0.01	0.03	0.01	0.22	0.36
0.2% NaP85 + 0% NaCl	0.01	0.03	0.01	0.12	0.28
0.2% NaP85 + 0.75% NaCl	0.01	0.03	0.01	0.12	0.20
0.2% NaP85 + 1.5% NaCl	0.01	0.03	0.01	0.12	0.20
0.3% NaP85 + 0.375% NaCl	0.01	0.03	0.01	0.22	0.03
0.3% NaP85 + 1.125% NaCl	0.01	0.03	0.01	0.12	0.20
0.4% NaP85 + 0.75% NaCl	0.10	0.15	0.01	0.12	0.03
0% NaP85 + 0.75% NaCl	0.09	0.03	0.01	0.03	0.03
Control (no injection)	0.01	0.03	0.01	0.01	0.20
Soda	.0001		0.814		
0.1% NaP85 + 0.375% NaCl	0.38	0.41	0.21	0.81	1.10
0.1% NaP85 + 1.125% NaCl	0.86	0.78	1.15	1.39	1.52
0.2% NaP85 + 0% NaCl	0.62	0.47	0.27	0.76	0.44
0.2% NaP85 + 0.75% NaCl	0.57	0.91	0.80	0.76	1.10
0.2% NaP85 + 1.5% NaCl	0.48	0.72	0.92	1.29	1.19
0.3% NaP85 + 0.375% NaCl	0.90	0.35	0.86	0.76	0.85
0.3% NaP85 + 1.125% NaCl	0.67	1.03	0.74	0.87	1.27
0.4% NaP85 + 0.75% NaCl	0.67	0.66	0.80	1.08	0.60
0% NaP85 + 0.75% NaCl	0.38	0.60	0.92	0.94	1.19
Control (no injection)	0.33	0.28	0.27	0.44	0.35

Treatment	Storage Time, days				
	0	7	14	21	28
Chemical[a]	.3291[b]		0.331[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	0.04	0.06	0.07	0.07	0.06
0.1% NaP85 + 1.125% NaCl	0.14	0.06	0.07	0.07	0.06
0.2% NaP85 + 0% NaCl	0.14	0.19	0.30	0.28	0.31
0.2% NaP85 + 0.75% NaCl	0.09	0.19	0.07	0.07	0.15
0.2% NaP85 + 1.5% NaCl	0.04	0.06	0.07	0.07	0.23
0.3% NaP85 + 0.375% NaCl	0.23	0.19	0.07	0.07	0.06
0.3% NaP85 + 1.125% NaCl	0.14	0.13	0.07	0.18	0.06
0.4% NaP85 + 0.75% NaCl	0.09	0.19	0.13	0.07	0.40
0% NaP85 + 0.75% NaCl	0.04	0.06	0.18	0.07	0.06
Control (no injection)	0.04	0.13	0.18	0.28	0.31
Metallic	.0003		0.730		
0.1% NaP85 + 0.375% NaCl	0.71	0.81	0.85	1.30	1.08
0.1% NaP85 + 1.125% NaCl	0.85	0.81	1.55	1.15	0.74
0.2% NaP85 + 0% NaCl	0.66	1.00	0.96	1.36	1.24
0.2% NaP85 + 0.75% NaCl	0.71	1.31	1.49	1.15	0.99
0.2% NaP85 + 1.5% NaCl	0.66	1.00	1.26	0.99	0.91
0.3% NaP85 + 0.375% NaCl	0.80	1.06	1.26	0.94	0.91
0.3% NaP85 + 1.125% NaCl	0.85	1.19	0.90	0.94	1.08
0.4% NaP85 + 0.75% NaCl	0.90	1.00	1.37	0.88	0.83
0% NaP85 + 0.75% NaCl	0.93	1.00	0.96	1.06	0.91
Control (no injection)	0.95	1.31	1.73	1.20	1.58
Mature	.3737		0.034		
0.1% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.1% NaP85 + 1.125% NaCl	0.00	0.06	0.00	0.00	0.00
0.2% NaP85 + 0% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.4% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.00

	Storage Time, days				
Treatment	0	7	14	21	28
Acidic[a]	.3417[b]		0.123[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	0.00	0.00	-0.01	-0.01	-0.01
0.1% NaP85 + 1.125% NaCl	0.00	0.00	-0.01	-0.01	-0.01
0.2% NaP85 + 0% NaCl	0.00	0.00	-0.01	-0.01	-0.01
0.2% NaP85 + 0.75% NaCl	0.00	0.18	-0.01	-0.01	-0.01
0.2% NaP85 + 1.5% NaCl	0.00	0.00	-0.01	-0.01	-0.01
0.3% NaP85 + 0.375% NaCl	0.00	0.00	-0.01	-0.01	-0.01
0.3% NaP85 + 1.125% NaCl	0.00	0.00	-0.01	-0.01	-0.01
0.4% NaP85 + 0.75% NaCl	0.00	0.00	-0.01	-0.01	-0.01
0% NaP85 + 0.75% NaCl	0.00	0.00	-0.01	-0.01	-0.01
Control (no injection)	0.00	0.12	-0.01	-0.01	-0.01
Musty	.0064		0.207		
0.1% NaP85 + 0.375% NaCl	0.00[b]	0.11	-0.01	-0.01	-0.01
0.1% NaP85 + 1.125% NaCl	0.00	0.11	-0.01	-0.01	-0.01
0.2% NaP85 + 0% NaCl	0.05	0.05	0.23	-0.01	0.24
0.2% NaP85 + 0.75% NaCl	0.00	-0.01	-0.01	-0.01	-0.01
0.2% NaP85 + 1.5% NaCl	0.00	0.11	-0.01	-0.01	-0.01
0.3% NaP85 + 0.375% NaCl	0.00	-0.01	-0.01	-0.01	-0.01
0.3% NaP85 + 1.125% NaCl	0.00	-0.01	-0.01	-0.01	-0.01
0.4% NaP85 + 0.75% NaCl	0.00	-0.01	-0.01	-0.01	0.32
0% NaP85 + 0.75% NaCl	0.00	-0.01	-0.01	-0.01	-0.01
Control (no injection)	0.00	-0.01	-0.01	-0.01	-0.01
Browned	.0801		0.259		
0.1% NaP85 + 0.375% NaCl	0.00	-0.01	-0.01	-0.01	-0.01
0.1% NaP85 + 1.125% NaCl	0.00	-0.01	-0.01	-0.01	-0.01
0.2% NaP85 + 0% NaCl	0.10	-0.01	-0.01	0.15	-0.01
0.2% NaP85 + 0.75% NaCl	0.00	-0.01	-0.01	-0.01	-0.01
0.2% NaP85 + 1.5% NaCl	0.00	-0.01	-0.01	0.10	-0.01
0.3% NaP85 + 0.375% NaCl	0.00	-0.01	0.05	0.10	0.32
0.3% NaP85 + 1.125% NaCl	0.00	-0.01	0.05	0.10	-0.01
0.4% NaP85 + 0.75% NaCl	0.00	-0.01	-0.01	-0.01	-0.01
0% NaP85 + 0.75% NaCl	0.09	0.12	0.11	-0.01	-0.01
Control (no injection)	0.00	-0.01	-0.01	0.31	0.07

Treatment	Storage Time, days 0	7	14	21	28
Serum/bloody[a]	.5008[b]		0.234[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	0.09	0.00	0.00	0.00	0.01
0.1% NaP85 + 1.125% NaCl	-0.01	0.00	0.00	0.00	0.01
0.2% NaP85 + 0% NaCl	-0.01	0.12	0.12	0.11	0.01
0.2% NaP85 + 0.75% NaCl	-0.01	0.00	0.12	0.11	0.01
0.2% NaP85 + 1.5% NaCl	-0.01	0.19	0.00	0.00	0.01
0.3% NaP85 + 0.375% NaCl	0.09	0.06	0.00	0.00	0.01
0.3% NaP85 + 1.125% NaCl	-0.01	0.00	0.00	0.00	0.01
0.4% NaP85 + 0.75% NaCl	-0.01	0.00	0.24	0.00	0.01
0% NaP85 + 0.75% NaCl	-0.01	0.06	0.00	0.00	0.01
Control (no injection)	-0.01	0.00	0.12	0.00	0.01
Smokey	.6797		0.069		
0.1% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.1% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.11	0.00
0.4% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.00
Oily	.6082		0.101		
0.1% NaP85[1] + 0.375% Na[2]	0.00	0.06	0.00	0.00	-0.01
0.1% NaP85 + 1.125% NaCl	0.00	0.00	0.06	0.00	-0.01
0.2% NaP85 + 0% NaCl	0.04	0.00	0.00	0.00	-0.01
0.2% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	-0.01
0.2% NaP85 + 1.5% NaCl	0.00	0.00	0.00	0.00	-0.01
0.3% NaP85 + 0.375% NaCl	0.04	0.00	0.00	0.00	-0.01
0.3% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.00	-0.01
0.4% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	-0.01
0% NaP85 + 0.75% NaCl	0.00	0.06	0.00	0.11	-0.01
Control (no injection)	0.00	0.00	0.00	0.00	-0.01

Treatment	Storage Time, days				
	0	7	14	21	28
Other[a]	.0286[b]		0.068[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	0.00	0.00	0.00	0.00	0.00
0.1% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0.2% NaP85 + 1.5% NaCl	0.00	0.00	0.00	0.00	0.00
0.3% NaP85 + 0.375% NaCl	0.00	0.00	0.00	0.00	0.17
0.3% NaP85 + 1.125% NaCl	0.00	0.00	0.00	0.00	0.00
0.4% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
0% NaP85 + 0.75% NaCl	0.00	0.00	0.00	0.00	0.00
Control (no injection)	0.00	0.00	0.00	0.00	0.00

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaP85: sodium phosphate 85, [2]NaCl: sodium chloride

APPENDIX O

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE MOUTHFEELS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 2 (n = 850)

	Storage Time, days				
Treatment	0	7	14	21	28
Metallic[a]	.0073[b]		0.496[c]		
0.1% NaP85[1] + 0.375% NaCl [2]	2.01[b]	1.95	2.03	2.26	2.21
0.1% NaP85 + 1.125% NaCl	2.20	2.26	2.38	2.48	2.30
0.2% NaP85 + 0% NaCl	2.11	2.13	2.26	2.48	2.38
0.2% NaP85 + 0.75% NaCl	2.11	2.32	2.32	2.21	2.55
0.2% NaP85 + 1.5% NaCl	1.96	2.20	2.14	2.37	2.38
0.3% NaP85 + 0.375% NaCl	2.20	2.38	2.08	2.26	2.21
0.3% NaP85 + 1.125% NaCl	2.06	2.32	2.26	2.26	2.38
0.4% NaP85 + 0.75% NaCl	2.15	2.13	2.20	2.26	2.30
0% NaP85 + 0.75% NaCl	2.01	2.20	1.91	2.28	2.30
Control (no injection)	2.20	2.32	2.56	2.48	2.46
Astringent	.0001		0.590		
0.1% NaP85 + 0.375% NaCl	2.06	2.02	2.30	2.49	2.40
0.1% NaP85 + 1.125% NaCl	2.54	2.46	2.71	2.86	2.48
0.2% NaP85 + 0% NaCl	2.30	2.40	2.47	2.65	2.73
0.2% NaP85 + 0.75% NaCl	2.39	2.46	2.77	2.49	2.65
0.2% NaP85 + 1.5% NaCl	2.11	2.65	2.59	2.59	2.48
0.3% NaP85 + 0.375% NaCl	2.35	2.40	2.71	2.54	2.48
0.3% NaP85 + 1.125% NaCl	2.16	2.46	2.53	2.44	2.73
0.4% NaP85 + 0.75% NaCl	2.30	2.46	2.71	2.38	2.57
0% NaP85 + 0.75% NaCl	1.97	2.40	2.24	2.57	2.57
Control (no injection)	2.11	2.71	2.83	2.65	2.82

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaP85: sodium phosphate 85, [2]NaCl: sodium chloride

APPENDIX P

LEAST SQUARES MEANS AND REGRESSION EQUATIONS FOR SENSORY ATTRIBUTES, COOK LOSS, AND PH FROM TREATMENT ANALYSIS FOR EXPERIMENT 2

Treatment		Least Squares Means		Regression Equation
Nutty	(n = 850)	.0293[a]	0.259[b]	
0.1% NaP85[1] + 0.375% Na[2]		0.13		
0.1% NaP85 + 1.125% NaCl		0.02		
0.2% NaP85 + 0% NaCl		0.04		
0.2% NaP85 + 0.75% NaCl		0.01		
0.2% NaP85 + 1.5% NaCl		0.09		
0.3% NaP85 + 0.375% NaCl		0.00		
0.3% NaP85 + 1.125% NaCl		0.03		
0.4% NaP85 + 0.75% NaCl		0.02		
0% NaP85 + 0.75% NaCl		0.00		
Control (no injection)		0.02		
Intercept				0.04
Sodium chloride (NaCl)				-0.04
Sodium phosphates (NaP)				0.25
NaCl x NaCl				0.01
NaP x NaCl				0.19
NaP x NaP				-1.12
R^2				28.29
Aftertaste chemical	(n = 850)	.0162[a]	0.344[b]	
0.1% NaP85 + 0.375% NaCl		0.00		
0.1% NaP85 + 1.125% NaCl		0.02		
0.2% NaP85 + 0% NaCl		0.18		
0.2% NaP85 + 0.75% NaCl		0.05		
0.2% NaP85 + 1.5% NaCl		0.03		
0.3% NaP85 + 0.375% NaCl		0.06		
0.3% NaP85 + 1.125% NaCl		0.05		
0.4% NaP85 + 0.75% NaCl		0.11		
0% NaP85 + 0.75% NaCl		0.02		
Control (no injection)		0.13		
Intercept				0.13
Sodium chloride (NaCl)				-0.27
Sodium phosphates (NaP)				-0.11
NaCl x NaCl				0.15
NaP x NaCl				-0.10
NaP x NaP				1.07
R^2				76.70

Treatment	Least Squares Means			Regression Equation
Cook loss	(n = 140)	.0099[a]	4.803[b]	
0.1% NaP85 + 0.375% NaCl	16.68			
0.1% NaP85 + 1.125% NaCl	18.06			
0.2% NaP85 + 0% NaCl	20.64			
0.2% NaP85 + 0.75% NaCl	17.68			
0.2% NaP85 + 1.5% NaCl	15.96			
0.3% NaP85 + 0.375% NaCl	16.93			
0.3% NaP85 + 1.125% NaCl	16.04			
0.4% NaP85 + 0.75% NaCl	14.49			
0% NaP85 + 0.75% NaCl	17.62			
Control (no injection)	21.38			
Intercept				20.86
Sodium chloride (NaCl)				-6.35
Sodium phosphates (NaP)				-0.66
NaCl x NaCl				2.93
NaP x NaCl				-1.23
NaP x NaP				-14.97
R^2				81.78
pH	(n = 150)	.0226	0.267	
0.1% NaP85 + 0.375% NaCl	5.93			
0.1% NaP85 + 1.125% NaCl	5.72			
0.2% NaP85 + 0% NaCl	5.98			
0.2% NaP85 + 0.75% NaCl	5.72			
0.2% NaP85 + 1.5% NaCl	5.89			
0.3% NaP85 + 0.375% NaCl	5.86			
0.3% NaP85 + 1.125% NaCl	5.92			
0.4% NaP85 + 0.75% NaCl	5.90			
0% NaP85 + 0.75% NaCl	5.80			
Control (no injection)	5.67			
Intercept				5.76
Sodium chloride (NaCl)				-0.13
Sodium phosphates (NaP)				0.94
NaCl x NaCl				0.13
NaP x NaCl				-0.46
NaP x NaP				-0.41
R^2				42.05

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaP: sodium phosphate 85, [2]NaCl: sodium chloride

APPENDIX Q

LEAST SQUARES MEANS FROM STORAGE DAY ANALYSIS FOR EXPERIMENT 2

Storage Day			
Vinegar		(n = 850)	.0067[a]
0	0.00		
7	0.00		
14	0.01		
21	0.03		
28	0.08		
Acidic		(n = 850)	.0075
0	0.00		
7	0.05		
14	0.01		
21	0.08		
28	0.00		
Canned meat		(n = 850)	.0307
0	0.00		
7	0.00		
14	0.05		
21	0.03		
28	0.00		
Poultry		(n = 850)	.0032
0	0.00		
7	0.01		
14	0.12		
21	0.06		
28	0.05		
Aftertaste soapy		(n = 850)	.0298
0	0.18		
7	0.08		
14	0.24		
21	0.18		
28	0.18		
Aftertaste mouthburn		(n = 850)	.0001
0	0.02		
7	0.01		
14	0.00		
21	0.10		
28	0.16		
Color of Discoloration		(n = 850)	.0577
0	2.75		
7	3.01		
14	2.60		
21	2.97		
28	2.89		

Storage Day			
Cook time		(n = 140)	.0117
0	21.03		
7	18.63		
14	18.00		
21	19.17		
28	17.11		
pH		(n = 150)	.0313
0	5.78		
7	5.96		
14	5.75		
21	5.83		
28	5.88		
Drip loss		(n = 150)	.0014
0	5.20		
7	4.80		
14	4.25		
21	8.45		
28	4.95		
*L**		(n = 150)	<.0001
0	41.47		
7	53.97		
14	55.62		
21	54.60		
28	55.94		

[a] P- value from Analysis of Variance table of SAS (1999)

APPENDIX R

LEAST SQUARES MEANS FOR SENSORY MEAT DESCRIPTIVE TEXTURE ATTRIBUTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 2 (n = 850)

	Storage Time, days				
Treatment	0	7	14	21	28
Muscle fiber tenderness[a]	.0001[b]		1.061[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	6.44	6.96	6.54	5.90	6.11
0.1% NaP85 + 1.125% NaCl	7.44	6.84	6.54	6.74	5.86
2.0% NaP85 + 0% NaCl	6.53	7.03	6.84	6.64	6.19
0.2% NaP85 + 0.75% NaCl	5.63	6.65	6.25	6.27	6.78
0.2% NaP85 + 1.5% NaCl	6.77	6.65	6.48	7.22	7.44
0.3% NaP85 + 0.375% NaCl	7.58	6.46	6.37	7.11	5.78
0.3% NaP85 + 1.125% NaCl	6.48	6.84	6.25	6.85	7.11
0.4% NaP85 + 0.75% NaCl	6.10	6.90	6.37	6.59	5.94
0% NaP85 + 0.75% NaCl	6.09	6.84	6.42	6.41	5.78
Control (no injection)	6.01	5.46	5.37	5.06	5.19
Juiciness	.0001		0.809		
0.1% NaP85 + 0.375% NaCl	5.10	4.94	5.17	4.27	5.29
0.1% NaP85 + 1.125% NaCl	5.48	5.37	5.23	4.96	4.54
2.0% NaP85 + 0% NaCl	5.05	4.87	5.29	5.22	4.54
0.2% NaP85 + 0.75% NaCl	4.43	5.06	5.00	4.69	5.62
0.2% NaP85 + 1.5% NaCl	5.00	5.06	4.76	4.90	5.54
0.3% NaP85 + 0.375% NaCl	5.62	4.81	4.94	5.48	4.46
0.3% NaP85 + 1.125% NaCl	5.00	5.25	5.12	4.96	5.37
0.4% NaP85 + 0.75% NaCl	4.86	5.44	4.88	5.12	4.71
0% NaP85 + 0.75% NaCl	4.61	5.50	5.06	5.27	4.87
Control (no injection)	4.24	4.12	4.59	3.80	3.79
Processed meat-like bite[d]	.0001		2.393		
0.1% NaP85 + 0.375% NaCl	10.51	10.25	10.67	8.01	9.80
0.1% NaP85 + 1.125% NaCl	11.84	9.93	10.50	10.38	9.13
2.0% NaP85 + 0% NaCl	9.65	10.75	10.67	10.33	8.21
0.2% NaP85 + 0.75% NaCl	7.61	10.31	9.38	9.17	10.80
0.2% NaP85 + 1.5% NaCl	10.61	9.31	10.44	11.27	11.05
0.3% NaP85 + 0.375% NaCl	12.08	9.93	9.73	11.12	8.63
0.3% NaP85 + 1.125% NaCl	10.18	9.93	9.91	10.75	11.13
0.4% NaP85 + 0.75% NaCl	9.51	10.68	9.38	10.22	9.13
0% NaP85 + 0.75% NaCl	9.06	11.00	9.67	10.08	8.71
Control (no injection)	7.75	6.25	7.50	6.80	5.96

[a]Sample evaluation on a 8-point scale for 0 = extremely tough; dry and 15 = extremely tender;juicy.
[b] P- value from Analysis of Variance table of SAS (1999).
[c] Root mean squares error.
[d] Sample evaluation on a 15-point scale for 0 = not processed and 15 = extremely processed.
[1]NaP85: sodium phosphate 85, [2]NaCl: sodium chloride.

APPENDIX S

LEAST SQUARES MEANS FOR SUBJECTIVE COLOR FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 2 (n = 850)

Treatment	Storage Time, days 0	7	14	21	28
Color[a]	.0001[b]		0.761[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	2.58	2.74	2.00	2.36	2.36
0.1% NaP85 + 1.125% NaCl	3.30	3.05	2.82	2.41	2.11
2.0% NaP85 + 0% NaCl	2.91	2.42	2.35	2.88	2.20
0.2% NaP85 + 0.75% NaCl	2.68	2.24	2.00	2.20	1.70
0.2% NaP85 + 1.5% NaCl	3.63	3.24	2.94	3.31	2.78
0.3% NaP85 + 0.375% NaCl	2.87	1.99	2.53	1.99	2.03
0.3% NaP85 + 1.125% NaCl	3.30	3.24	2.82	2.73	2.95
0.4% NaP85 + 0.75% NaCl	3.58	3.17	3.06	3.04	3.45
0% NaP85 + 0.75% NaCl	2.84	2.17	2.29	2.53	2.28
Control (no injection)	2.34	2.30	2.12	2.41	1.95
Amount of Discoloration[d]	.0001		0.847		
0.1% NaP85 + 0.375% NaCl	2.43	1.80	2.32	1.74	1.39
0.1% NaP85 + 1.125% NaCl	2.14	2.17	2.03	2.00	1.72
2.0% NaP85 + 0% NaCl	1.52	2.24	1.15	1.11	1.22
0.2% NaP85 + 0.75% NaCl	1.85	1.74	1.79	1.27	1.30
0.2% NaP85 + 1.5% NaCl	1.43	2.30	1.38	2.16	1.72
0.3% NaP85 + 0.375% NaCl	2.24	2.49	1.74	1.27	1.64
0.3% NaP85 + 1.125% NaCl	1.66	1.49	1.91	1.27	1.30
0.4% NaP85 + 0.75% NaCl	1.38	1.74	1.44	1.32	1.30
0% NaP85 + 0.75% NaCl	1.91	2.67	1.97	1.67	1.72
Control (no injection)	1.19	1.42	1.38	1.37	1.47
Color of Discoloration (n = 460)	.2170		0.944		
0.1% NaP85 + 0.375% NaCl	2.82	3.67	2.53	2.97	2.51
0.1% NaP85 + 1.125% NaCl	2.99	3.10	2.64	2.98	3.08
2.0% NaP85 + 0% NaCl	2.59	3.61	2.60	3.40	2.28
0.2% NaP85 + 0.75% NaCl	3.12	2.44	2.79	3.17	2.16
0.2% NaP85 + 1.5% NaCl	2.61	3.19	2.72	3.28	3.64
0.3% NaP85 + 0.375% NaCl	3.12	3.21	3.09	2.32	2.50
0.3% NaP85 + 1.125% NaCl	3.02	3.14	2.97	3.08	3.82
0.4% NaP85 + 0.75% NaCl	2.57	2.65	2.71	2.97	3.36
0% NaP85 + 0.75% NaCl	3.23	2.93	2.43	3.11	3.02
Control (no injection)	2.60	3.15	2.93	2.75	2.76

[a]Sample evaluation for Color and Color of Discoloration on a 6-point National Pork Board color scale for 1=extremely light and 6=extremely dark
[b] P- value from Analysis of Variance table of SAS (1999).
[c] Root mean squares error
[d]Sample evaluation for Amount of Discoloration on a 7-point scale, 1 = no discoloration and 7 = 100% discoloration.
[1]NaP85: sodium phosphate 85, [2]NaCl: sodium chloride.

APPENDIX T

LEAST SQUARES MEANS FOR OBJECTIVE COLOR FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 2 (n = 150)

	Storage Time, days				
Treatment	0	7	14	21	28
*L**	.0727[a]		8.413[b]		
0.1% NaP85[1] + 0.375% Na[2]	43.79	53.50	58.14	56.91	57.43
0.1% NaP85 + 1.125% NaCl	41.12	55.11	54.57	54.49	56.06
2.0% NaP85 + 0% NaCl	42.25	54.35	56.57	55.78	55.72
0.2% NaP85 + 0.75% NaCl	41.58	55.54	57.23	55.22	57.16
0.2% NaP85 + 1.5% NaCl	42.28	51.30	53.69	51.25	54.53
0.3% NaP85 + 0.375% NaCl	43.08	56.81	55.56	56.82	57.67
0.3% NaP85 + 1.125% NaCl	38.76	51.24	53.73	53.34	53.62
0.4% NaP85 + 0.75% NaCl	40.73	50.93	54.24	51.98	53.08
0% NaP85 + 0.75% NaCl	39.71	56.40	57.31	54.98	57.18
Control (no injection)	41.42	54.54	55.10	55.18	56.93
*a**	.0046		1.941		
0.1% NaP85 + 0.375% NaCl	3.81	6.40	7.37	6.82	7.98
0.1% NaP85 + 1.125% NaCl	4.50	7.18	7.43	7.12	7.32
2.0% NaP85 + 0% NaCl	5.81	7.54	8.51	7.69	8.15
0.2% NaP85 + 0.75% NaCl	3.89	7.09	6.70	5.93	6.87
0.2% NaP85 + 1.5% NaCl	4.49	6.64	7.81	6.44	6.80
0.3% NaP85 + 0.375% NaCl	2.78	7.34	7.28	7.55	7.26
0.3% NaP85 + 1.125% NaCl	3.34	5.98	6.65	5.88	5.68
0.4% NaP85 + 0.75% NaCl	3.65	7.02	7.09	7.29	7.18
0% NaP85 + 0.75% NaCl	4.92	6.57	7.92	8.73	7.23
Control (no injection)	5.62	9.11	9.34	8.77	9.38
*b**	.0001		1.355		
0.1% NaP85 + 0.375% NaCl	2.55	3.72	5.27	4.86	5.70
0.1% NaP85 + 1.125% NaCl	2.39	4.23	3.94	3.71	4.17
2.0% NaP85 + 0% NaCl	3.37	3.97	5.75	4.52	4.81
0.2% NaP85 + 0.75% NaCl	1.53	4.85	4.44	3.58	4.66
0.2% NaP85 + 1.5% NaCl	1.85	3.13	4.83	3.04	3.84
0.3% NaP85 + 0.375% NaCl	1.87	5.57	4.15	5.12	4.27
0.3% NaP85 + 1.125% NaCl	1.30	2.55	3.40	2.96	2.66
0.4% NaP85 + 0.75% NaCl	1.03	3.00	4.11	3.89	3.69
0% NaP85 + 0.75% NaCl	2.34	4.13	5.08	5.53	4.19
Control (no injection)	2.61	6.00	6.53	5.23	6.08

[a] P- value from Analysis of Variance table of SAS (1999).
[b] Root mean squares error
[1]NaP85: sodium phosphate 85, [2]NaCl: sodium chloride.

APPENDIX U

LEAST SQUARES MEANS FOR COOK TIME, COOK LOSS, AND PACKAGE PURGE FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 2 (n = 140)

	Storage Time, days				
Treatment	0	7	14	21	28
Cook time[a]	.0578[b]		4.039[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	18.00	22.67	19.33	18.67	14.11
0.1% NaP85 + 1.125% NaCl	24.33	18.67	15.67	20.67	19.11
2.0% NaP85 + 0% NaCl	27.33	17.33	17.00	21.00	19.61
0.2% NaP85 + 0.75% NaCl	20.67	19.67	18.33	17.67	14.11
0.2% NaP85 + 1.5% NaCl	24.33	18.67	19.00	20.00	18.11
0.3% NaP85 + 0.375% NaCl	17.33	17.67	14.67	17.33	18.61
0.3% NaP85 + 1.125% NaCl	18.67	18.67	18.67	24.33	13.61
0.4% NaP85 + 0.75% NaCl	20.33	15.00	16.67	16.00	17.61
0% NaP85 + 0.75% NaCl	21.00	15.00	22.67	15.67	14.61
Control (no injection)	18.33	23.00	18.00	20.33	21.61
Cook loss	.0746		4.803		
0.1% NaP85 + 0.375% NaCl	15.31	21.03	17.21	19.54	10.33
0.1% NaP85 + 1.125% NaCl	20.31	16.74	15.36	19.49	18.41
2.0% NaP85 + 0% NaCl	25.13	19.04	17.61	19.47	21.96
0.2% NaP85 + 0.75% NaCl	22.01	18.60	16.09	15.47	16.25
0.2% NaP85 + 1.5% NaCl	20.36	15.92	12.63	17.00	13.89
0.3% NaP85 + 0.375% NaCl	13.63	15.99	16.11	17.02	21.88
0.3% NaP85 + 1.125% NaCl	13.90	16.29	15.57	19.62	14.81
0.4% NaP85 + 0.75% NaCl	18.33	11.99	13.31	14.32	14.51
0% NaP85 + 0.75% NaCl	21.64	15.27	20.76	13.94	16.48
Control (no injection)	23.32	26.99	15.61	20.98	20.01
Package purge (n = 120)	.0003		1.848		
0.1% NaP85 + 0.375% NaCl	.	4.54	7.41	8.85	9.37
0.1% NaP85 + 1.125% NaCl	.	5.63	6.22	5.91	7.84
2.0% NaP85 + 0% NaCl	.	7.79	9.27	9.00	10.93
0.2% NaP85 + 0.75% NaCl	.	5.45	6.36	7.07	6.64
0.2% NaP85 + 1.5% NaCl	.	4.44	5.21	5.14	5.44
0.3% NaP85 + 0.375% NaCl	.	7.38	7.63	8.56	9.42
0.3% NaP85 + 1.125% NaCl	.	5.25	5.73	5.11	6.59
0.4% NaP85 + 0.75% NaCl	.	5.88	6.51	5.81	6.77
0% NaP85 + 0.75% NaCl	.	5.73	5.69	8.06	8.37
Control (no injection)	.	6.95	8.54	9.40	10.66

[a] P- value from Analysis of Variance table of SAS (1999).
[b] Root mean squares error
[1]NaP85: sodium phosphate 85, [2]NaCl: sodium chloride

APPENDIX V

LEAST SQUARES MEANS FOR PH AND DRIP LOSS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 2 (n = 150)

	Storage Time, days				
Treatment	0	7	14	21	28
pH[a]	.7787[b]		0.267[c]		
0.1% NaP85[1] + 0.375% NaCl[2]	5.96	6.11	5.81	5.82	5.93
0.1% NaP85 + 1.125% NaCl	5.72	5.88	5.62	5.63	5.78
2.0% NaP85 + 0% NaCl	5.94	6.11	5.97	5.93	5.95
0.2% NaP85 + 0.75% NaCl	5.62	5.79	5.64	5.84	5.72
0.2% NaP85 + 1.5% NaCl	5.90	6.11	5.62	5.88	5.96
0.3% NaP85 + 0.375% NaCl	5.74	5.98	5.81	5.82	5.97
0.3% NaP85 + 1.125% NaCl	5.78	6.05	5.89	6.00	5.89
0.4% NaP85 + 0.75% NaCl	5.81	5.93	5.88	5.93	5.96
0% NaP85 + 0.75% NaCl	5.77	5.85	5.70	5.86	5.81
Control (no injection)	5.62	5.79	5.60	5.57	5.80
Drip loss	.7924		4.155		
0.1% NaP85 + 0.375% NaCl	5.15	5.85	4.50	13.15	5.00
0.1% NaP85 + 1.125% NaCl	4.35	4.65	3.35	6.65	5.00
2.0% NaP85 + 0% NaCl	8.65	6.65	6.85	6.65	5.65
0.2% NaP85 + 0.75% NaCl	6.00	5.00	3.65	6.85	5.35
0.2% NaP85 + 1.5% NaCl	2.50	4.00	3.85	9.85	4.65
0.3% NaP85 + 0.375% NaCl	5.65	5.65	4.00	6.50	4.65
0.3% NaP85 + 1.125% NaCl	3.50	3.85	3.35	6.85	5.00
0.4% NaP85 + 0.75% NaCl	4.00	3.35	3.15	7.65	4.50
0% NaP85 + 0.75% NaCl	5.15	4.15	4.50	6.85	5.35
Control (no injection)	7.15	5.00	5.15	13.35	4.35

[a] P- value from Analysis of Variance table of SAS (1999).
[b] Root mean squares error
[1]NaP85: sodium phosphate 85, [2]NaCl: sodium chloride

APPENDIX W

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR AROMATICS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 3

(n = 666)

	Storage Time, days				
Treatment	0	7	14	21	28
Pork lean/brothy[a]	.0001[b]	0.916[c]			
1.0% NaL [1]+ 0.1% NaP85[2]	6.75	6.80	6.34	5.87	5.94
1.0% NaL + 0.3% NaP85	6.56	6.47	6.03	6.24	5.87
2.0% NaL + 0% NaP85	6.50	6.13	6.26	6.42	5.94
2.0% NaL + 0.2% NaP85	6.44	6.53	6.34	6.24	6.37
2.0% NaL + 0.4% NaP85	6.37	6.67	6.34	6.42	5.65
3.0% NaL + 0.1% NaP85	6.19	6.00	5.41	6.33	5.58
3.0% NaL + 0.3% NaP85	6.12	6.13	6.03	6.20	5.58
4.0% NaL + 0.2% NaP85	6.56	6.07	5.49	6.14	5.72
0% NaL + 0.2% NaP85	6.25	6.47	6.34	5.60	5.87
Control (no injection)	5.90	5.24	5.05	5.86	4.72
Pork fat	.0001	0.526			
1.0% NaL + 0.1% NaP85	1.97	2.07	2.10	2.32	2.20
1.0% NaL + 0.3% NaP85	1.85	2.27	2.02	2.41	1.99
2.0% NaL + 0% NaP85	1.97	2.27	1.72	2.23	1.99
2.0% NaL + 0.2% NaP85	1.72	2.21	1.95	2.04	2.34
2.0% NaL + 0.4% NaP85	1.97	2.14	2.02	2.41	2.27
3.0% NaL + 0.1% NaP85	1.91	1.94	1.64	2.50	2.06
3.0% NaL + 0.3% NaP85	1.78	2.14	1.79	2.23	2.13
4.0% NaL + 0.2% NaP85	1.78	2.01	1.64	2.50	2.13
0% NaL + 0.2% NaP85	2.03	2.14	2.18	2.13	1.92
Control (no injection)	1.57	1.61	1.12	2.75	1.36
Soda	.0001	0.722			
1.0% NaL + 0.1% NaP85	2.00	1.64	2.07	1.66	1.78
1.0% NaL + 0.3% NaP85	1.75	1.50	1.69	2.12	2.14
2.0% NaL + 0% NaP85	1.44	1.90	1.61	1.48	1.71
2.0% NaL + 0.2% NaP85	2.06	1.77	2.07	1.66	2.21
2.0% NaL + 0.4% NaP85	1.81	1.90	2.15	2.03	1.85
3.0% NaL + 0.1% NaP85	1.81	1.84	1.92	1.66	1.92
3.0% NaL + 0.3% NaP85	1.94	2.24	1.99	1.63	2.00
4.0% NaL + 0.2% NaP85	2.31	2.04	1.84	1.57	1.57
0% NaL + 0.2% NaP85	1.37	1.84	1.30	1.85	1.50

Treatment	Storage Time, days				
	0	7	14	21	28
Chemical[a]	.0006[b]	0.555[c]			
1.0% NaL[1]+ 0.1% NaP85[2]	0.19	0.18	0.16	0.44	0.51
1.0% NaL + 0.3% NaP85	0.19	0.12	0.16	0.35	0.37
2.0% NaL + 0% NaP85	0.19	0.25	0.08	0.08	0.44
2.0% NaL + 0.2% NaP85	0.06	0.05	0.16	0.44	0.80
2.0% NaL + 0.4% NaP85	0.25	-0.02	0.31	0.26	0.65
3.0% NaL + 0.1% NaP85	0.31	0.25	0.54	0.35	0.72
3.0% NaL + 0.3% NaP85	0.31	0.12	0.16	0.26	0.72
4.0% NaL + 0.2% NaP85	0.38	0.18	0.23	0.44	0.51
0% NaL + 0.2% NaP85	0.19	0.12	0.23	0.81	0.65
Control (no injection)	0.20	0.16	0.36	0.06	0.74
Browned	.0008	0.619			
1.0% NaL + 0.1% NaP85	0.15	0.23	0.47	0.24	0.21
1.0% NaL + 0.3% NaP85	0.34	0.23	0.47	0.06	0.43
2.0% NaL + 0% NaP85	0.15	0.23	0.77	0.51	0.50
2.0% NaL + 0.2% NaP85	0.15	0.23	0.70	0.24	0.71
2.0% NaL + 0.4% NaP85	0.15	0.23	0.54	1.33	0.28
3.0% NaL + 0.1% NaP85	0.15	0.23	0.31	0.33	0.43
3.0% NaL + 0.3% NaP85	0.27	0.23	0.47	0.53	0.43
4.0% NaL + 0.2% NaP85	0.27	0.23	0.47	0.42	0.35
0% NaL + 0.2% NaP85	0.15	0.23	0.85	0.15	0.21
Control (no injection)	0.19	0.32	0.99	0.41	0.08
Soapy	.2681	0.256			
1.0% NaL + 0.1% NaP85	0.22	0.15	0.16	0.05	0.15
1.0% NaL + 0.3% NaP85	0.09	0.08	0.09	0.14	0.01
2.0% NaL + 0% NaP85	0.16	0.01	0.09	0.05	0.01
2.0% NaL + 0.2% NaP85	0.22	0.08	0.01	0.05	0.08
2.0% NaL + 0.4% NaP85	0.16	0.15	0.01	0.05	0.15
3.0% NaL + 0.1% NaP85	0.16-	0.05	-0.07	0.14	0.08
3.0% NaL + 0.3% NaP85	0.03	0.08	0.09	0.25	0.01
4.0% NaL + 0.2% NaP85	0.16	0.08	-0.07	0.05	0.01
0% NaL + 0.2% NaP85	0.09	0.08	0.01	-0.04	0.08
Control (no injection)	0.07-	0.05	-0.06	-0.03	0.05

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaL: sodium lactate, [2]NaP85: sodium phosphate 85

APPENDIX X

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR BASIC TASTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 3

(n = 666)

	Storage Time, days				
Treatment	0	7	14	21	28
Sour[a]	.0001[b]		0.502[c]		
1.0% NaL[1] + 0.1% NaP85[2]	2.40	2.30	2.44	2.77	2.55
1.0% NaL + 0.3% NaP85	2.33	2.23	2.44	2.59	2.48
2.0% NaL + 0% NaP85	2.15	2.30	2.20	2.22	2.19
2.0% NaL + 0.2% NaP85	2.65	2.43	2.59	2.59	2.69
2.0% NaL + 0.4% NaP85	2.40	2.43	2.59	2.59	2.62
3.0% NaL + 0.1% NaP85	2.58	2.56	2.74	2.68	2.76
3.0% NaL + 0.3% NaP85	2.58	2.50	2.44	2.45	2.48
4.0% NaL + 0.2% NaP85	2.58	2.36	2.59	2.49	2.41
0% NaL + 0.2% NaP85	2.21	2.10	2.13	2.86	2.41
Control (no injection)	2.18	1.89	2.37	1.95	2.34
Bitter	.0002		0.511		
1.0% NaL + 0.1% NaP85	2.14	2.30	2.32	2.28	2.43
1.0% NaL + 0.3% NaP85	2.20	2.30	2.32	2.37	2.43
2.0% NaL + 0% NaP85	2.01	2.37	2.32	2.28	2.28
2.0% NaL + 0.2% NaP85	2.39	2.44	2.32	2.46	2.64
2.0% NaL + 0.4% NaP85	2.26	2.24	2.55	2.46	2.43
3.0% NaL + 0.1% NaP85	2.51	2.37	2.63	2.28	2.71
3.0% NaL + 0.3% NaP85	2.58	2.37	2.40	2.55	2.71
4.0% NaL + 0.2% NaP85	2.58	2.24	2.24	2.46	2.64
0% NaL + 0.2% NaP85	2.39	2.44	2.32	2.83	2.64
Control (no injection)	2.54	3.25	2.48	2.63	2.82
Sweet	.0507		0.422		
1.0% NaL + 0.1% NaP85	0.20	0.26	0.29	0.22	-0.01
1.0% NaL + 0.3% NaP85	0.14	0.13	0.21	0.04	-0.01
2.0% NaL + 0% NaP85	0.52	0.26	0.29	0.40	0.21
2.0% NaL + 0.2% NaP85	0.14	0.19	0.13	0.13	0.21
2.0% NaL + 0.4% NaP85	0.14	0.13	0.13	0.22	-0.01
3.0% NaL + 0.1% NaP85	0.08	-0.01	-0.02	0.22	-0.01
3.0% NaL + 0.3% NaP85	0.02	0.19	0.06	-0.06	-0.01
4.0% NaL + 0.2% NaP85	0.14	0.19	0.06	0.22	-0.01
0% NaL + 0.2% NaP85	0.14	0.26	0.60	0.13	0.06
Control (no injection)	0.16	0.05	0.37	0.38	0.05

Treatment	Storage Time, days				
	0	7	14	21	28
Salt[a]	.0001[b]		1.459[c]		
1.0% NaL[1] + 0.1% NaP85[2]	3.88	3.48	4.87	4.76	4.88
1.0% NaL + 0.3% NaP85	3.63	3.34	3.64	6.21	4.88
2.0% NaL + 0% NaP85	3.19	3.61	3.87	4.85	4.45
2.0% NaL + 0.2% NaP85	5.06	3.94	4.56	4.67	6.38
2.0% NaL + 0.4% NaP85	4.56	3.81	5.41	5.30	5.88
3.0% NaL + 0.1% NaP85	5.25	3.88	5.25	4.67	5.81
3.0% NaL + 0.3% NaP85	5.38	4.01	3.79	5.20	5.66
4.0% NaL + 0.2% NaP85	5.19	3.61	4.10	4.67	4.45
0% NaL + 0.2% NaP85	3.38	3.61	3.48	4.76	4.73
Control (no injection)	2.41	1.91	2.29	2.55	2.77

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaL: sodium lactate, [2]NaP85: sodium phosphate 85

APPENDIX Y

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE MOUTHFEELS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 3 (n = 666)

	Storage Time, days				
Treatment	0	7	14	21	28
Metallic[a]	.0001[b]		0.632[c]		
1.0% NaL[1] + 0.1% NaP85[2]	2.47	1.99	2.78	2.69	2.68
1.0% NaL + 0.3% NaP85	2.41	1.72	2.24	2.78	2.60
2.0% NaL + 0% NaP85	2.29	2.52	2.32	2.42	2.39
2.0% NaL + 0.2% NaP85	2.41	2.12	2.62	2.69	2.75
2.0% NaL + 0.4% NaP85	2.35	2.59	2.55	2.60	2.68
3.0% NaL + 0.1% NaP85	2.79	2.05	2.62	2.51	2.75
3.0% NaL + 0.3% NaP85	2.60	2.19	2.62	2.62	2.89
4.0% NaL + 0.2% NaP85	2.60	2.05	2.55	2.69	2.68
0% NaL + 0.2% NaP85	2.47	2.32	2.09	2.60	2.60
Control (no injection)	2.37	2.16	2.59	2.16	2.66
Astringent	.0001		0.682		
1.0% NaL + 0.1% NaP85	2.68	2.08	2.94	3.01	2.96
1.0% NaL + 0.3% NaP85	2.55	1.88	2.47	3.01	2.96
2.0% NaL + 0% NaP85	2.43	2.62	2.47	2.83	2.46
2.0% NaL + 0.2% NaP85	2.49	2.28	2.86	3.01	3.03
2.0% NaL + 0.4% NaP85	2.49	2.62	2.78	2.92	2.96
3.0% NaL + 0.1% NaP85	2.93	2.08	3.09	2.83	2.96
3.0% NaL + 0.3% NaP85	2.86	2.35	2.78	2.69	2.89
4.0% NaL + 0.2% NaP85	2.74	2.08	2.70	3.01	2.89
0% NaL + 0.2% NaP85	2.43	2.68	2.40	3.01	2.89
Control (no injection)	2.33	2.23	2.52	2.47	2.50

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaL: sodium lactate, [2]NaP85: sodium phosphate 85

APPENDIX Z

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR AFTERTASTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 3

		Storage Time, days				
Treatment		0	7	14	21	28
Sour[a]	(n = 666)	.0039	0.780			
1.0% NaL[1] + 0.1% NaP85[2]		0.82	0.34	0.98	1.18	1.21
1.0% NaL + 0.3% NaP85		1.20	0.68	0.67	1.18	0.78
2.0% NaL + 0% NaP85		0.45	0.54	0.90	0.55	0.92
2.0% NaL + 0.2% NaP85		1.26	0.68	1.21	1.18	1.49
2.0% NaL + 0.4% NaP85		0.82	0.61	0.82	1.09	0.92
3.0% NaL + 0.1% NaP85		1.01	0.94	1.21	1.27	1.14
3.0% NaL + 0.3% NaP85		0.95	0.94	0.90	0.56	1.07
4.0% NaL + 0.2% NaP85		1.14	0.48	1.21	1.09	0.99
0% NaL + 0.2% NaP85		0.89	0.48	0.75	1.45	0.92
Control (no injection)		0.65	0.63	0.74	0.21	1.09
Salty	(n = 663)	.0001	1.006			
1.0% NaL + 0.1% NaP85		1.56	1.27	1.93	1.68	1.78
1.0% NaL + 0.3% NaP85		1.18	1.27	2.01	2.77	1.99
2.0% NaL + 0% NaP85		1.06	1.67	1.93	1.96	1.63
2.0% NaL + 0.2% NaP85		2.12	1.61	2.16	1.96	2.92
2.0% NaL + 0.4% NaP85		2.06	1.67	2.09	1.86	2.13
3.0% NaL + 0.1% NaP85		2.56	1.87	2.47	1.86	2.63
3.0% NaL + 0.3% NaP85		2.43	1.88	2.01	2.67	2.49
4.0% NaL + 0.2% NaP85		2.56	1.27	1.62	1.50	1.35
0% NaL + 0.2% NaP85		1.00	1.80	1.16	1.68	1.85
Control (no injection)		0.41	0.59	0.48	0.56	0.20
Bitter	(n = 664)	.0001	0.864			
1.0% NaL + 0.1% NaP85		0.88	1.03	0.78	1.09	1.27
1.0% NaL + 0.3% NaP85		1.13	0.77	0.55	1.00	1.35
2.0% NaL + 0% NaP85		0.88	0.77	0.47	0.82	0.56
2.0% NaL + 0.2% NaP85		0.94	0.70	0.93	1.46	1.13
2.0% NaL + 0.4% NaP85		0.75	0.37	0.70	1.27	1.35
3.0% NaL + 0.1% NaP85		1.31	0.70	0.93	1.27	1.56
3.0% NaL + 0.3% NaP85		1.00	1.03	0.55	1.34	1.35
4.0% NaL + 0.2% NaP85		1.35	0.83	0.47	1.64	1.42
0% NaL + 0.2% NaP85		1.13	0.97	0.55	1.91	1.27
Control (no injection)		1.59	1.13	1.15	1.80	1.60

Treatment		Storage Time, days				
		0	7	14	21	28
Soapy[a]	(n = 665)	.5816[b]		0.345[c]		
1.0% NaL + 0.1% NaP85		0.15	0.22	0.17	0.02	0.00
1.0% NaL + 0.3% NaP85		0.09	0.22	0.09	0.11	0.00
2.0% NaL + 0% NaP85		0.15	0.15	0.09	0.02	-0.07
2.0% NaL + 0.2% NaP85		0.15	0.15	0.09	0.02	0.00
2.0% NaL + 0.4% NaP85		0.15	0.03	0.01	0.02	0.00
3.0% NaL + 0.1% NaP85		0.09	0.15	-0.06	-0.07	-0.07
3.0% NaL + 0.3% NaP85		0.03	0.08	0.09	0.22	0.00
4.0% NaL + 0.2% NaP85		0.28	0.08	-0.06	0.02	0.00
0% NaL + 0.2% NaP85		0.03	0.22	0.01	-0.07	-0.07
Control (no injection)		0.04	0.15	-0.06	-0.09	-0.08
Mouthburn	(n = 666)	.3363	0.660			
1.0% NaL + 0.1% NaP85		0.11	0.05	0.20	0.38	0.14
1.0% NaL + 0.3% NaP85		0.43	0.05	0.58	0.38	0.29
2.0% NaL + 0% NaP85		0.05	0.19	0.20	0.38	0.43
2.0% NaL + 0.2% NaP85		0.49	0.19	0.20	0.20	0.21
2.0% NaL + 0.4% NaP85		0.18	0.05	0.89	0.74	0.00
3.0% NaL + 0.1% NaP85		0.30	0.05	0.28	0.20	0.14
3.0% NaL + 0.3% NaP85		0.30	0.19	0.58	0.41	0.29
4.0% NaL + 0.2% NaP85		0.18	0.05	0.51	0.29	0.14
0% NaL + 0.2% NaP85		0.30	0.19	0.51	0.47	0.29
Control (no injection)		0.11	-0.09	0.12	0.05	0.25
Soda	(n = 666)	.0001	0.782			
1.0% NaL + 0.1% NaP85		0.68	0.84	1.29	1.51	1.50
1.0% NaL + 0.3% NaP85		0.68	0.84	1.29	1.88	1.36
2.0% NaL + 0% NaP85		0.74	1.04	1.44	1.42	1.22
2.0% NaL + 0.2% NaP85		0.93	0.97	1.52	1.70	1.65
2.0% NaL + 0.4% NaP85		1.05	1.10	1.68	1.61	1.57
3.0% NaL + 0.1% NaP85		1.30	1.04	1.83	1.42	1.57
3.0% NaL + 0.3% NaP85		1.12	1.10	1.91	1.24	1.72
4.0% NaL + 0.2% NaP85		1.24	1.10	1.68	1.51	1.22
0% NaL + 0.2% NaP85		0.62	0.97	1.14	1.51	1.29
Control (no injection)		0.81	0.77	0.68	0.44	0.53

Treatment		0	7	14	21	28
		Storage Time, days				
Browned[A]	(n = 666)	.1240[b]	0.436[c]			
1.0% NaL[1]+ 0.1% NaP85[2]		0.06	0.03	0.33	0.26	0.15
1.0% NaL + 0.3% NaP85		0.12	0.03	0.25	-0.02	0.01
2.0% NaL + 0% NaP85		0.06	0.03	0.48	0.26	0.15
2.0% NaL + 0.2% NaP85		0.06	0.03	0.02	0.17	0.22
2.0% NaL + 0.4% NaP85		0.06	0.03	0.33	0.62	0.01
3.0% NaL + 0.1% NaP85		0.06	0.03	0.18	0.17	0.15
3.0% NaL + 0.3% NaP85		0.06	0.03	0.18	0.42	0.01
4.0% NaL + 0.2% NaP85		0.06	0.03	0.33	0.26	0.01
0% NaL + 0.2% NaP85		0.06	0.03	0.25	0.17	0.15
Control (no injection)		0.08	0.04	0.37	0.02	0.01
Chemical	(n = 666)	.4169	0.206			
1.0% NaL + 0.1% NaP85		0.01	-0.01	-0.01	0.00	-0.01
1.0% NaL + 0.3% NaP85		0.01	-0.01	-0.01	0.00	-0.01
2.0% NaL + 0% NaP85		0.01	-0.01	-0.01	0.00	-0.01
2.0% NaL + 0.2% NaP85		0.01	-0.01	-0.01	0.00	-0.01
2.0% NaL + 0.4% NaP85		0.01	-0.01	-0.01	0.00	-0.01
3.0% NaL + 0.1% NaP85		0.14	-0.01	-0.01	0.00	0.13
3.0% NaL + 0.3% NaP85		0.14	-0.01	-0.01	0.01	-0.01
4.0% NaL + 0.2% NaP85		0.14	-0.01	-0.01	0.00	0.13
0% NaL + 0.2% NaP85		0.20	-0.01	-0.01	0.00	-0.01
Control (no injection)		0.19	-0.02	-0.01	0.01	-0.01
Metallic	(n = 664)	.4378	0.535			
1.0% NaL + 0.1% NaP85		0.75	0.64	0.43	0.65	0.64
1.0% NaL + 0.3% NaP85		0.60	0.51	0.43	0.56	0.57
2.0% NaL + 0% NaP85		0.73	0.58	0.43	0.56	0.71
2.0% NaL + 0.2% NaP85		0.48	0.58	0.59	0.56	0.57
2.0% NaL + 0.4% NaP85		0.85	0.58	0.43	0.56	0.50
3.0% NaL + 0.1% NaP85		0.91	0.51	0.59	0.65	0.71
3.0% NaL + 0.3% NaP85		0.66	0.44	0.51	0.77	0.86
4.0% NaL + 0.2% NaP85		0.82	0.44	0.43	0.74	0.78
0% NaL + 0.2% NaP85		0.85	0.44	0.59	0.74	0.64
Control (no injection)		0.44	0.52	0.95	0.56	1.09

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaL: sodium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AA

LEAST SQUARES MEANS FROM STORAGE DAY ANALYSIS FOR EXPERIMENT 3

Storage Day			
Sweet		(n = 666)	.0155[a]
0	0.16		
7	0.17		
14	0.23		
21	0.24		
28	0.06		
Aftertaste mouthburn		(n = 666)	.0054
0	0.32		
7	0.17		
14	0.51		
21	0.35		
28	0.22		
Aftertaste browned		(n = 666)	<.0001
0	0.01		
7	0.00		
14	0.25		
21	0.24		
28	0.08		
Aftertaste chemical		(n = 666)	.0091
0	0.08		
7	0.00		
14	0.00		
21	0.01		
28	0.03		
28			
Aftertaste soapy		(n = 665)	.0120
0	0.15		
7	0.19		
14	0.10		
21	0.08		
28	0.04		
Aftertaste metallic		(n = 665)	<.0001
0	0.47		
7	0.48		
14	0.39		
21	0.97		
28	0.85		

Storage Day			
Cook time		(n = 145)	.0003
0	19.35		
7	21.58		
14	21.48		
21	23.40		
28	17.61		
pH		(n = 144)	.0002
0	5.87		
7	5.82		
14	5.81		
21	5.71		
28	5.75		

[a] P- value from Analysis of Variance table of SAS (1999)

APPENDIX AB

LEAST SQUARES MEANS AND REGRESSION EQUATIONS FOR SWEET BASIC TASTE, PH, AND CIE A* COLOR SPACE VALUES FROM TREATMENT ANALYSIS FOR EXPERIMENT 3

Treatment	Least Squares Means			Regression Equation
Sweet	(n = 666)	.0059[a]	0.449[b]	
1.0% NaL + 0.1% NaP85	0.20			
1.0% NaL + 0.3% NaP85	0.12			
2.0% NaL + 0% NaP85	0.35			
2.0% NaL + 0.2% NaP85	0.18			
2.0% NaL + 0.4% NaP85	0.14			
3.0% NaL + 0.1% NaP85	0.07			
3.0% NaL + 0.3% NaP85	0.06			
4.0% NaL + 0.2% NaP85	0.14			
0% NaL + 0.2% NaP85	0.25			
Control (no injection)	0.22			
Intercept				0.84
Sodium lactate (NaL)				0.42
Sodium phosphates (NaP)				0.49
NaL x NaL				-0.25
NaP85 x NaL				0.21
NaP85 x NaP85				-2.09
R^2				63.25
pH	(n = 144)	.0269[a]	0.132[b]	
1.0% NaL + 0.1% NaP85	5.77			
1.0% NaL + 0.3% NaP85	5.75			
2.0% NaL + 0% NaP85	5.87			
2.0% NaL + 0.2% NaP85	5.78			
2.0% NaL + 0.4% NaP85	5.90			
3.0% NaL + 0.1% NaP85	5.74			
3.0% NaL + 0.3% NaP85	5.78			
4.0% NaL + 0.2% NaP85	5.78			
0% NaL + 0.2% NaP85	5.75			
Control (no injection)	5.80			
Intercept				5.81
Sodium lactate (NaL)				0.02
Sodium phosphates (NaP)				-0.94
NaL x NaL				-0.00
NaP85 x NaL				-0.01
NaP85 x NaP85				2.66
R^2				77.80

Treatment	Least Squares Means			Regression Equation
a*	(n = 143)	.0008[a]	1.284[b]	
1.0% NaL + 0.1% NaP85	6.87			
1.0% NaL + 0.3% NaP85	5.96			
2.0% NaL + 0% NaP85	7.27			
2.0% NaL + 0.2% NaP85	5.62			
2.0% NaL + 0.4% NaP85	5.97			
3.0% NaL + 0.1% NaP85	6.54			
3.0% NaL + 0.3% NaP85	6.42			
4.0% NaL + 0.2% NaP85	6.67			
0% NaL + 0.2% NaP85	7.23			
Control (no injection)	7.01			
Intercept				7.32
Sodium lactate (NaL)				-0.54
Sodium phosphates (NaP)				-4.26
NaL x NaL				0.19
NaP85 x NaL				-1.19
NaP85 x NaP85				10.39
R^2				66.78

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaL: sodium lactate, [2]NaP: sodium phosphate 85

APPENDIX AC

LEAST SQUARES MEANS FOR SENSORY MEAT DESCRIPTIVE TEXTURE ATTRIBUTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 3 (n = 666)

	Storage Time, days				
Treatment	0	7	14	21	28
Muscle fiber tenderness[a]	.0001[b]	1.149[c]			
1.0% NaL[1] + 0.1% NaP85[2]	6.30	7.43	7.34	6.79	6.85
1.0% NaL + 0.3% NaP85	4.93	5.83	6.19	7.33	6.35
2.0% NaL + 0% NaP85	7.36	6.97	6.03	6.43	6.14
2.0% NaL + 0.2% NaP85	5.99	6.43	6.34	6.52	7.28
2.0% NaL + 0.4% NaP85	6.55	6.90	6.80	7.24	7.07
3.0% NaL + 0.1% NaP85	5.43	5.90	6.65	6.52	6.43
3.0% NaL + 0.3% NaP85	5.05	6.17	6.11	6.03	6.85
4.0% NaL + 0.2% NaP85	5.68	6.23	5.72	6.06	6.00
0% NaL + 0.2% NaP85	5.68	6.50	6.49	6.70	6.85
Control (no injection)	5.44	5.69	5.32	6.48	6.14
Juiciness[a]	.0001	0.924			
1.0% NaL + 0.1% NaP85	4.80	5.19	5.24	5.27	5.14
1.0% NaL + 0.3% NaP85	3.93	4.73	4.47	5.54	4.57
2.0% NaL + 0% NaP85	4.93	4.99	4.39	5.00	4.57
2.0% NaL + 0.2% NaP85	5.30	4.59	4.85	5.27	5.07
2.0% NaL + 0.4% NaP85	5.05	4.86	4.70	5.09	4.79
3.0% NaL + 0.1% NaP85	4.18	4.39	4.47	4.54	4.50
3.0% NaL + 0.3% NaP85	4.05	4.86	4.47	4.05	4.64
4.0% NaL + 0.2% NaP85	4.61	4.39	4.01	4.63	4.79
0% NaL + 0.2% NaP85	4.43	4.93	4.70	5.09	4.64
Control (no injection)	4.27	4.32	4.03	4.64	4.12
Processed meat- like bite[c]	.0001	2.430			
1.0% NaL + 0.1% NaP85	8.35	10.96	11.14	10.53	10.70
1.0% NaL + 0.3% NaP85	5.98	6.56	8.83	11.35	9.41
2.0% NaL + 0% NaP85	9.79	9.49	8.06	9.44	8.98
2.0% NaL + 0.2% NaP85	8.73	8.76	8.98	9.44	11.34
2.0% NaL + 0.4% NaP85	9.54	9.49	10.21	10.89	10.70
3.0% NaL + 0.1% NaP85	6.54	7.36	9.29	9.44	9.27
3.0% NaL + 0.3% NaP85	5.60	8.23	8.45	8.81	10.20
4.0% NaL + 0.2% NaP85	7.04	8.43	7.68	8.44	8.56
0% NaL + 0.2% NaP85	7.98	8.26	9.60	9.98	9.56
Control (no injection)	6.83	6.42	6.07	8.46	6.96

[a]Sample evaluation on a 8-point scale for 0 = extremely tough; dry and 15 = extremely tender;juicy.
[b] P- value from Analysis of Variance table of SAS (1999).
[c] Root mean squares error.
[d] Sample evaluation on a 15-point scale for 0 = not processed and 15 = extremely processed.
[1]NaL: sodium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AD

LEAST SQUARES MEANS FOR SUBJECTIVE COLOR FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 3 (n = 666)

	Storage Time, days				
Treatment	0	7	14	21	28
Color[a]	.0001[b]	0.731[c]			
1.0% NaL[1] + 0.1% NaP85[2]	2.90	2.82	1.95	2.76	2.74
1.0% NaL + 0.3% NaP85	2.65	2.75	2.49	2.85	2.95
2.0% NaL + 0% NaP85	3.40	3.42	3.10	3.12	2.59
2.0% NaL + 0.2% NaP85	3.83	2.95	2.18	1.94	2.24
2.0% NaL + 0.4% NaP85	3.40	3.35	3.10	2.30	2.81
3.0% NaL + 0.1% NaP85	2.96	3.35	3.26	2.21	3.31
3.0% NaL + 0.3% NaP85	3.33	3.42	2.72	3.04	2.95
4.0% NaL + 0.2% NaP85	3.21	3.62	2.79	2.30	2.74
0% NaL + 0.2% NaP85	2.58	2.55	2.56	2.39	2.74
Control (no injection)	2.33	2.29	1.87	2.53	1.68
Amount of Discoloration	.0001	1.032			
1.0% NaL + 0.1% NaP85	1.93	1.45	2.44	1.72	1.84
1.0% NaL + 0.3% NaP85	2.12	2.85	2.82	3.54	1.84
2.0% NaL + 0% NaP85	1.87	2.32	1.28	1.36	1.34
2.0% NaL + 0.2% NaP85	1.87	2.45	1.67	1.72	2.55
2.0% NaL + 0.4% NaP85	1.62	2.32	1.90	3.36	1.98
3.0% NaL + 0.1% NaP85	2.06	1.72	1.67	1.09	1.12
3.0% NaL + 0.3% NaP85	2.06	2.52	1.98	1.73	2.27
4.0% NaL + 0.2% NaP85	2.25	2.25	1.82	1.91	1.91
0% NaL + 0.2% NaP85	2.12	2.98	2.05	1.91	1.48
Control (no injection)	1.41	1.90	1.68	1.39	1.71
Color of Discoloration (n = 397)	.0751	0.926			
1.0% NaL + 0.1% NaP85	2.78	3.11	2.94	2.55	2.62
1.0% NaL + 0.3% NaP85	2.48	2.42	2.87	3.18	3.00
2.0% NaL + 0% NaP85	2.89	3.10	2.43	2.48	3.13
2.0% NaL + 0.2% NaP85	3.22	3.04	2.72	3.07	2.43
2.0% NaL + 0.4% NaP85	3.67	2.92	2.93	3.06	2.78
3.0% NaL + 0.1% NaP85	3.00	3.32	2.76	2.38	2.79
3.0% NaL + 0.3% NaP85	2.64	3.55	1.99	2.69	2.82
4.0% NaL + 0.2% NaP85	2.49	2.96	3.75	3.07	3.40
0% NaL + 0.2% NaP85	2.35	2.78	1.98	3.00	3.07
Control (no injection)	2.31	2.40	2.16	2.78	2.58

[a] Sample evaluation for Color and Color of Discoloration on a 6-point National Pork Board color scale for 1=extremely light and 6=extremely dark.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[d]Sample evaluation for Amount of Discoloration on a 7-point scale, 1 = no discoloration and 7 = 100% discoloration.
[1]NaL: sodium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AE

LEAST SQUARES MEANS FOR OBJECTIVE COLOR FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 3 (n = 143)

	Storage Time, days				
Treatment	0	7	14	21	28
*L**	.0378[a]		2.479[b]		
1.0% NaL[1] + 0.1% NaP85[2]	51.76	52.11	53.66	53.96	53.97
3.0% NaL + 0.1% NaP85	50.28	51.44	49.91	53.75	51.82
1.0% NaL + 0.3% NaP85	52.51	52.86	52.18	52.30	52.88
3.0% NaL + 0.3% NaP85	51.21	52.13	52.15	51.07	55.29
0% NaL + 0.2% NaP85	53.76	54.43	54.44	54.63	54.31
4.0% NaL + 0.2% NaP85	51.41	51.31	50.99	56.13	55.13
2.0% NaL + 0% NaP85	50.76	52.21	51.12	53.53	53.80
2.0% NaL + 0.4% NaP85	49.95	51.29	51.96	53.28	54.55
2.0% NaL + 0.2% NaP85	49.30	51.29	51.11	56.56	54.55
Control (no injection)	54.22	55.99	54.21	55.40	57.39
*a**	.1563		1.128		
1.0% NaL + 0.1% NaP85	6.42	7.22	6.28	6.90	7.54
1.0% NaL + 0.3% NaP85	6.05	6.09	5.48	5.46	6.70
2.0% NaL + 0% NaP85	6.33	7.31	8.11	6.77	7.81
2.0% NaL + 0.2% NaP85	5.12	6.23	6.01	5.61	5.10
2.0% NaL + 0.4% NaP85	5.93	6.23	6.11	6.32	5.26
3.0% NaL + 0.1% NaP85	5.84	6.60	6.66	7.10	6.52
3.0% NaL + 0.3% NaP85	6.46	6.18	7.48	6.17	5.78
4.0% NaL + 0.2% NaP85	6.01	6.13	7.23	6.92	7.06
0% NaL + 0.2% NaP85	6.38	6.72	7.83	7.56	7.66
Control (no injection)	5.98	7.60	7.63	6.75	7.07
*b**	.0032		1.025		
1.0% NaL + 0.1% NaP85	3.02	3.90	3.32	3.56	4.08
1.0% NaL + 0.3% NaP85	3.10	2.82	2.39	1.75	3.30
2.0% NaL + 0% NaP85	2.82	3.57	3.29	3.21	4.03
2.0% NaL + 0.2% NaP85	1.43	3.08	2.26	3.28	2.63
2.0% NaL + 0.4% NaP85	1.85	3.08	3.00	3.14	3.21
3.0% NaL + 0.1% NaP85	1.26	3.87	2.34	4.12	2.50
3.0% NaL + 0.3% NaP85	2.76	2.14	3.26	2.23	2.97
4.0% NaL + 0.2% NaP85	2.35	2.69	2.90	4.29	3.92
0% NaL + 0.2% NaP85	3.22	3.93	4.40	3.76	3.87
Control (no injection)	2.89	5.08	4.89	4.95	4.96

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaL: sodium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AF

LEAST SQUARES MEANS FOR COOK TIME, COOK LOSS, AND PACKAGE PURGE FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 3 (n = 144)

	Storage Time, days				
Treatment	0	7	14	21	28
Cook time[a]	.2384[b]		4.923[c]		
1.0% NaL[1] + 0.1% NaP85[2]	19.67	20.33	21.00	19.00	18.33
1.0% NaL + 0.3% NaP85	25.67	24.00	20.00	24.33	17.33
2.0% NaL + 0% NaP85	18.67	16.00	24.00	21.67	15.67
.0% NaL + 0.2% NaP85	20.67	26.00	19.67	31.00	16.33
2.0% NaL + 0.4% NaP85	17.33	21.00	19.67	21.67	20.33
3.0% NaL + 0.1% NaP85	15.22	15.73	17.46	16.70	12.17
3.0% NaL + 0.3% NaP85	15.57	14.14	16.86	18.82	14.60
4.0% NaL + 0.2% NaP85	16.30	15.14	19.85	18.06	10.59
0% NaL + 0.2% NaP85	14.35	20.28	19.04	17.91	15.03
Control (no injection)	14.09	18.38	22.29	23.92	17.41
Cook loss (n = 144)	.0199		3.953		
1.0% NaL + 0.1% NaP85	14.39	17.28	18.47	15.27	13.14
1.0% NaL + 0.3% NaP85	23.56	17.66	19.87	17.47	12.49
2.0% NaL + 0% NaP85	16.83	13.47	20.56	16.42	11.10
2.0% NaL + 0.2% NaP85	14.66	20.63	16.65	14.82	11.27
2.0% NaL + 0.4% NaP85	11.47	15.76	16.38	14.34	14.41
3.0% NaL + 0.1% NaP85	15.22	15.73	17.46	16.70	12.17
3.0% NaL + 0.3% NaP85	15.57	14.14	16.86	18.82	14.60
4.0% NaL + 0.2% NaP85	16.30	15.14	19.85	18.06	10.59
0% NaL + 0.2% NaP85	14.35	20.28	19.04	17.91	15.03
Control (no injection)	14.09	18.38	22.29	23.92	17.41
Package purge (n = 116)	.0142		1.200		
1.0% NaL + 0.1% NaP85	0.00	5.21	4.46	4.27	5.80
1.0% NaL + 0.3% NaP85	0.00	5.39	4.44	2.42	4.81
2.0% NaL + 0% NaP85	0.00	4.58	4.73	4.39	4.99
2.0% NaL + 0.2% NaP85	0.00	4.48	4.74	6.93	4.06
2.0% NaL + 0.4% NaP85	0.00	4.07	4.28	3.97	4.71
3.0% NaL + 0.1% NaP85	0.00	4.46	4.50	5.22	5.04
3.0% NaL + 0.3% NaP85	0.00	4.24	4.81	3.87	4.66
4.0% NaL + 0.2% NaP85	0.00	4.60	4.72	5.37	6.09
0% NaL + 0.2% NaP85	0.00	5.07	5.77	5.52	5.53
Control (no injection)	0.00	5.80	7.74	5.64	8.16

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaL: sodium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AG

LEAST SQUARES MEANS FOR PH AND DRIP LOSS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 3

		Storage Time, days				
Treatment		0	7	14	21	28
pH	(n = 144)	.1405[a]	0.132[b]			
1.0% NaL[1] + 0.1% NaP85[2]		5.83	5.87	5.77	5.62	5.77
1.0% NaL + 0.3% NaP85		5.81	5.74	5.79	5.68	5.73
2.0% NaL + 0% NaP85		6.10	5.82	5.86	5.81	5.75
2.0% NaL + 0.2% NaP85		5.84	5.80	5.79	5.68	5.81
2.0% NaL + 0.4% NaP85		6.00	5.85	5.90	5.83	5.92
3.0% NaL + 0.1% NaP85		5.82	5.78	5.79	5.65	5.68
3.0% NaL + 0.3% NaP85		5.78	5.81	5.86	5.67	5.78
4.0% NaL + 0.2% NaP85		5.79	5.83	5.80	5.73	5.74
0% NaL + 0.2% NaP85		5.89	5.78	5.78	5.69	5.63
Control (no injection)		5.87	5.89	5.76	5.78	5.69
Drip loss	(n = 143)	.0040	1.290			
1.0% NaL + 0.1% NaP85		4.50	5.50	5.50	4.35	4.50
1.0% NaL + 0.3% NaP85		4.35	3.85	5.00	4.35	3.35
2.0% NaL + 0% NaP85		4.00	7.85	5.50	4.35	4.15
2.0% NaL + 0.2% NaP85		4.50	3.65	4.65	4.65	5.00
2.0% NaL + 0.4% NaP85		3.65	3.35	3.65	4.35	3.00
3.0% NaL + 0.1% NaP85		4.00	3.85	3.85	4.65	4.00
3.0% NaL + 0.3% NaP85		4.35	2.35	5.00	4.15	2.50
4.0% NaL + 0.2% NaP85		3.35	3.85	3.65	4.00	3.35
0% NaL + 0.2% NaP85		5.10	5.10	5.50	5.50	3.85
Control (no injection)		7.35	6.35	7.10	4.35	4.10

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaL: sodium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AH

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR AROMATICS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 4

(n = 665)

Treatment	Storage Time, days				
	0	7	14	21	28
Pork lean/brothy[a]	.0731[b]	1.497[c]			
1.0% KL[1] + 0.1% NaP85[2]	6.18	6.30	5.80	5.82	5.44
1.0% KL + 0.3% NaP85	6.56	6.16	5.80	6.32	8.27
2.0% KL + 0% NaP85	6.33	6.01	6.05	6.01	5.85
2.0% KL + 0.2% NaP85	6.06	6.08	6.38	6.13	5.69
2.0% KL + 0.4% NaP85	6.37	6.23	6.13	6.01	6.35
3.0% KL + 0.1% NaP85	5.87	6.30	5.97	6.38	5.60
3.0% KL + 0.3% NaP85	6.13	6.01	5.80	5.57	5.85
4.0% KL + 0.2% NaP85	5.93	6.44	6.13	6.07	5.60
0% KL + 0.2% NaP85	6.68	5.87	6.30	5.76	5.77
Control (no injection)	6.00	5.13	5.27	4.97	4.60
Pork fat	.0110	0.557			
1.0% KL + 0.1% NaP85	2.08	2.05	2.09	2.09	2.22
1.0% KL + 0.3% NaP85	1.95	1.91	1.59	2.34	2.14
2.0% KL + 0% NaP85	2.09	1.91	1.84	2.09	2.14
2.0% KL + 0.2% NaP85	1.83	2.05	2.09	2.21	2.14
2.0% KL + 0.4% NaP85	1.95	1.98	2.09	2.28	2.31
3.0% KL + 0.1% NaP85	1.83	2.20	2.01	2.28	2.22
3.0% KL + 0.3% NaP85	1.99	2.13	1.67	2.03	2.06
4.0% KL + 0.2% NaP85	1.76	2.05	1.76	2.28	2.22
0% KL + 0.2% NaP85	1.95	1.98	1.92	1.90	2.31
Control (no injection)	1.86	1.90	1.49	1.77	1.44
Soapy	.8680	0.426			
1.0% KL + 0.1% NaP85	0.10	0.31	0.01	0.10	0.06
1.0% KL + 0.3% NaP85	0.16	0.24	0.09	0.10	0.06
2.0% KL + 0% NaP85	0.04	0.31	0.17	0.10	0.06
2.0% KL + 0.2% NaP85	0.16	0.24	0.17	0.11	0.06
2.0% KL + 0.4% NaP85	0.16	0.24	0.01	0.04	-0.02
3.0% KL + 0.1% NaP85	0.10	0.31	0.01	0.16	0.15
3.0% KL + 0.3% NaP85	0.04	0.10	0.01	0.16	-0.02
4.0% KL + 0.2% NaP85	0.22	0.31	-0.08	0.10	0.06
0% KL + 0.2% NaP85	0.10	0.38	0.09	0.04	0.15
Control (no injection)	0.06	0.16	-0.09	-0.03	0.00

Treatment	Storage Time, days				
	0	7	14	21	28
Soda[a]	.0001[b]		0.835[c]		
1.0% KL[1] + 0.1% NaP85[2]	2.05	1.97	1.92	1.84	1.63
1.0% KL + 0.3% NaP85	1.61	1.54	1.67	2.03	1.72
2.0% KL + 0% NaP85	2.70	2.12	1.67	1.84	1.88
2.0% KL + 0.2% NaP85	2.11	1.83	2.34	2.15	2.22
2.0% KL + 0.4% NaP85	1.80	1.54	1.76	2.22	2.05
3.0% KL + 0.1% NaP85	2.17	2.12	1.67	2.34	2.30
3.0% KL + 0.3% NaP85	0.80	1.62	1.67	1.91	2.30
4.0% KL + 0.2% NaP85	1.92	2.26	2.17	2.03	1.88
0% KL + 0.2% NaP85	1.74	1.76	1.84	2.16	2.13
Control (no injection)	1.08	1.01	0.72	1.07	0.91
Chemical	.0040		0.727		
1.0% KL + 0.1% NaP85	0.40	0.38	0.45	0.55	0.48
1.0% KL + 0.3% NaP85	0.40	0.24	0.11	0.43	0.73
2.0% KL + 0% NaP85	0.40	0.38	0.20	0.55	0.82
2.0% KL + 0.2% NaP85	0.40	0.24	0.28	0.63	0.73
2.0% KL + 0.4% NaP85	0.40	0.38	0.28	0.43	0.90
3.0% KL + 0.1% NaP85	0.40	0.60	0.28	0.55	1.32
3.0% KL + 0.3% NaP85	0.40	0.10	0.03	0.30	0.82
4.0% KL + 0.2% NaP85	0.40	0.31	0.20	0.55	0.73
0% KL + 0.2% NaP85	0.40	0.17	0.28	0.11	0.90
Control (no injection)	0.40	0.20	0.34	0.34	0.52
Browned	.0001		0.749		
1.0% KL + 0.1% NaP85	0.05	0.25	0.58	1.05	0.29
1.0% KL + 0.3% NaP85	0.17	0.46	0.50	0.80	0.38
2.0% KL + 0% NaP85	0.04	0.53	0.58	0.93	0.71
2.0% KL + 0.2% NaP85	-0.01	0.39	0.67	1.13	0.63
2.0% KL + 0.4% NaP85	-0.01	0.68	0.50	0.68	0.96
3.0% KL + 0.1% NaP85	0.05	0.32	0.50	1.24	0.71
3.0% KL + 0.3% NaP85	0.44	0.25	0.67	0.49	0.71
4.0% KL + 0.2% NaP85	0.30	0.39	0.67	1.12	0.71
0% KL + 0.2% NaP85	0.36	0.46	0.67	0.55	0.54
Control (no injection)	0.39	0.29	0.68	0.94	0.74

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]KL: potassium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AI

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR BASIC TASTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 4

(n = 665)

	Storage Time, days				
Treatment	0	7	14	21	28
Sour[a]	.0444[b]	0.532[c]			
1.0% KL[1] + 0.1% NaP85[2]	2.45	2.56	2.30	2.31	2.44
1.0% KL + 0.3% NaP85	2.39	2.28	2.38	2.49	2.61
2.0% KL + 0% NaP85	2.62	2.42	2.38	2.31	2.52
2.0% KL + 0.2% NaP85	2.51	2.56	2.80	2.50	2.77
2.0% KL + 0.4% NaP85	2.39	2.42	2.30	2.43	2.44
3.0% KL + 0.1% NaP85	2.70	2.35	2.46	2.56	2.86
3.0% KL + 0.3% NaP85	2.12	2.13	2.13	2.18	2.52
4.0% KL + 0.2% NaP85	2.51	2.20	2.21	2.62	2.44
0% KL + 0.2% NaP85	2.26	2.28	2.30	2.31	2.69
Control (no injection)	2.44	2.13	2.22	2.34	2.31
Bitter	.4898	1.392			
1.0% KL + 0.1% NaP85	2.52	2.35	2.22	2.61	2.63
1.0% KL + 0.3% NaP85	2.46	2.71	5.05	2.48	2.79
2.0% KL + 0% NaP85	2.94	2.71	2.38	2.42	2.79
2.0% KL + 0.2% NaP85	2.58	2.64	2.63	2.75	2.54
2.0% KL + 0.4% NaP85	2.58	2.35	2.22	2.61	2.54
3.0% KL + 0.1% NaP85	2.89	2.71	2.55	2.67	3.13
3.0% KL + 0.3% NaP85	2.64	2.42	2.38	2.42	2.79
4.0% KL + 0.2% NaP85	2.96	2.57	2.63	2.67	2.88
0% KL + 0.2% NaP85	2.64	2.28	2.38	2.48	2.71
Control (no injection)	2.43	2.41	2.45	2.63	2.57
Sweet	.8360	0.604			
1.0% KL + 0.1% NaP85	0.17	0.30	0.43	0.24	0.00
1.0% KL + 0.3% NaP85	0.17	0.23	0.27	0.12	0.09
2.0% KL + 0% NaP85	0.17	0.09	0.43	0.12	0.17
2.0% KL + 0.2% NaP85	0.11	0.09	0.10	0.05	-0.08
2.0% KL + 0.4% NaP85	0.30	0.30	0.35	0.06	0.09
3.0% KL + 0.1% NaP85	0.36	-0.05	0.10	0.56	0.09
3.0% KL + 0.3% NaP85	0.37	0.16	0.27	0.12	0.09
4.0% KL + 0.2% NaP85	0.17	0.30	-0.07	0.18	0.17
0% KL + 0.2% NaP85	0.30	0.30	0.02	0.12	0.00
Control (no injection)	0.25	0.37	0.68	0.02	0.04

Treatment	Storage Time, days				
	0	7	14	21	28
Salt[a]	.0001[b]		1.817[c]		
1.0% KL[1] + 0.1% NaP85[2]	4.41	4.46	3.60	4.07	4.41
1.0% KL + 0.3% NaP85	5.22	3.96	3.94	4.70	4.99
2.0% KL + 0% NaP85	6.31	4.53	3.77	4.95	4.57
2.0% KL + 0.2% NaP85	5.29	5.11	6.35	5.87	6.99
2.0% KL + 0.4% NaP85	4.29	3.61	3.44	6.20	5.24
3.0% KL + 0.1% NaP85	7.10	5.46	5.69	6.26	6.41
3.0% KL + 0.3% NaP85	2.91	3.39	3.52	4.64	5.41
4.0% KL + 0.2% NaP85	4.72	3.89	4.02	4.32	4.16
0% KL + 0.2% NaP85	4.29	3.46	4.60	5.70	5.99
Control (no injection)	2.49	1.94	2.11	2.20	1.81

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]KL: potassium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AJ

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR AFTERTASTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 4

(n = 665)

	Storage Time, days				
Treatment	0	7	14	21	28
Sour[a]	.0026[a]		0.789[b]		
1.0% KL[1] + 0.1% NaP85[2]	0.92	0.45	0.75	0.65	0.61
1.0% KL + 0.3% NaP85	0.92	0.53	1.00	0.40	1.03
2.0% KL + 0% NaP85	0.80	0.38	0.34	0.46	0.78
2.0% KL + 0.2% NaP85	0.80	1.03	1.09	0.71	1.28
2.0% KL + 0.4% NaP85	0.80	0.60	0.42	0.71	1.28
3.0% KL + 0.1% NaP85	0.74	0.53	0.50	0.90	1.11
3.0% KL + 0.3% NaP85	0.70	0.31	0.50	0.40	0.94
4.0% KL + 0.2% NaP85	0.61	0.67	0.67	1.15	1.19
0% KL + 0.2% NaP85	0.55	0.38	0.50	0.65	1.61
Control (no injection)	0.33	0.58	0.81	0.95	0.72
Salty	.0001		1.196		
1.0% KL + 0.1% NaP85	2.02	2.00	1.73	1.63	1.36
1.0% KL + 0.3% NaP85	2.21	1.57	1.56	2.19	1.77
2.0% KL + 0% NaP85	3.20	1.79	1.56	2.44	1.69
2.0% KL + 0.2% NaP85	2.71	2.22	2.40	2.93	3.27
2.0% KL + 0.4% NaP85	1.77	1.07	1.73	3.13	2.61
3.0% KL + 0.1% NaP85	3.15	2.65	2.15	2.88	3.19
3.0% KL + 0.3% NaP85	1.30	1.72	1.40	2.44	2.02
4.0% KL + 0.2% NaP85	2.40	1.29	1.65	1.94	1.94
0% KL + 0.2% NaP85	2.21	1.22	2.06	2.69	2.61
Control (no injection)	0.55	0.31	0.53	0.54	0.34
Bitter	.0053		0.938		
1.0% KL + 0.1% NaP85	1.25	0.88	0.31	1.15	1.40
1.0% KL + 0.3% NaP85	1.25	0.95	0.89	1.27	1.32
2.0% KL + 0% NaP85	1.51	1.10	0.39	1.46	1.32
2.0% KL + 0.2% NaP85	1.38	0.88	0.98	1.26	1.15
2.0% KL + 0.4% NaP85	1.06	1.03	0.56	1.34	1.15
3.0% KL + 0.1% NaP85	1.50	1.38	1.06	1.52	1.74
3.0% KL + 0.3% NaP85	1.21	1.17	0.89	1.65	1.49
4.0% KL + 0.2% NaP85	1.38	0.74	1.48	1.59	1.57
0% KL + 0.2% NaP85	1.13	0.60	0.56	1.34	1.57
Control (no injection)	1.51	0.79	1.47	1.71	1.48

Treatment	Storage Time, days 0	7	14	21	28
Soapy[a]	.0856[b]		0.266[c]		
1.0% KL[1] + 0.1% NaP85[2]	0.04	0.10	0.03	0.09	-0.02
1.0% KL + 0.3% NaP85	0.17	0.17	0.12	0.09	0.06
2.0% KL + 0% NaP85	0.08	0.10	0.20	0.03	-0.02
2.0% KL + 0.2% NaP85	0.17	0.03	0.20	0.03	0.06
2.0% KL + 0.4% NaP85	0.17	0.03	0.03	-0.03	-0.02
3.0% KL + 0.1% NaP85	0.11	0.03	0.03	0.09	0.06
3.0% KL + 0.3% NaP85	0.08	0.17	0.03	0.34	-0.02
4.0% KL + 0.2% NaP85	0.23	0.10	-0.05	0.03	-0.02
0% KL + 0.2% NaP85	0.11	0.10	0.12	-0.03	0.06
Control (no injection)	-0.01	-0.04	-0.04	-0.02	0.00
Mouthburn	.3517		0.722		
1.0% KL + 0.1% NaP85	0.05	0.36	0.19	0.36	0.54
1.0% KL + 0.3% NaP85	-0.07	0.50	0.36	0.11	0.54
2.0% KL + 0% NaP85	0.01	0.50	0.36	0.49	0.37
2.0% KL + 0.2% NaP85	0.55	0.57	0.86	0.48	0.45
2.0% KL + 0.4% NaP85	0.12	0.50	0.36	0.36	0.54
3.0% KL + 0.1% NaP85	0.74	0.43	0.69	0.43	0.54
3.0% KL + 0.3% NaP85	0.81	0.50	0.44	0.24	0.54
4.0% KL + 0.2% NaP85	0.74	0.50	0.36	0.11	0.54
0% KL + 0.2% NaP85	0.43	0.36	0.36	0.36	0.62
Control (no injection)	0.11	0.46	-0.05	0.42	0.22
Soda	.0001		0.843		
1.0% KL + 0.1% NaP85	1.01	1.13	1.21	1.65	1.31
1.0% KL + 0.3% NaP85	0.76	0.85	1.37	1.71	1.48
2.0% KL + 0% NaP85	1.55	1.27	1.29	1.59	1.40
2.0% KL + 0.2% NaP85	1.26	1.27	1.96	1.81	1.56
2.0% KL + 0.4% NaP85	1.13	1.06	1.37	1.78	1.65
3.0% KL + 0.1% NaP85	1.13	1.27	1.71	1.78	1.90
3.0% KL + 0.3% NaP85	0.15	0.85	1.46	1.46	1.56
4.0% KL + 0.2% NaP85	1.07	1.27	1.54	1.71	1.31
0% KL + 0.2% NaP85	0.82	0.99	1.62	1.59	1.56
Control (no injection)	0.29	0.83	0.65	0.67	0.56

Treatment	Storage Time, days 0	7	14	21	28
Chemical[a]	0.5124[b]		0.374[c]		
1.0% KL[1] + 0.1% NaP85[2]	0.15	-0.01	0.01	0.11	0.09
1.0% KL + 0.3% NaP85	0.03	-0.01	0.01	0.11	0.17
2.0% KL + 0% NaP85	0.20	-0.01	0.01	0.05	0.17
2.0% KL + 0.2% NaP85	0.03	-0.01	0.01	0.12	0.09
2.0% KL + 0.4% NaP85	0.15	-0.01	0.01	0.05	0.09
3.0% KL + 0.1% NaP85	0.15	-0.01	0.01	0.18	0.09
3.0% KL + 0.3% NaP85	0.00	-0.01	0.01	0.05	0.09
4.0% KL + 0.2% NaP85	0.47	-0.01	0.01	0.05	0.34
0% KL + 0.2% NaP85	0.03	-0.01	0.01	0.05	0.09
Control (no injection)	0.01	-0.02	0.00	0.16	0.38
Metallic	.3113		0.596		
1.0% KL + 0.1% NaP85	0.37	0.41	0.61	0.69	0.85
1.0% KL + 0.3% NaP85	0.37	0.55	0.52	0.50	0.69
2.0% KL + 0% NaP85	0.44	0.62	0.52	0.81	0.69
2.0% KL + 0.2% NaP85	0.62	0.69	0.44	0.75	0.60
2.0% KL + 0.4% NaP85	0.62	0.34	0.44	0.56	0.44
3.0% KL + 0.1% NaP85	0.49	0.41	0.44	0.81	1.02
3.0% KL + 0.3% NaP85	0.74	0.69	0.36	0.50	0.60
4.0% KL + 0.2% NaP85	0.62	0.41	0.44	0.56	1.02
0% KL + 0.2% NaP85	0.87	0.41	0.69	0.56	0.69
Control (no injection)	0.94	0.55	0.56	0.85	0.81
Browned	.2326		0.440		
1.0% KL + 0.1% NaP85	-0.01	0.02	0.22	0.10	0.08
1.0% KL + 0.3% NaP85	0.11	0.17	0.39	-0.02	0.33
2.0% KL + 0% NaP85	-0.02	0.02	0.47	0.10	0.16
2.0% KL + 0.2% NaP85	-0.01	0.02	0.47	0.10	0.33
2.0% KL + 0.4% NaP85	-0.01	0.10	0.22	-0.02	0.16
3.0% KL + 0.1% NaP85	-0.01	0.02	0.31	0.10	0.08
3.0% KL + 0.3% NaP85	0.28	0.17	0.14	0.04	0.41
4.0% KL + 0.2% NaP85	0.11	0.02	0.22	0.10	0.16
0% KL + 0.2% NaP85	0.05	0.02	0.14	0.23	-0.01
Control (no injection)	0.17	0.04	0.10	0.16	0.38

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]KL: potassium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AK

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE MOUTHFEELS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 4 (n = 665)

	Storage Time, days				
Treatment	0	7	14	21	28
Metallic[a]	0.0073[b]	0.515[c]			
1.0% KL[1] + 0.1% NaP85[2]	2.56	2.49	2.28	2.40	2.27
1.0% KL + 0.3% NaP85	2.31	2.49	2.28	2.15	2.52
2.0% KL + 0% NaP85	2.60	2.63	2.11	2.27	2.27
2.0% KL + 0.2% NaP85	2.56	2.71	2.61	2.14	2.69
2.0% KL + 0.4% NaP85	2.24	2.49	2.03	2.21	2.19
3.0% KL + 0.1% NaP85	2.62	2.63	2.53	2.65	2.52
3.0% KL + 0.3% NaP85	2.20	2.49	2.19	2.21	2.61
4.0% KL + 0.2% NaP85	2.43	2.63	2.36	2.34	2.61
0% KL + 0.2% NaP85	2.43	2.42	2.19	2.27	2.44
Control (no injection)	2.61	2.23	2.28	2.40	2.28
Astringent	.0081	0.567			
1.0% KL + 0.1% NaP85	2.80	2.64	2.42	2.55	2.52
1.0% KL + 0.3% NaP85	2.49	2.64	2.58	2.80	2.77
2.0% KL + 0% NaP85	3.13	2.64	2.42	2.61	2.52
2.0% KL + 0.2% NaP85	2.92	2.71	3.00	2.68	2.85
2.0% KL + 0.4% NaP85	2.74	2.50	2.33	2.86	2.60
3.0% KL + 0.1% NaP85	2.92	2.78	2.75	2.99	2.94
3.0% KL + 0.3% NaP85	2.23	2.50	2.50	2.80	2.77
4.0% KL + 0.2% NaP85	2.86	2.64	2.75	2.80	2.60
0% KL + 0.2% NaP85	2.55	2.36	2.67	2.68	2.85
Control (no injection)	2.48	2.21	2.35	2.44	2.38

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]KL: potassium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AL

LEAST SQUARES MEANS AND REGRESSION EQUATIONS FOR SENSORY ATTRIBUTES, AND CIE L* AND A* COLOR SPACE VALUES FROM TREATMENT ANALYSIS FOR EXPERIMENT 4

Treatment	Least Squares Means			Regression Equation
Pork lean/brothy	(n = 665)	.0057[a]	1.607[b]	
1.0% KL + 0.1% NaP85	5.95			
1.0% KL + 0.3% NaP85	6.67			
2.0% KL + 0% NaP85	6.08			
2.0% KL + 0.2% NaP85	6.12			
2.0% KL + 0.4% NaP85	6.27			
3.0% KL + 0.3% NaP85	5.91			
3.0% KL + 0.1% NaP85	6.07			
4.0% KL + 0.2% NaP85	6.08			
0% KL + 0.2% NaP85	6.12			
Control (no injection)	5.24			
Intercept				5.24
Potassium lactate (KL)				0.41
Sodium phosphates (NaP)				4.73
KL x KL				-0.01
NaP x KL				-2.19
NaP x NaP				1.07
R^2				92.52
*L**	(n = 142)	.0300[a]	3.010[b]	
1.0% KL + 0.1% NaP85	51.95			
1.0% KL + 0.3% NaP85	52.15			
2.0% KL + 0% NaP85	52.51			
2.0% KL + 0.2% NaP85	50.98			
2.0% KL + 0.4% NaP85	53.12			
3.0% KL + 0.3% NaP85	52.74			
3.0% KL + 0.1% NaP85	51.82			
4.0% KL + 0.2% NaP85	51.47			
0% KL + 0.2% NaP85	52.84			
Control (no injection)	55.89			
Intercept				55.70
Potassium lactate (KL)				-2.08
Sodium phosphates (NaP)				-23.53
KL x KL				0.28
NaP x KL				3.62
NaP x NaP				44.86
R^2				92.75

Treatment	Least Squares Means			Regression Equation
a*	(n = 142)	.0083[a]	1.382[b]	
1.0% KL + 0.1% NaP85	7.06			
1.0% KL + 0.3% NaP85	5.91			
2.0% KL + 0% NaP85	6.36			
2.0% KL + 0.2% NaP85	5.45			
2.0% KL + 0.4% NaP85	6.47			
3.0% KL + 0.3% NaP85	6.63			
3.0% KL + 0.1% NaP85	7.11			
4.0% KL + 0.2% NaP85	6.77			
0% KL + 0.2% NaP85	6.05			
Control (no injection)	7.55			
Intercept				7.56
Potassium lactate (KL)				-0.59
Sodium phosphates (NaP)				-9.10
KL x KL				0.11
NaP x KL				1.65
NaP x NaP				11.58
R^2				57.92

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]KL: potassium lactate, [2]NaP: sodium phosphate 85

APPENDIX AM

LEAST SQUARES MEANS FROM STORAGE DAY ANALYSIS FOR EXPERIMENT 4

Storage Day			
Soapy		(n = 665)	.0009
0	0.14		
7	0.31		
14	0.12		
21	0.12		
28	0.08		
Aftertaste chemical		(n = 665)	.0018
0	0.10		
7	0.01		
14	0.00		
21	0.11		
28	0.17		
Aftertaste metallic		(n = 665)	<.0001
0	0.36		
7	0.54		
14	0.30		
21	0.79		
28	0.82		
Aftertaste browned		(n = 665)	.0003
0	0.08		
7	0.03		
14	0.30		
21	0.11		
28	0.21		
Drip loss		(n = 134)	.0027
0	4.50		
7	3.75		
14	6.00		
21	4.35		
28	6.75		

[a] P- value from Analysis of Variance table of SAS (1999)

APPENDIX AN

LEAST SQUARES MEANS FOR SENSORY MEAT DESCRIPTIVE TEXTURE ATTRIBUTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 4 (n = 665)

	Storage Time, days				
Treatment	0	7	14	21	28
Muscle fiber tenderness[a] (n = 664)	.0001[b]	0.908[c]			
1.0% KL[1] + 0.1% NaP85[2]	5.89	6.41	6.25	5.96	6.32
1.0% KL + 0.3% NaP85	6.89	5.91	6.34	6.64	6.41
2.0% KL + 0% NaP85	7.04	6.41	6.84	6.39	6.32
2.0% KL + 0.2% NaP85	6.45	6.62	6.59	6.64	7.07
2.0% KL + 0.4% NaP85	5.83	5.83	6.17	6.27	7.07
3.0% KL + 0.1% NaP85	7.33	6.98	7.09	7.08	7.07
3.0% KL + 0.3% NaP85	6.04	5.98	6.09	6.08	6.74
4.0% KL + 0.2% NaP85	6.08	6.48	6.09	6.46	5.74
0% KL + 0.2% NaP85	6.02	6.55	6.25	6.21	7.16
Control (no injection)	4.78	4.47	4.85	5.65	5.20
Juiciness	.0001	0.781			
1.0% KL + 0.1% NaP85	4.73	4.89	4.05	4.02	4.40
1.0% KL + 0.3% NaP85	4.79	4.46	4.13	4.40	4.23
2.0% KL + 0% NaP85	4.93	4.46	4.80	4.59	4.31
2.0% KL + 0.2% NaP85	4.91	4.68	4.63	4.58	4.81
2.0% KL + 0.4% NaP85	4.60	4.18	4.38	4.71	4.81
3.0% KL + 0.1% NaP85	4.85	4.75	4.80	4.96	4.81
3.0% KL + 0.3% NaP85	4.53	4.25	4.38	4.40	4.98
4.0% KL + 0.2% NaP85	4.10	4.68	4.13	4.65	4.73
0% KL + 0.2% NaP85	4.10	4.53	4.63	4.71	4.90
Control (no injection)	3.83	3.99	3.57	4.22	3.59
Processed meat-like bite	.0001	2.357			
1.0% KL + 0.1% NaP85	8.00	8.75	8.61	8.80	8.25
1.0% KL + 0.3% NaP85	10.19	7.68	9.20	10.05	8.50
2.0% KL + 0% NaP85	10.45	8.89	10.45	9.92	8.33
2.0% KL + 0.2% NaP85	9.50	8.96	10.61	10.13	11.00
2.0% KL + 0.4% NaP85	7.19	7.32	9.11	9.48	10.16
3.0% KL + 0.1% NaP85	10.75	9.89	11.11	10.86	10.16
3.0% KL + 0.3% NaP85	8.55	6.61	8.86	9.55	10.41
4.0% KL + 0.2% NaP85	8.32	8.96	8.45	9.80	8.16
0% KL + 0.2% NaP85	7.25	8.25	8.86	9.48	11.08
Control (no injection)	4.88	3.29	4.11	6.45	5.43

[a]Sample evaluation on a 8-point scale for 0 = extremely tough; dry and 15 = extremely tender;juicy.
[b] P- value from Analysis of Variance table of SAS (1999).
[c] Root mean squares error.
[d] Sample evaluation on a 15-point scale for 0 = not processed and 15 = extremely processed.
[1]KL: potassium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AO

LEAST SQUARES MEANS FOR SUBJECTIVE COLOR FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 4 (n = 665)

	Storage Time, days				
Treatment	0	7	14	21	28
Color[b]	0.0001[b]		0.760[c]		
1.0% KL[1] + 0.1% NaP85[2]	3.38	2.50	2.73	2.58	2.55
1.0% KL + 0.3% NaP85	3.19	2.43	2.48	2.58	3.14
2.0% KL + 0% NaP85	4.37	2.71	2.40	2.64	2.80
2.0% KL + 0.2% NaP85	3.57	3.50	2.82	3.26	3.30
2.0% KL + 0.4% NaP85	3.07	3.07	1.98	2.33	2.30
3.0% KL + 0.1% NaP85	3.57	3.57	2.90	4.08	3.55
3.0% KL + 0.3% NaP85	3.57	2.50	2.65	3.02	2.55
4.0% KL + 0.2% NaP85	3.44	3.00	2.48	3.08	2.72
0% KL + 0.2% NaP85	3.25	2.86	2.15	3.02	2.97
Control (no injection)	2.06	2.00	2.33	2.02	2.31
Amount of Discoloration	.0020		1.183		
1.0% KL + 0.1% NaP85	2.27	2.49	2.36	2.80	1.82
1.0% KL + 0.3% NaP85	2.08	2.56	2.03	3.36	2.41
2.0% KL + 0% NaP85	1.76	2.20	2.20	1.86	2.07
2.0% KL + 0.2% NaP85	1.90	2.28	1.86	2.44	2.66
2.0% KL + 0.4% NaP85	2.08	2.13	2.11	2.67	2.16
3.0% KL + 0.1% NaP85	2.08	2.06	1.36	1.49	1.41
3.0% KL + 0.3% NaP85	1.46	1.92	1.53	2.05	2.16
4.0% KL + 0.2% NaP85	2.15	2.13	1.78	2.05	1.99
0% KL + 0.2% NaP85	2.08	2.06	1.95	2.61	2.49
Control (no injection)	2.50	1.17	1.14	2.98	2.83
Color of Discoloration (n = 401)	.0023		0.925		
1.0% KL + 0.1% NaP85	3.05	2.15	2.93	2.50	2.86
1.0% KL + 0.3% NaP85	1.47	2.43	1.97	1.70	1.95
2.0% KL + 0% NaP85	3.33	2.08	2.65	2.03	2.76
2.0% KL + 0.2% NaP85	2.92	2.74	3.00	2.58	2.32
2.0% KL + 0.4% NaP85	2.15	2.37	2.93	1.91	2.44
3.0% KL + 0.1% NaP85	2.44	2.09	2.67	3.13	2.38
3.0% KL + 0.3% NaP85	2.96	2.55	3.29	2.40	3.33
4.0% KL + 0.2% NaP85	2.19	2.48	2.46	2.74	2.90
0% KL + 0.2% NaP85	2.90	2.18	1.93	2.44	2.91
Control (no injection)	2.59	2.41	3.58	2.01	2.63

[a] Sample evaluation for Color and Color of Discoloration on a 6-point National Pork Board color scale for 1=extremely light and 6=extremely dark.
[b] P- value
[c] Root mean squares error
[d]Sample evaluation for Amount of Discoloration on a 7-point scale, 1 = no discoloration and 7 = 100% discoloration
[1]KL: potassium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AP

LEAST SQUARES MEANS FOR OBJECTIVE COLOR FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 4 (n = 142)

	Storage Time, days				
Treatment	0	7	14	21	28
*L**	.0708[a]		3.010[b]		
1.0% KL[1] + 0.1% NaP85[2]	49.89	49.63	53.43	54.61	52.18
1.0% KL + 0.3% NaP85	55.90	52.99	50.50	51.21	50.15
2.0% KL + 0% NaP85	52.45	50.42	50.87	54.10	54.73
2.0% KL + 0.2% NaP85	54.64	51.11	48.52	48.37	52.27
2.0% KL + 0.4% NaP85	54.29	51.02	51.74	54.26	54.30
3.0% KL + 0.1% NaP85	52.62	54.12	51.90	48.74	51.71
3.0% KL + 0.3% NaP85	52.26	53.22	52.65	50.43	55.14
4.0% KL + 0.2% NaP85	52.91	49.99	50.69	51.20	52.56
0% KL + 0.2% NaP85	48.94	55.11	53.63	54.05	52.48
Control (no injection)	54.45	53.69	55.93	57.17	58.20
*a**	.1911		1.382		
1.0% KL + 0.1% NaP85	6.04	8.19	6.04	8.65	6.37
1.0% KL + 0.3% NaP85	6.54	6.76	5.59	4.79	5.84
2.0% KL + 0% NaP85	6.37	6.52	5.83	7.05	6.04
2.0% KL + 0.2% NaP85	5.03	5.59	5.80	6.36	4.47
2.0% KL + 0.4% NaP85	6.29	7.83	6.32	5.84	6.07
3.0% KL + 0.1% NaP85	7.32	8.14	6.55	6.41	7.13
3.0% KL + 0.3% NaP85	5.80	6.38	6.78	7.08	7.11
4.0% KL + 0.2% NaP85	6.66	7.20	5.17	7.62	7.18
0% KL + 0.2% NaP85	6.47	6.16	5.44	6.61	5.56
Control (no injection)	6.78	7.44	7.50	7.77	8.28
*b**	.0221		1.176		
1.0% KL + 0.1% NaP85	2.32	3.31	2.94	4.92	3.31
1.0% KL + 0.3% NaP85	3.47	2.74	1.79	2.04	2.41
2.0% KL + 0% NaP85	3.46	2.68	2.12	3.64	3.63
2.0% KL + 0.2% NaP85	2.76	1.86	2.26	2.65	2.28
2.0% KL + 0.4% NaP85	4.01	3.61	2.60	3.71	3.84
3.0% KL + 0.1% NaP85	3.30	4.84	2.18	2.69	3.50
3.0% KL + 0.3% NaP85	2.57	3.23	3.13	2.55	4.40
4.0% KL + 0.2% NaP85	2.93	2.74	2.01	4.07	3.44
0% KL + 0.2% NaP85	1.76	3.59	3.07	3.79	2.72
Control (no injection)	3.34	2.87	4.65	5.64	5.83

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]KL: potassium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AQ

LEAST SQUARES MEANS FOR COOK TIME, COOK LOSS, AND PACKAGE PURGE FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 4 (n = 144)

Treatment		Storage Time, days				
		0	7	14	21	28
Cook time	(n = 144)	.0301[a]	3.473[b]			
1.0% KL[1] + 0.1% NaP85[2]		19.67	20.67	23.67	24.00	15.67
1.0% KL + 0.3% NaP85		19.00	24.67	22.00	25.33	19.00
2.0% KL + 0% NaP85		20.33	20.33	19.00	20.67	17.00
2.0% KL + 0.2% NaP85		17.67	25.67	25.67	23.33	20.00
2.0% KL + 0.4% NaP85		19.33	20.33	21.67	21.00	19.67
3.0% KL + 0.1% NaP85		17.67	20.33	19.33	21.00	17.67
3.0% KL + 0.3% NaP85		17.33	20.67	21.67	22.00	18.33
4.0% KL + 0.2% NaP85		19.00	23.00	25.87	23.33	18.00
0% KL + 0.2% NaP85		24.00	23.00	25.00	24.67	19.33
Control (no injection)		21.87	20.87	19.87	23.37	20.87
Cook loss	(n = 145)	.0010	4.112			
1.0% KL + 0.1% NaP85		17.64	18.68	25.65	24.41	15.96
1.0% KL + 0.3% NaP85		16.22	20.04	24.27	22.84	14.43
2.0% KL + 0% NaP85		18.26	17.37	17.87	16.08	13.61
2.0% KL + 0.2% NaP85		16.13	17.40	17.27	19.07	15.60
2.0% KL + 0.4% NaP85		15.98	17.43	16.17	23.32	11.79
3.0% KL + 0.1% NaP85		18.13	15.39	13.37	17.53	10.58
3.0% KL + 0.3% NaP85		16.07	17.13	18.77	17.23	12.07
4.0% KL + 0.2% NaP85		18.52	18.35	20.62	18.57	10.09
0% KL + 0.2% NaP85		21.54	20.88	19.62	20.62	15.03
Control (no injection)		20.21	22.29	21.96	23.44	21.29
Package Purge	(n = 116)	.0001	0.919			
1.0% KL + 0.1% NaP85		.	4.49	4.86	5.03	4.34
1.0% KL + 0.3% NaP85		.	5.41	4.75	4.49	5.03
2.0% KL + 0% NaP85		.	4.38	4.31	4.07	3.98
2.0% KL + 0.2% NaP85		.	3.90	3.46	3.94	3.55
2.0% KL + 0.4% NaP85		.	4.56	4.69	4.75	3.65
3.0% KL + 0.1% NaP85		.	3.99	3.90	4.94	4.79
3.0% KL + 0.3% NaP85		.	3.95	4.33	4.66	4.31
4.0% KL + 0.2% NaP85		.	3.82	4.20	4.16	4.42
0% KL + 0.2% NaP85		.	3.48	4.40	4.03	4.22
Control (no injection)		.	7.08	8.45	7.78	7.90

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]KL: potassium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AR

LEAST SQUARES MEANS FOR PH AND DRIP LOSS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 4

Treatment		Storage Time, days				
		0	7	14	21	28
pH	(n = 143)	.1377[a]	0.189[b]			
1.0% KL[1] + 0.1% NaP85[2]		5.89	5.88	5.73	5.83	5.85
1.0% KL + 0.3% NaP85		5.54	5.74	5.77	5.98	5.86
2.0% KL + 0% NaP85		5.87	5.94	5.89	5.81	5.79
2.0% KL + 0.2% NaP85		5.91	5.96	6.01	5.95	5.94
2.0% KL + 0.4% NaP85		5.85	5.73	5.80	6.06	5.79
3.0% KL + 0.1% NaP85		5.85	5.54	5.79	6.18	5.92
3.0% KL + 0.3% NaP85		5.77	5.86	5.85	5.81	5.75
4.0% KL + 0.2% NaP85		5.85	5.95	6.06	5.93	5.92
0% KL + 0.2% NaP85		6.05	5.76	5.76	5.67	5.94
Control (no injection)		5.65	5.67	5.76	5.64	5.71
Drip loss	(n = 134)	.1613	3.000			
1.0% KL + 0.1% NaP85		4.00	3.65	7.05	4.60	4.50
1.0% KL + 0.3% NaP85		3.55	4.85	8.30	4.10	8.50
2.0% KL + 0% NaP85		4.35	4.15	4.90	4.30	5.05
2.0% KL + 0.2% NaP85		4.65	3.60	6.10	4.70	4.65
2.0% KL + 0.4% NaP85		4.40	2.75	4.70	4.05	7.00
3.0% KL + 0.1% NaP85		3.35	1.50	5.20	4.35	4.00
3.0% KL + 0.3% NaP85		3.70	5.75	6.00	3.30	4.50
4.0% KL + 0.2% NaP85		7.70	3.25	4.75	3.90	13.50
0% KL + 0.2% NaP85		4.35	4.75	7.00	5.55	11.35
Control (no injection)		5.00	3.20	5.70	4.80	4.50

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]KL: potassium lactate, [2]NaP85: sodium phosphate 85

APPENDIX AS

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR AROMATICS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 5

(n = 651)

	Storage Time, days				
Treatment	0	7	14	21	28
Pork lean/brothy[a]	0.001[b]	0.868[c]			
0.05% NaDi[1] + 0.1% NaP85[2]	5.83	5.93	6.74	7.05	6.95
0.05% NaDi + 0.3% NaP85	5.47	6.30	6.58	6.98	6.72
0.1% NaDi + 0% NaP	5.08	6.11	6.66	6.72	6.65
0.1% NaDi + 0.2% NaP85	4.76	6.02	6.74	6.85	6.72
0.1% NaDi + 0.4% NaP85	5.47	5.48	6.58	6.92	6.81
0.15% NaDi + 0.1% NaP85	5.26	5.48	6.43	6.65	6.42
0.15% NaDi + 0.3% NaP85	5.19	5.48	6.20	6.58	6.72
0.2% NaDi + 0.2% NaP85	5.05	5.91	6.12	6.85	6.42
0% NaDi + 0.2% NaP85	5.62	6.21	6.89	6.85	6.80
Control (no injection)	4.97	5.21	5.58	5.92	5.42
Pork fat	.0001	0.342			
0.05% NaDi + 0.1% NaP85	1.84	1.79	1.87	1.70	2.00
0.05% NaDi + 0.3% NaP85	1.76	1.79	1.80	1.90	1.69
0.1% NaDi + 0% NaP	1.68	1.97	1.87	2.04	1.93
0.1% NaDi + 0.2% NaP85	1.55	2.06	1.80	1.84	1.93
0.1% NaDi + 0.4% NaP85	1.69	1.70	1.80	1.90	1.63
0.15% NaDi + 0.1% NaP85	1.84	1.88	1.80	1.90	1.93
0.15% NaDi + 0.3% NaP85	1.84	1.97	1.87	1.84	1.85
0.2% NaDi + 0.2% NaP85	1.62	1.84	1.72	2.04	2.00
0% NaDi + 0.2% NaP85	1.69	1.79	1.87	1.77	1.85
Control (no injection)	1.48	1.42	1.57	1.70	1.62
Cardboardy	.1087	0.204			
0.05% NaDi + 0.1% NaP85	-0.01	-0.01	0.00	0.07	0.00
0.05% NaDi + 0.3% NaP85	-0.01	-0.01	0.00	0.00	0.08
0.1% NaDi + 0% NaP	-0.01	-0.01	0.08	0.00	0.00
0.1% NaDi + 0.2% NaP85	0.06	-0.01	0.00	0.00	0.15
0.1% NaDi + 0.4% NaP85	-0.01	-0.01	0.00	0.00	0.00
0.15% NaDi + 0.1% NaP85	-0.01	-0.01	0.00	0.00	0.08
0.15% NaDi + 0.3% NaP85	-0.01	-0.01	0.00	0.07	0.31
0.2% NaDi + 0.2% NaP85	-0.01	-0.01	0.00	0.00	0.15
0% NaDi + 0.2% NaP85	-0.01	-0.01	0.00	0.00	0.00
Control (no injection)	-0.01	0.08	0.00	0.07	0.23

Treatment	Storage Time, days 0	7	14	21	28
Soapy[a]	.2737[b]	0.260[c]			
0.05% NaDi[1]+ 0.1% NaP85[2]	0.03	0.01	0.17	0.03	0.10
0.05% NaDi + 0.3% NaP85	0.17	0.10	0.02	0.16	0.10
0.1% NaDi + 0% NaP	0.07	0.10	0.02	0.16	0.18
0.1% NaDi + 0.2% NaP85	0.10	0.10	0.10	0.16	0.10
0.1% NaDi + 0.4% NaP85	0.10	0.01	0.10	0.16	0.18
0.15% NaDi + 0.1% NaP85	0.17	0.01	-0.06	-0.04	0.10
0.15% NaDi + 0.3% NaP85	0.03	0.10	0.17	0.10	0.03
0.2% NaDi + 0.2% NaP85	0.17	0.01	0.02	0.16	0.10
0% NaDi + 0.2% NaP85	0.10	0.38	0.10	0.03	0.10
Control (no injection)	0.03	0.01	0.02	0.03	-0.05
Chemical (n = 650)	.3319	0.689			
0.05% NaDi + 0.1% NaP85	0.73	0.38	1.05	0.71	0.85
0.05% NaDi + 0.3% NaP85	0.44	0.56	0.74	0.71	0.62
0.1% NaDi + 0% NaP	0.59	0.47	0.51	1.18	1.00
0.1% NaDi + 0.2% NaP85	0.51	0.56	0.66	1.04	0.62
0.1% NaDi + 0.4% NaP85	0.51	0.65	0.82	0.84	0.88
0.15% NaDi + 0.1% NaP85	0.58	0.65	0.90	0.98	0.69
0.15% NaDi + 0.3% NaP85	0.80	0.74	0.90	0.84	0.62
0.2% NaDi + 0.2% NaP85	0.87	0.77	0.66	0.91	1.00
0% NaDi + 0.2% NaP85	0.50	0.47	0.59	0.71	0.77
Control (no injection)	0.73	0.65	0.20	0.84	0.31
Browned[a]	.4102[b]	0.710[c]			
0.05% NaDi[1] + 0.1% NaP85[2]	0.39	0.65	0.66	1.00	1.02
0.05% NaDi + 0.3% NaP85	0.67	0.65	0.74	0.80	1.09
0.1% NaDi + 0% NaP	0.72	0.37	0.66	0.80	0.94
0.1% NaDi + 0.2% NaP85	0.74	0.37	0.58	0.74	0.71
0.1% NaDi + 0.4% NaP85	0.60	0.28	0.74	0.67	0.73
0.15% NaDi + 0.1% NaP85	0.39	0.65	0.51	0.94	0.63
0.15% NaDi + 0.3% NaP85	0.60	0.65	0.58	0.80	0.63
0.2% NaDi + 0.2% NaP85	0.39	0.74	0.51	0.67	1.25
0% NaDi + 0.2% NaP85	0.53	0.47	1.12	0.74	0.71
Control (no injection)	0.46	0.83	0.58	0.40	0.79

Treatment	Storage Time, days 0	7	14	21	28
Soured	.5547	0.124			
0.05% NaDi + 0.1% NaP85	0.01	0.01	0.00	0.00	0.00
0.05% NaDi + 0.3% NaP85	0.01	0.01	0.00	0.00	0.00
0.1% NaDi + 0% NaP	0.01	0.01	0.00	0.00	0.00
0.1% NaDi + 0.2% NaP85	0.01	0.01	0.00	0.00	0.00
0.1% NaDi + 0.4% NaP85	0.01	0.01	0.00	0.06	0.00
0.15% NaDi + 0.1% NaP85	0.01	0.01	0.00	0.00	0.00
0.15% NaDi + 0.3% NaP85	0.01	0.01	0.00	0.00	0.00
0.2% NaDi + 0.2% NaP85	0.01	0.01	0.00	0.00	0.00
0% NaDi + 0.2% NaP85	0.01	0.01	0.00	0.00	0.00
Control (no injection)	0.01	0.01	0.00	0.00	0.23
Serum/bloody	.6795	0.111			
0.05% NaDi + 0.1% NaP85	0.01	0.01	0.00	0.00	0.00
0.05% NaDi + 0.3% NaP85	0.01	0.01	0.00	0.00	0.00
0.1% NaDi + 0% NaP	0.01	0.01	0.00	0.00	0.00
0.1% NaDi + 0.2% NaP85	0.01	0.01	0.00	0.00	0.00
00.1% NaDi + 0.4% NaP85	0.01	0.01	0.15	0.00	0.00
0.15% NaDi + 0.1% NaP85	0.01	0.01	0.00	0.13	0.00
0.15% NaDi + 0.3% NaP85	0.01	0.01	0.00	0.00	0.00
0.2% NaDi + 0.2% NaP85	0.01	0.01	0.00	0.00	0.00
0% NaDi + 0.2% NaP85	0.01	0.01	0.00	0.00	0.00
Control (no injection)	0.01	0.01	0.00	0.00	0.00
Vinegar[a]	.0118[b]	0.541[c]			
0.05% NaDi[1] + 0.1% NaP85[2]	0.13	0.14	0.17	-0.04	-0.07
0.05% NaDi + 0.3% NaP85	0.13	0.59	0.09	0.30	0.23
0.1% NaDi + 0% NaP	0.33	0.32	0.09	0.30	0.31
0.1% NaDi + 0.2% NaP85	0.13	0.68	0.17	0.30	0.16
0.1% NaDi + 0.4% NaP85	0.13	0.32	0.09	0.03	0.18
0.15% NaDi + 0.1% NaP85	0.27	0.14	0.17	0.30	0.08
0.15% NaDi + 0.3% NaP85	0.27	0.68	0.40	0.36	0.31
0.2% NaDi + 0.2% NaP85	0.13	0.57	0.32	0.36	0.62
0% NaDi + 0.2% NaP85	0.13	0.14	-0.14	0.16	-0.07
Control (no injection)	0.13	0.14	0.01	-0.04	-0.15

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaDi: sodium diacetate, [2]NaP85: sodium phosphate 85

APPENDIX AT

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR BASIC TASTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 5

(n = 666)

	Storage Time, days				
Treatment	0	7	14	21	28
Sour[a]	.0013[b]	0.597[c]			
0.05% NaDi[1] + 0.1% NaP85[2]	2.61	2.74	2.84	2.73	2.65
0.05% NaDi + 0.3% NaP85	2.61	3.02	2.54	2.73	2.88
0.1% NaDi + 0% NaP	2.52	3.38	2.61	3.13	3.03
0.1% NaDi + 0.2% NaP85	2.47	3.02	2.69	3.00	2.96
0.1% NaDi + 0.4% NaP85	2.68	2.93	2.69	2.73	2.92
0.15% NaDi + 0.1% NaP85	2.61	3.02	2.84	3.00	2.65
0.15% NaDi + 0.3% NaP85	2.76	3.20	2.77	2.87	2.96
0.2% NaDi + 0.2% NaP85	2.90	2.83	2.69	2.93	3.11
0% NaDi + 0.2% NaP85	2.40	3.02	2.46	2.60	2.57
Control (no injection)	2.47	2.65	2.23	2.60	2.65
Bitter	.6850	0.473			
0.05% NaDi + 0.1% NaP85	2.59	2.43	3.00	2.56	2.59
0.05% NaDi + 0.3% NaP85	2.45	2.61	2.77	2.76	2.82
0.1% NaDi + 0% NaP	2.61	2.88	2.54	2.96	2.75
0.1% NaDi + 0.2% NaP85	2.52	2.70	2.69	2.56	2.82
0.1% NaDi + 0.4% NaP85	2.66	2.52	2.69	2.70	2.67
0.15% NaDi + 0.1% NaP85	2.59	2.61	2.85	2.63	2.59
0.15% NaDi + 0.3% NaP85	2.73	2.52	2.62	2.76	2.59
0.2% NaDi + 0.2% NaP85	2.66	2.71	2.77	2.63	2.90
0% NaDi + 0.2% NaP85	2.52	2.61	2.62	2.63	2.67
Control (no injection)	2.66	2.61	2.69	2.90	2.67
Sweet	.5323	0.465			
0.05% NaDi + 0.1% NaP85	0.18	0.34	0.21	0.13	0.13
0.05% NaDi + 0.3% NaP85	0.26	0.06	0.05	0.26	0.05
0.1% NaDi + 0% NaP	0.32	0.06	-0.02	0.06	0.05
0.1% NaDi + 0.2% NaP85	0.26	0.25	0.28	0.13	-0.03
0.1% NaDi + 0.4% NaP85	0.26	0.06	-0.02	0.20	0.32
0.15% NaDi + 0.1% NaP85	0.26	0.06	0.28	0.13	0.43
0.15% NaDi + 0.3% NaP85	0.11	0.16	0.21	0.06	0.20
0.2% NaDi + 0.2% NaP85	0.11	0.16	0.05	0.33	-0.03
0% NaDi + 0.2% NaP85	0.18	0.16	-0.02	0.33	0.28
Control (no injection)	0.40	0.25	0.28	0.40	0.43

Treatment		Storage Time, days				
		0	7	14	21	28
Salt[a]	(n = 650)	0.0001	1.317			
0.05% NaDi[1] + 0.1% NaP85[2]		4.33	4.33	6.23	6.14	5.62
0.05% NaDi + 0.3% NaP85		5.90	4.96	5.38	6.68	5.46
0.1% NaDi + 0% NaP		4.54	5.24	5.46	7.61	5.31
0.1% NaDi + 0.2% NaP85		3.90	5.42	5.15	7.21	5.39
0.1% NaDi + 0.4% NaP85		3.97	4.96	5.84	6.08	6.60
0.15% NaDi + 0.1% NaP85		4.76	4.78	5.69	6.21	5.08
0.15% NaDi + 0.3% NaP85		5.04	4.24	5.77	5.68	5.00
0.2% NaDi + 0.2% NaP85		5.19	4.43	4.61	6.74	6.23
0% NaDi + 0.2% NaP85		4.54	5.60	5.30	5.61	5.08
Control (no injection)		2.66	2.60	2.92	2.81	2.46

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaDi: sodium diacetate, [2]NaP85: sodium phosphate 85

APPENDIX AU

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE FLAVOR AFTERTASTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 5

	Storage Time, days				
Treatment	0	7	14	21	28
Sour[a]	.0762[b]	0.803[c]			
0.05% NaDi[1] + 0.1% NaP85[2]	0.76	1.22	0.87	1.02	1.02
0.05% NaDi + 0.3% NaP85	0.97	1.13	0.49	1.29	1.10
0.1% NaDi + 0% NaP	0.92	1.31	0.72	1.42	1.17
0.1% NaDi + 0.2% NaP85	0.69	1.13	0.87	1.49	1.17
0.1% NaDi + 0.4% NaP85	1.12	0.95	0.56	1.09	1.17
0.15% NaDi + 0.1% NaP85	0.76	1.22	1.02	1.09	0.79
0.15% NaDi + 0.3% NaP85	1.12	1.22	1.10	1.15	0.94
0.2% NaDi + 0.2% NaP85	0.90	1.13	1.02	1.42	0.87
0% NaDi + 0.2% NaP85	0.83	1.04	0.49	1.09	1.02
Control (no injection)	0.62	0.40	0.49	0.89	0.63
Salty	.0001	0.914			
0.05% NaDi + 0.1% NaP85	2.02	1.70	2.40	2.98	2.40
0.05% NaDi + 0.3% NaP85	2.73	2.34	1.94	3.45	2.55
0.1% NaDi + 0% NaP	2.07	2.43	2.25	3.25	2.47
0.1% NaDi + 0.2% NaP85	1.73	2.15	2.17	3.25	2.32
0.1% NaDi + 0.4% NaP85	1.73	2.06	2.33	2.58	3.29
0.15% NaDi + 0.1% NaP85	1.95	1.97	2.63	2.85	2.32
0.15% NaDi + 0.3% NaP85	2.23	1.61	2.56	2.85	2.24
0.2% NaDi + 0.2% NaP85	2.30	1.86	1.63	2.71	2.63
0% NaDi + 0.2% NaP85	1.95	2.34	2.40	2.38	2.16
Control (no injection)	0.80	0.88	0.94	1.05	0.70
Bitter	.3538	0.808			
0.05% NaDi + 0.1% NaP85	1.04	0.81	1.50	1.24	1.53
0.05% NaDi + 0.3% NaP85	1.18	1.54	1.50	1.51	1.30
0.1% NaDi + 0% NaP	1.42	1.26	1.57	1.71	1.45
0.1% NaDi + 0.2% NaP85	1.18	1.54	1.34	1.58	1.68
0.1% NaDi + 0.4% NaP85	1.18	1.08	1.42	1.64	1.19
0.15% NaDi + 0.1% NaP85	1.33	1.35	1.27	1.64	1.30
0.15% NaDi + 0.3% NaP85	1.40	1.35	1.04	1.71	1.68
0.2% NaDi + 0.2% NaP85	1.61	1.23	1.27	1.31	1.76
0% NaDi + 0.2% NaP85	1.26	1.63	1.11	1.64	1.15

Treatment	Storage Time, days 0	7	14	21	28
Soapy[a]	.3804[b]	0.242[c]			
0.05% NaDi[1] + 0.1% NaP85[2]	0.03	0.03	0.19	0.04	0.03
0.05% NaDi + 0.3% NaP85	0.10	0.12	0.04	0.17	0.11
0.1% NaDi + 0% NaP	0.07	0.12	0.04	0.17	0.11
0.1% NaDi + 0.2% NaP85	0.10	0.12	0.11	0.17	0.11
0.1% NaDi + 0.4% NaP85	0.10	0.03	-0.04	0.17	0.18
0.15% NaDi + 0.1% NaP85	0.18	0.03	-0.04	-0.03	0.03
0.15% NaDi + 0.3% NaP85	0.03	0.12	0.11	0.11	0.03
0.2% NaDi + 0.2% NaP85	0.03	0.03	0.04	0.17	0.03
0% NaDi + 0.2% NaP85	0.18	0.21	0.11	0.04	-0.04
Control (no injection)	0.03	0.03	0.04	0.04	-0.04
Mouthburn	.5257	1.090			
0.05% NaDi + 0.1% NaP85	-0.01	0.18	0.38	0.49	0.53
0.05% NaDi + 0.3% NaP85	0.14	0.45	0.30	0.56	0.37
0.1% NaDi + 0% NaP	0.17	0.09	0.45	0.76	0.29
0.1% NaDi + 0.2% NaP85	0.14	0.27	0.15	0.69	0.22
0.1% NaDi + 0.4% NaP85	0.06	0.09	0.38	0.76	0.28
0.15% NaDi + 0.1% NaP85	0.14	0.18	0.45	0.42	0.22
0.15% NaDi + 0.3% NaP85	0.14	-0.09	0.38	0.36	0.53
0.2% NaDi + 0.2% NaP85	-0.08	0.51	0.15	1.69	0.53
0% NaDi + 0.2% NaP85	0.06	0.36	0.30	0.62	0.45
Control (no injection)	-0.08	0.00	0.15	0.22	-0.01
Soda	.0001	0.673			
0.05% NaDi + 0.1% NaP85	1.47	1.60	2.03	1.93	2.02
0.05% NaDi + 0.3% NaP85	1.82	2.24	2.03	2.06	1.94
0.1% NaDi + 0% NaP	1.69	2.15	2.03	2.20	2.09
0.1% NaDi + 0.2% NaP85	1.82	1.87	1.80	2.13	2.09
00.1% NaDi + 0.4% NaP85	1.61	1.87	1.95	1.60	2.12
0.15% NaDi + 0.1% NaP85	1.61	1.69	1.88	1.86	1.71
0.15% NaDi + 0.3% NaP85	1.82	1.78	2.03	2.06	1.86
0.2% NaDi + 0.2% NaP85	1.61	1.86	1.95	1.60	2.02
0% NaDi + 0.2% NaP85	1.54	1.96	1.64	1.60	1.78
Control (no injection)	0.68	1.33	0.72	1.26	0.86

Treatment		Storage Time, days				
		0	7	14	21	28
Chemical[a]	(n = 650)	.0142[b]	0.531[c]			
0.05% NaDi[1] + 0.1% NaP85[2]		0.08	-0.02	0.33	0.52	0.22
0.05% NaDi + 0.3% NaP85		0.08	-0.02	0.26	0.45	0.30
0.1% NaDi + 0% NaP		0.28	-0.02	0.10	0.45	0.30
0.1% NaDi + 0.2% NaP85		0.08	-0.02	0.33	0.58	0.37
0.1% NaDi + 0.4% NaP85		0.15	-0.02	0.33	0.65	0.55
0.15% NaDi + 0.1% NaP85		0.08	-0.02	0.33	0.38	0.30
0.15% NaDi + 0.3% NaP85		0.08	0.16	0.33	0.38	0.30
0.2% NaDi + 0.2% NaP85		0.15	0.00	0.26	0.32	0.60
0% NaDi + 0.2% NaP85		0.01	-0.02	0.18	0.32	0.30
Control (no injection)		0.08	-0.02	0.18	0.58	0.30
Metallic		.8437	0.493			
0.05% NaDi + 0.1% NaP85		0.58	0.63	0.37	0.53	0.52
0.05% NaDi + 0.3% NaP85		0.44	0.63	0.45	0.53	0.60
0.1% NaDi + 0% NaP		0.55	0.72	0.21	0.60	0.60
0.1% NaDi + 0.2% NaP85		0.51	0.63	0.37	0.53	0.60
0.1% NaDi + 0.4% NaP85		0.51	0.63	0.29	0.53	0.53
0.15% NaDi + 0.1% NaP85		0.51	0.72	0.45	0.53	0.68
0.15% NaDi + 0.3% NaP85		0.58	0.72	0.45	0.60	0.60
0.2% NaDi + 0.2% NaP85		0.58	0.62	0.45	0.60	0.68
0% NaDi + 0.2% NaP85		0.52	0.54	0.21	0.47	0.76
Control (no injection)		0.80	0.54	0.45	0.73	0.45
Mature		.9999	0.348			
0.05% NaDi + 0.1% NaP85		0.02	0.04	0.14	0.13	0.02
0.05% NaDi + 0.3% NaP85		0.02	0.04	0.14	0.20	0.02
0.1% NaDi + 0% NaP		0.09	0.04	0.14	0.13	0.02
0.1% NaDi + 0.2% NaP85		0.02	0.04	0.14	0.13	0.02
0.1% NaDi + 0.4% NaP85		0.02	0.04	-0.01	0.20	0.08
0.15% NaDi + 0.1% NaP85		0.02	0.04	0.14	0.13	0.02
0.15% NaDi + 0.3% NaP85		0.02	0.04	0.14	0.13	0.02
0.2% NaDi + 0.2% NaP85		0.02	0.05	0.14	0.06	0.02
0% NaDi + 0.2% NaP85		0.02	0.04	0.14	0.13	0.02
Control (no injection)		0.02	0.04	0.14	0.20	0.02

Treatment	Storage Time, days				
	0	7	14	21	28
Browned[a]	.3846[b]	0.400[c]			
0.05% NaDi[1] + 0.1% NaP85[2]	0.17	0.14	0.05	0.17	0.01
0.05% NaDi + 0.3% NaP85	0.10	0.05	0.44	0.17	0.01
0.1% NaDi + 0% NaP	0.27	0.05	0.29	0.24	0.01
0.1% NaDi + 0.2% NaP85	0.10	0.05	0.21	0.17	0.16
0.1% NaDi + 0.4% NaP85	0.17	0.05	0.21	0.04	0.19
0.15% NaDi + 0.1% NaP85	0.10	0.24	0.21	0.11	0.16
0.15% NaDi + 0.3% NaP85	0.10	0.14	0.36	0.17	0.16
0.2% NaDi + 0.2% NaP85	0.10	0.26	0.05	0.17	0.16
0% NaDi + 0.2% NaP85	0.24	0.05	0.59	0.04	0.01
Control (no injection)	0.24	0.05	0.21	0.04	0.01

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaDi: sodium diacetate, [2]NaP85: sodium phosphate 85

APPENDIX AV

LEAST SQUARES MEANS FOR SENSORY DESCRIPTIVE ATTRIBUTE MOUTHFEELS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 5 (n = 666)

	Storage Time, days				
Treatment	0	7	14	21	28
Metallic[a]	.0058[b]	0.510[c]			
0.05% NaDi[1] + 0.1% NaP85[2]	2.54	2.04	2.47	2.37	2.50
0.05% NaDi + 0.3% NaP85	2.39	2.13	2.39	2.44	2.27
0.1% NaDi + 0% NaP	2.59	2.40	2.31	2.57	2.58
0.1% NaDi + 0.2% NaP85	2.47	2.22	2.31	2.57	2.35
0.1% NaDi + 0.4% NaP85	2.32	1.94	2.39	2.24	2.44
0.15% NaDi + 0.1% NaP85	2.68	2.13	2.31	2.50	2.42
0.15% NaDi + 0.3% NaP85	2.75	2.22	2.31	2.30	2.42
0.2% NaDi + 0.2% NaP85	2.61	2.21	2.16	2.30	2.81
0% NaDi + 0.2% NaP85	2.47	2.13	2.08	2.17	2.35
Control (no injection)	2.39	2.04	2.16	2.44	2.19
Astringent (n = 650)	.0001	0.414			
0.05% NaDi + 0.1% NaP85	2.75	2.47	3.00	2.87	2.79
0.05% NaDi + 0.3% NaP85	2.82	2.93	2.77	2.87	3.10
0.1% NaDi + 0% NaP	2.67	3.02	2.77	3.13	2.94
0.1% NaDi + 0.2% NaP85	2.61	2.84	2.62	3.20	2.94
0.1% NaDi + 0.4% NaP85	2.54	2.65	2.77	2.87	2.96
0.15% NaDi + 0.1% NaP85	2.82	2.65	2.62	3.13	2.64
0.15% NaDi + 0.3% NaP85	3.04	2.93	2.93	3.13	3.02
0.2% NaDi + 0.2% NaP85	2.75	2.86	2.77	3.00	3.17
0% NaDi + 0.2% NaP85	2.54	2.75	2.54	2.87	2.64
Control (no injection)	2.56	2.47	2.47	2.53	2.48

[a] Sample evaluation on a 15-point scale for 0=extremely bland and 15=extremely intense.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[1]NaDi: sodium diacetate, [2]NaP85: sodium phosphate 85

APPENDIX AW

LEAST SQUARES MEANS FROM STORAGE DAY ANALYSIS FOR EXPERIMENT 5

Storage Day			
Cardboardy		(n = 661)	.0010[a]
0	0.00		
7	0.01		
14	0.01		
21	0.02		
28	0.10		
Browned		(n = 661)	<.0001
0	0.31		
7	0.38		
14	0.47		
21	0.69		
28	0.84		
Chemical		(n = 661)	<.0001
0	0.59		
7	0.57		
14	0.95		
21	1.03		
28	0.72		
Aftertaste sour		(n = 661)	<.0001
0	0.89		
7	1.12		
14	1.35		
21	1.57		
28	1.19		
Aftertaste bitter		(n = 661)	.0009
0	1.14		
7	1.25		
14	1.45		
21	1.67		
28	1.42		
Aftertaste mouthburn		(n = 661)	.0016
0	0.14		
7	0.31		
14	0.32		
21	0.70		
28	0.43		
Aftertaste mature		(n = 661)	.0001
0	0.00		
7	0.01		
14	0.14		
21	0.15		
28	0.01		

Storage Day			
Aftertaste browned		(n = 661)	.0315
0	0.31		
7	0.38		
14	0.47		
21	0.67		
28	0.84		
Aftertaste metallic		(n = 661)	.0476
0	0.47		
7	0.45		
14	0.68		
21	0.77		
28	0.61		
Cook loss		(n = 149)	.0270
0	20.82		
7	16.58		
14	18.80		
21	16.94		
28	17.46		
pH		(n = 149)	<.0001
0	5.64		
7	5.79		
14	5.53		
21	5.72		
28	5.83		

[a] P- value from Analysis of Variance table of SAS (1999)

APPENDIX AX

LEAST SQUARES MEANS FOR SENSORY MEAT DESCRIPTIVE TEXTURE ATTRIBUTES FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 5 (n = 650)

	Storage Time, days				
Treatment	0	7	14	21	28
Muscle fiber tenderness[a]	.0001[b]	0.744[c]			
0.05% NaDi[1] + 0.1% NaP85[2]	6.39	7.01	7.35	6.72	7.14
0.05% NaDi + 0.3% NaP85	6.97	6.83	6.65	6.86	6.37
0.1% NaDi + 0% NaP	6.42	7.19	7.12	7.19	7.06
0.1% NaDi + 0.2% NaP85	6.75	7.56	7.12	7.59	7.14
0.1% NaDi + 0.4% NaP85	6.25	6.46	6.73	7.19	7.14
0.15% NaDi + 0.1% NaP85	6.39	6.37	6.27	6.59	6.53
0.15% NaDi + 0.3% NaP85	6.75	6.46	6.58	6.46	7.06
0.2% NaDi + 0.2% NaP85	6.82	6.85	6.35	7.39	6.53
0% NaDi + 0.2% NaP85	6.04	7.01	6.96	6.39	6.91
Control (no injection)	6.28	5.83	5.89	6.39	7.14
Juiciness	.0001	0.729			
0.05% NaDi + 0.1% NaP85	4.23	4.90	5.12	4.45	4.86
0.05% NaDi + 0.3% NaP85	4.09	4.54	4.43	5.25	4.24
0.1% NaDi + 0% NaP	3.81	5.27	4.74	5.32	4.78
0.1% NaDi + 0.2% NaP85	3.59	4.99	4.82	5.05	4.78
0.1% NaDi + 0.4% NaP85	3.94	4.27	5.28	4.65	4.75
0.15% NaDi + 0.1% NaP85	3.80	4.63	4.20	4.85	4.16
0.15% NaDi + 0.3% NaP85	4.23	4.72	4.74	4.72	4.55
0.2% NaDi + 0.2% NaP85	4.16	4.82	4.12	5.25	5.01
0% NaDi + 0.2% NaP85	3.87	4.90	4.82	4.79	4.47
Control (no injection)	3.60	3.81	3.82	4.59	3.70
Processed meat-like bite[d]	.0001	1.950			
0.05% NaDi + 0.1% NaP85	9.03	11.56	10.03	10.47	10.68
0.05% NaDi + 0.3% NaP85	10.53	9.56	9.80	11.60	9.30
0.1% NaDi + 0% NaP	9.12	11.92	10.80	11.54	10.84
0.1% NaDi + 0.2% NaP85	8.60	11.56	10.34	11.80	11.76
0.1% NaDi + 0.4% NaP85	9.39	9.74	10.64	11.60	11.83
0.15% NaDi + 0.1% NaP85	10.10	9.47	8.41	10.80	9.22
0.15% NaDi + 0.3% NaP85	9.39	9.01	10.72	9.14	10.99
0.2% NaDi + 0.2% NaP85	9.82	10.86	9.49	12.47	10.84
0% NaDi + 0.2% NaP85	8.67	11.38	10.41	10.27	10.53
Control (no injection)	6.80	7.01	6.80	10.07	8.68

[a]Sample evaluation on a 8-point scale for 0 = extremely tough; dry and 15 = extremely tender;juicy.
[b] P- value from Analysis of Variance table of SAS (1999).
[c] Root mean squares error.
[d] Sample evaluation on a 15-point scale for 0 = not processed and 15 = extremely processed.
[1]NaDi: sodium diacetate, [2]NaP85: sodium phosphate 85

APPENDIX AY

LEAST SQUARES MEANS FOR SUBJECTIVE COLOR FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 5 (n = 651)

	Storage Time, days				
Treatment	0	7	14	21	28
Color[a]	.0001[b]	0.751[c]			
0.05% NaDi[1] + 0.1% NaP85[2]	4.12	3.35	3.52	3.32	3.55
0.05% NaDi + 0.3% NaP85	3.47	2.99	3.13	3.05	3.09
0.1% NaDi + 0% NaP	2.80	2.72	2.75	2.92	2.17
0.1% NaDi + 0.2% NaP85	3.19	2.53	3.21	3.05	3.17
0.1% NaDi + 0.4% NaP85	3.04	2.53	3.36	2.65	3.11
0.15% NaDi + 0.1% NaP85	3.54	3.08	3.13	3.12	3.02
0.15% NaDi + 0.3% NaP85	2.97	2.44	2.90	2.58	2.94
0.2% NaDi + 0.2% NaP85	3.19	3.06	3.05	3.38	2.86
0% NaDi + 0.2% NaP85	3.26	2.99	2.75	2.98	3.09
Control (no injection)	2.26	1.81	2.28	1.78	2.02
Amount of Discoloration	.0001	1.256			
0.05% NaDi + 0.1% NaP85	2.04	1.56	1.44	1.41	1.48
0.05% NaDi + 0.3% NaP85	2.75	2.20	1.52	3.34	1.17
0.1% NaDi + 0% NaP	2.34	3.20	2.37	2.34	2.48
0.1% NaDi + 0.2% NaP85	2.39	1.92	1.98	2.08	1.32
0.1% NaDi + 0.4% NaP85	2.89	3.38	2.60	2.61	2.82
0.15% NaDi + 0.1% NaP85	2.75	1.56	2.44	2.14	2.40
0.15% NaDi + 0.3% NaP85	2.54	2.29	1.60	1.94	1.86
0.2% NaDi + 0.2% NaP85	2.97	2.28	2.52	2.28	1.48
0% NaDi + 0.2% NaP85	2.25	2.65	1.60	2.14	1.79
Control (no injection)	2.32	1.38	2.29	2.61	2.17
Color of Discoloration[d] (n = 515)	.0001	1.268			
0.05% NaDi + 0.1% NaP85	3.06	2.09	2.15	1.32	0.89
0.05% NaDi + 0.3% NaP85	2.69	1.93	2.34	1.92	1.00
0.1% NaDi + 0% NaP	2.30	2.29	2.84	1.19	0.53
0.1% NaDi + 0.2% NaP85	2.30	1.89	2.07	1.70	1.58
0.1% NaDi + 0.4% NaP85	2.44	2.02	2.84	2.52	1.49
0.15% NaDi + 0.1% NaP85	2.68	2.25	2.64	2.01	1.83
0.15% NaDi + 0.3% NaP85	2.75	2.26	2.52	1.54	1.00
0.2% NaDi + 0.2% NaP85	2.66	2.48	2.49	2.19	1.46
0% NaDi + 0.2% NaP85	2.42	2.69	2.06	1.91	2.16
Control (no injection)	1.92	1.45	1.59	2.25	0.84

[a] Sample evaluation for Color and Color of Discoloration on a 6-point National Pork Board color scale for 1=extremely light and 6=extremely dark.
[b] P- value from Analysis of Variance table of SAS (1999)
[c] Root mean squares error
[d]Sample evaluation for Amount of Discoloration on a 7-point scale, 1 = no discoloration and 7 =
[1]NaDi: sodium diacetate, [2]NaP85: sodium phosphate 85

APPENDIX AZ

LEAST SQUARES MEANS FOR OBJECTIVE COLOR FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 5 (n = 128)

		Storage Time, days				
Treatment		0	7	14	21	28
L*	(n = 129)	.0010[a]	2.685[b]			
0.05% NaDi[1] + 0.1% NaP85[2]		48.52	49.29	51.76	51.37	50.38
0.05% NaDi + 0.3% NaP85		50.98	49.25	52.78	53.54	50.79
0.1% NaDi + 0% NaP		50.80	51.49	54.39	53.76	52.86
0.1% NaDi + 0.2% NaP85		51.44	53.63	52.97	52.93	50.09
0.1% NaDi + 0.4% NaP85		53.21	50.85	48.80	57.49	53.35
0.15% NaDi + 0.1% NaP85		51.12	51.09	53.68	53.60	52.30
0.15% NaDi + 0.3% NaP85		52.68	51.55	54.18	52.97	53.51
0.2% NaDi + 0.2% NaP85		53.15	50.68	53.03	50.39	51.19
0% NaDi + 0.2% NaP85		51.37	50.21	53.66	52.76	50.55
Control (no injection)		56.60	54.04	59.19	59.65	58.37
a*	.1484		1.295			
0.05% NaDi + 0.1% NaP85		6.38	6.94	6.52	5.62	7.45
0.05% NaDi + 0.3% NaP85		5.42	6.03	5.58	5.79	5.47
0.1% NaDi + 0% NaP		6.48	6.77	6.74	6.32	7.34
0.1% NaDi + 0.2% NaP85		6.16	6.58	5.65	5.14	5.17
0.1% NaDi + 0.4% NaP85		6.59	7.36	6.00	6.58	6.40
0.15% NaDi + 0.1% NaP85		5.84	7.33	6.00	6.16	7.14
0.15% NaDi + 0.3% NaP85		6.82	8.27	6.41	7.06	6.92
0.2% NaDi + 0.2% NaP85		5.03	6.39	6.04	6.81	6.21
0% NaDi + 0.2% NaP85		4.97	6.28	5.48	5.50	6.60
Control (no injection)		7.65	8.44	7.28	7.62	10.20
b*	.0012		1.139			
0.05% NaDi + 0.1% NaP85		2.36	3.35	2.61	2.54	3.87
0.05% NaDi + 0.3% NaP85		2.13	2.15	2.68	3.52	2.63
0.1% NaDi + 0% NaP		3.06	3.36	3.37	3.54	4.66
0.1% NaDi + 0.2% NaP85		2.82	3.37	2.14	2.75	2.29
0.1% NaDi + 0.4% NaP85		3.44	3.75	2.99	4.97	4.76
0.15% NaDi + 0.1% NaP85		2.52	3.65	3.19	3.52	4.63
0.15% NaDi + 0.3% NaP85		3.37	4.12	3.78	4.09	4.32
0.2% NaDi + 0.2% NaP85		2.91	2.93	2.75	3.01	4.16
0% NaDi + 0.2% NaP85		2.16	2.88	2.73	2.96	3.62
Control (no injection)		4.30	4.60	5.69	6.34	7.74

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaDi: sodium diacetate, [2]NaP85: sodium phosphate 85

APPENDIX AAA

LEAST SQUARES MEANS AND REGRESSION EQUATIONS FOR CIE A* COLOR SPACE VALUES AND DRIP LOSS FROM TREATMENT ANALYSIS FOR EXPERIMENT 5

Treatment	Least Squares Means			Regression Equation
*a**	(n = 128)	<.0001[a]	1.295[b]	
0.05% NaDi[1] + 0.1% NaP85[2]	6.58			
0.05% NaDi + 0.3% NaP85	5.66			
0.1% NaDi + 0% NaP85	6.73			
0.1% NaDi + 0.2% NaP85	5.74			
0.1% NaDi + 0.4% NaP85	6.59			
0.15% NaDi + 0.1% NaP85	6.49			
0.15% NaDi + 0.3% NaP85	7.09			
0.2% NaDi + 0.2% NaP85	6.10			
0% NaDi + 2% NaP85	5.76			
Control (no injection)	8.24			
Intercept				8.19
Sodium diacetate (NaDi)				-12.54
Sodium phosphates (NaP)				-15.76
NaDi x NaDi				-5.06
NaP x NaDi				83.89
NaP x NaP				16.99
R^2				90.18
Drip loss	(n = 139)	.0119[a]	0.447[b]	
0.05% NaDi + 0.1% NaP85	4.25			
0.05% NaDi + 0.3% NaP85	3.60			
0.1% NaDi + 0% NaP85	5.85			
0.1% NaDi + 0.2% NaP85	4.55			
0.1% NaDi + 0.4% NaP85	3.90			
0.15% NaDi + 0.1% NaP85	3.95			
0.15% NaDi + 0.3% NaP85	4.10			
0.2% NaDi + 0.2% NaP85	3.85			
0% NaDi + 0.2% NaP85	5.10			
Control (no injection)	6.55			
Intercept				6.60
Sodium diacetate (NaDi)				-14.64
Sodium phosphates (NaP)				-13.17
NaDi x NaDi				28.69
NaP x NaDi				26.03
NaP x NaP				26.04
R^2				87.63

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]KL: potassium lactate, [2]NaP: sodium phosphate 85

APPENDIX AAB

LEAST SQUARES MEANS FOR COOK TIME, COOK LOSS, AND PACKAGE PURGE FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 5 (n = 149)

	Storage Time, days				
Treatment	0	7	14	21	28
Cook time	.8737[a]	4.527[b]			
0.05% NaDi[1] + 0.1% NaP85[2]	20.67	18.33	18.00	19.33	19.00
0.05% NaDi + 0.3% NaP85	21.33	20.00	21.33	15.33	19.67
0.1% NaDi + 0% NaP	22.33	18.67	20.33	21.33	20.33
0.1% NaDi + 0.2% NaP85	24.00	27.33	22.67	22.00	22.00
0.1% NaDi + 0.4% NaP85	16.67	20.67	19.00	16.00	23.13
0.15% NaDi + 0.1% NaP85	24.33	20.00	21.67	17.67	22.00
0.15% NaDi + 0.3% NaP85	19.33	18.67	22.33	20.00	20.00
0.2% NaDi + 0.2% NaP85	22.33	21.00	20.67	20.00	19.67
0% NaDi + 0.2% NaP85	21.33	18.67	21.67	25.33	22.00
Control (no injection)	24.00	21.67	22.67	22.00	20.67
Cook loss	.5604	5.580			
0.05% NaDi + 0.1% NaP85	31.35	16.36	13.68	18.24	15.37
0.05% NaDi + 0.3% NaP85	16.57	15.22	17.53	12.93	16.93
0.1% NaDi + 0% NaP	21.44	15.03	19.25	15.80	15.78
0.1% NaDi + 0.2% NaP85	22.06	13.12	19.16	14.93	18.27
0.1% NaDi + 0.4% NaP85	17.54	17.85	15.48	16.08	16.69
0.15% NaDi + 0.1% NaP85	22.15	17.16	21.23	17.10	18.40
0.15% NaDi + 0.3% NaP85	18.79	18.93	21.22	18.65	17.21
0.2% NaDi + 0.2% NaP85	17.25	16.03	18.86	16.52	15.49
0% NaDi + 0.2% NaP85	17.76	15.44	18.48	18.41	18.28
Control (no injection)	23.28	20.71	23.13	20.76	22.14
Package Purge (n = 116)	.5848	9.583			
0.05% NaDi + 0.1% NaP85	.	4.75	4.55	4.87	4.47
0.05% NaDi + 0.3% NaP85	.	4.09	4.16	4.27	4.26
0.1% NaDi + 0% NaP	.	4.38	4.58	4.05	4.98
0.1% NaDi + 0.2% NaP85	.	4.86	4.53	3.87	4.36
0.1% NaDi + 0.4% NaP85	.	4.58	4.86	4.88	5.01
0.15% NaDi + 0.1% NaP85	.	4.80	4.68	4.19	4.77
0.15% NaDi + 0.3% NaP85	.	4.47	4.82	4.25	4.51
0.2% NaDi + 0.2% NaP85	.	4.31	4.24	4.27	4.93
0% NaDi + 0.2% NaP85	.	4.32	3.88	3.92	4.02
Control (no injection)	.	5.29	5.68	4.77	4.92

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaDi: sodium diacetate, [2]NaP85: sodium phosphate 85

APPENDIX AAC

LEAST SQUARES MEANS FOR PH AND DRIP LOSS FROM TREATMENT X STORAGE DAY ANALYSIS FROM EXPERIMENT 5

Treatment		Storage Time, days				
		0	7	14	21	28
pH	(n = 149)	.0521[a]	0.191[b]			
0.05% NaDi[1] + 0.1% NaP85[2]		5.89	5.85	5.56	5.80	5.91
0.05% NaDi + 0.3% NaP85		5.67	5.85	5.46	5.90	5.92
0.1% NaDi + 0% NaP		5.49	5.90	5.53	5.60	5.73
0.1% NaDi + 0.2% NaP85		5.59	5.75	5.54	5.74	5.80
0.1% NaDi + 0.4% NaP85		5.65	5.75	5.67	5.75	5.97
0.15% NaDi + 0.1% NaP85		5.62	5.73	5.51	5.65	5.82
0.15% NaDi + 0.3% NaP85		5.63	5.76	5.51	5.60	5.73
0.2% NaDi + 0.2% NaP85		5.63	5.83	5.50	5.72	5.80
0% NaDi + 0.2% NaP85		5.63	5.86	5.55	5.71	5.87
Control (no injection)		5.58	5.66	5.45	5.70	5.77
Drip loss	(n = 138)	.3744	2.235			
0.05% NaDi + 0.1% NaP85		4.35	4.40	4.25	5.00	3.20
0.05% NaDi + 0.3% NaP85		3.60	3.30	5.00	1.80	4.35
0.1% NaDi + 0% NaP		9.65	3.80	4.75	6.75	4.40
0.1% NaDi + 0.2% NaP85		4.50	4.75	5.75	4.20	3.50
0.1% NaDi + 0.4% NaP85		4.10	3.60	4.70	3.80	3.35
0.15% NaDi + 0.1% NaP85		4.50	3.70	3.80	3.65	4.05
0.15% NaDi + 0.3% NaP85		2.85	4.00	4.10	6.40	3.05
0.2% NaDi + 0.2% NaP85		3.65	3.85	4.15	4.20	3.40
0% NaDi + 0.2% NaP85		5.70	4.55	5.50	5.15	4.60
Control (no injection)		6.45	5.75	6.10	8.30	6.10

[a] P- value from Analysis of Variance table of SAS (1999)
[b] Root mean squares error
[1]NaDi: sodium diacetate, [2]NaP85: sodium phosphate 85

APPENDIX AAD

REGRESSION EQUATIONS FOR VARIABLES WITH TREATMENT X STORAGE DAY INTERACTIONS IN EXPERIMENT 1

	Storage Time, days				
Attribute and Variable	0	7	14	21	28
Pork lean/brothy					
Intercept	6.5	5.4	5.6	4.5	5.0
Sodium chloride (NaCl)	0.8	0.6	1.5	2.9	2.4
Sodium phosphates (NaP)	-2.7	2.3	-0.5	1.8	-0.4
NaCl x NaCl	-0.7	-0.8	-0.9	-1.0	-1.3
NaP x NaCl	2.5	1.8	2.2	-1.7	1.5
NaP x NaP	8.2	-11.6	-3.8	-1.3	-4.0
R^2	78.47	45.40	70.10	85.93	90.27
Pork fat					
Intercept	1.6	1.4	1.8	1.7	1.3
Sodium chloride (NaCl)	0.6	0.4	-0.2	0.5	1.1
Sodium phosphates (NaP)	0.0	0.4	-2.0	-1.4	-0.6
NaCl x NaCl	-0.6	-0.3	0.2	-0.4	-0.3
NaP x NaCl	1.9	0.0	0.2	1.5	-0.9
NaP x NaP	-1.2	-2.2	6.4	0.8	3.2
R^2	83.13	24.63	79.2	83.96	98.57
Cardboardy					
Intercept	0.1	0.0	0.1	0.1	0.2
Sodium chloride (NaCl)	0.0	0.1	-0.1	-0.1	-0.2
Sodium phosphates (NaP)	0.0	0.1	-0.4	-0.1	1.4
NaCl x NaCl	0.0	0.0	0.0	0.1	0.0
NaP x NaCl	0.1	-0.2	0.4	-0.2	0.4
NaP x NaP	-0.4	0.0	0.6	1.1	-4.6
R^2	24.48	32.46	90.43	94.49	43.56
Soda					
Intercept	0.9	0.9	1.0	0.9	1.0
Sodium chloride (NaCl)	0.1	0.5	0.2	0.5	1.0
Sodium phosphates (NaP)	-1.0	-3.0	-0.6	0.7	1.5
NaCl x NaCl	0.0	-0.4	-0.1	-0.6	-0.5
NaP x NaCl	-0.6	2.2	0.6	3.0	0.1
NaP x NaP	6.5	2.8	2.1	-7.0	-4.3
R^2	39.82	82.34	59.41	65.1	91.32
Chemical					
Intercept	0.5	0.2	0.1	0.1	0.2
Sodium chloride (NaCl)	-0.5	0.0	0.2	0.2	0.4
Sodium phosphates (NaP)	-1.8	-0.8	0.7	0.9	1.4
NaCl x NaCl	0.4	0.0	0.1	0.2	0.3
NaP x NaCl	-0.8	-0.4	0.7	1.0	1.6
NaP x NaP	6.8	2.6	2.0	2.7	4.3
R^2	46.38	46.58	67.39	71.73	49.43

Attribute and Variable	Storage Time, days 0	7	14	21	28
Sour					
Intercept	1.5	1.6	1.6	1.7	1.6
Sodium chloride (NaCl)	0.5	-0.4	0.1	0.4	0.5
Sodium phosphates (NaP)	0.3	-2.1	-1.4	-0.6	-0.3
NaCl x NaCl	-0.2	0.5	0.1	-0.2	0.1
NaP x NaCl	-0.1	0.0	-0.6	0.0	-2.5
NaP x NaP	-1.3	6.6	5.2	1.0	7.1
R^2	21.18	66.75	47.61	58.19	77.8
Bitter					
Intercept	1.6	1.5	1.8	2.0	2.6
Sodium chloride (NaCl)	0.2	0.2	-0.1	0.0	-0.8
Sodium phosphates (NaP)	-0.3	1.4	-1.0	-0.3	-2.1
NaCl x NaCl	0.0	-0.2	0.1	-0.1	0.5
NaP x NaCl	-0.2	0.1	-0.1	0.9	0.8
NaP x NaP	0.2	-4.2	3.1	-1.5	2.7
R^2	76.99	37.73	21.5	11.42	84.52
Sweet					
Intercept	1.1	1.1	0.5	0.2	-0.1
Sodium chloride (NaCl)	0.1	-0.3	0.6	0.9	0.8
Sodium phosphates (NaP)	0.9	-1.5	0.7	1.7	0.3
NaCl x NaCl	-0.4	0.1	0.0	-0.5	-0.5
NaP x NaCl	1.6	0.2	-2.3	-0.2	1.6
NaP x NaP	-5.0	3.0	0.7	-6.0	-2.3
R^2	62.39	57.84	49.31	69.25	74.08
Salt					
Intercept	2.3	2.1	1.7	1.7	1.7
Sodium chloride (NaCl)	1.6	1.6	3.5	2.9	3.0
Sodium phosphates (NaP)	1.8	-3.2	5.3	-0.1	-1.2
NaCl x NaCl	-0.9	0.1	-2.1	-0.7	-0.6
NaP x NaCl	1.2	-3.9	5.3	0.6	-0.3
NaP x NaP	-1.6	14.8	-23.1	0.2	3.5
R^2	54.24	59.12	89.39	97.55	92.72
Aftertaste sour					
Intercept	-0.1	0.1	0.4	0.5	0.3
Sodium chloride (NaCl)	-0.1	-0.2	-0.3	-0.7	0.1
Sodium phosphates (NaP)	0.7	-1.2	-1.3	-1.5	-0.6
NaCl x NaCl	0.2	0.3	0.2	0.4	0.2
NaP x NaCl	-1.3	-0.4	-0.3	0.1	-2.9
NaP x NaP	1.8	4.7	4.2	5.3	7.1
R^2	61.81	51.28	15.6	66.92	85.19

Attribute and Variable	Storage Time, days				
	0	7	14	21	28
Aftertaste *salty*					
Intercept	0.3	0.3	0.1	-0.2	-0.2
Sodium chloride (NaCl)	0.2	0.1	0.9	0.9	0.7
Sodium phosphates (NaP)	-0.6	-2.7	0.0	1.6	0.6
NaCl x NaCl	0.3	0.2	-0.4	0.0	0.1
NaP x NaCl	-2.8	-0.7	2.9	0.2	2.0
NaP x NaP	8.3	8.7	-5.4	-3.8	-3.6
R^2	35.49	39.03	90.21	91.54	98.22
Aftertaste *bitter*					
Intercept	0.7	0.5	0.9	1.1	1.3
Sodium chloride (NaCl)	-0.7	-0.3	0.2	0.1	-0.7
Sodium phosphates (NaP)	-4.1	0.3	-0.7	-0.1	-0.1
NaCl x NaCl	0.4	-0.1	-0.4	-0.2	0.5
NaP x NaCl	1.5	1.0	1.5	-0.1	-1.2
NaP x NaP	7.1	-0.8	-1.5	-1.8	-0.2
R^2	72.64	33.05	35.15	58.14	74.29
Aftertaste *soda*					
Intercept	0.4	0.1	0.2	0.4	0.2
Sodium chloride (NaCl)	0.1	0.7	0.3	0.0	0.0
Sodium phosphates (NaP)	-0.6	-0.8	-0.8	0.0	-0.6
NaCl x NaCl	0.0	-0.5	-0.4	0.3	0.5
NaP x NaCl	-1.0	1.5	3.0	-1.3	-2.3
NaP x NaP	3.3	0.2	-1.7	1.3	6.8
R^2	14.37	76.52	75.9	22.8	83.06
Aftertaste *metallic*					
Intercept	0.1	0.2	0.2	0.4	0.5
Sodium chloride (NaCl)	0.4	-0.2	-0.2	-0.1	-0.4
Sodium phosphates (NaP)	0.2	-0.5	0.6	-1.1	0.7
NaCl x NaCl	-0.5	0.1	0.0	0.0	0.2
NaP x NaCl	1.7	0.3	0.3	0.9	-0.4
NaP x NaP	-4.8	0.9	-2.0	1.1	-1.1
R^2	85.19	55.78	61.34	50.73	67.11
Aftertaste *mature*					
Intercept	0.0	0.1	0.0	0.1	0.1
Sodium chloride (NaCl)	0.1	0.0	0.0	-0.4	0.0
Sodium phosphates (NaP)	0.4	-0.1	0.0	-0.2	-0.5
NaCl x NaCl	-0.1	-0.1	0.0	0.3	0.0
NaP x NaCl	0.5	0.7	0.0	-0.8	0.5
NaP x NaP	-1.9	-1.2	0.0	4.2	0.0
R^2	38.72	48.26	100	82.98	81.27

Attribute and Variable	Storage Time, days				
	0	7	14	21	28
Muscle Fiber Tenderness					
Intercept	9.3	8.6	10.6	10.5	9.5
Sodium chloride (NaCl)	0.6	0.7	1.7	1.1	2.9
Sodium phosphates (NaP)	-5.0	3.4	-1.0	-0.8	1.1
NaCl x NaCl	-0.5	1.2	-1.5	-1.3	-1.2
NaP x NaCl	1.8	-12.4	6.5	10.0	-0.1
NaP x NaP	20.7	13.5	-7.9	-13.7	-1.5
R^2	51.7	85.67	55.55	72.15	83.59
Juiciness					
Intercept	3.0	3.2	3.5	3.2	2.5
Sodium chloride (NaCl)	0.5	0.1	0.4	0.5	1.7
Sodium phosphates (NaP)	2.6	0.7	-3.0	-1.3	1.4
NaCl x NaCl	-0.3	0.5	-0.5	-0.3	-0.5
NaP x NaCl	1.0	-3.6	3.8	1.9	-1.2
NaP x NaP	-2.8	4.8	2.3	1.7	-2.1
R^2	75.81	38.7	57.26	71.1	89.51
Processed meat like texture					
Intercept	0.8	1.9	2.4	3.9	2.6
Sodium chloride (NaCl)	1.3	-0.3	1.0	0.6	2.8
Sodium phosphates (NaP)	3.1	0.4	4.1	-2.7	-0.3
NaCl x NaCl	-1.1	1.0	-1.2	-0.6	-0.3
NaP x NaCl	1.4	-2.9	7.4	5.3	-7.8
NaP x NaP	-5.0	10.2	-18.0	3.4	17.6
R^2	53.21	75.55	84.05	92.41	93.55
Color					
Intercept	2.7	2.4	2.1	2.6	1.7
Sodium chloride (NaCl)	0.4	0.4	1.2	-0.2	1.3
Sodium phosphates (NaP)	1.7	-0.9	4.2	2.7	5.4
NaCl x NaCl	-1.1	-0.2	-1.1	-0.4	-1.0
NaP x NaCl	8.1	1.2	4.1	3.5	2.4
NaP x NaP	-15.9	0.1	-15.8	-7.1	-15.3
R^2	66.23	36.47	72.66	85.33	81.61
Amount of discoloration					
Intercept	2.3	2.0	1.6	1.7	1.5
Sodium chloride (NaCl)	0.2	-0.1	-0.1	-0.9	-0.1
Sodium phosphates (NaP)	-0.1	-2.1	-1.4	0.1	-2.1
NaCl x NaCl	-0.2	0.0	0.1	0.9	0.0
NaP x NaCl	0.2	0.8	0.5	-1.9	0.8
NaP x NaP	2.6	4.2	3.5	3.1	7.6
R^2	30.17	31.03	20.35	47.62	77.55

Attribute and Variable	Storage Time, days				
	0	7	14	21	28
Package purge					
Intercept	.	5.39	5.83	6.08	6.06
Sodium chloride (NaCl)	.	-2.22	-1.91	-1.93	-0.21
Sodium phosphates (NaP)	.	3.93	0.05	7.87	1.25
NaCl x NaCl	.	0.19	0.47	0.28	-1.15
NaP x NaCl	.	5.58	2.35	-0.93	3.89
NaP x NaP	.	-17.43	-4.38	-19.44	-10.23
R^2	.	78.04	77.31	78.68	81.6
Drip loss					
Intercept	5.46	4.16	2.89	3.20	3.14
Sodium lactate (NaL)	-1.74	-1.02	-0.89	-0.55	-2.17
Sodium phosphates (NaP)	1.23	2.85	-2.06	-0.97	1.31
NaL x NaL	0.01	0.20	1.73	-0.03	1.90
NaNaP x NaL	4.25	-1.96	-8.16	2.48	-3.86
NaP x NaP	-10.22	-7.66	21.37	-0.37	-0.31
R^2	93.88	80.44	66.46	66.46	47.81
*L**					
Intercept	53.630	54.360	54.601	55.732	56.644
Sodium chloride (NaCl)	-1.677	-2.503	-0.158	-1.705	-0.784
Sodium phosphates (NaP)	-12.331	-2.269	-24.492	-26.867	-13.270
NaCl x NaCl	3.085	3.035	0.971	3.351	0.718
NaP x NaCl	-18.715	-17.605	-12.664	-28.306	-14.461
NaP x NaP	37.190	8.330	75.382	97.524	52.336
R^2	84.53	81.58	75.19	88.34	73.08

APPENDIX AAE

REGRESSION EQUATIONS FOR VARIABLES WITH TREATMENT X STORAGE DAY INTERACTIONS IN EXPERIMENT 2

	Storage Time, days				
Attribute and Variable	0	7	14	21	28
Pork lean brothy					
Intercept	5.6	5.8	5.1	5.3	5.0
Sodium chloride (NaCl)	0.3	2.1	2.1	1.5	1.9
Sodium phosphates (NaP)	4.1	-5.7	-0.8	0.2	0.4
NaCl x NaCl	0.9	-1.0	-0.9	-0.4	-0.5
NaP x NaCl	-5.5	1.2	0.0	-1.6	-2.0
NaP x NaP	2.2	9.5	3.2	3.0	3.4
R^2	93.52	87.92	81.6	55.12	85.16
Pork fat					
Intercept	1.8	1.8	1.8	1.7	1.6
Sodium chloride (NaCl)	-0.3	0.5	0.3	0.2	0.3
Sodium phosphates (NaP)	2.5	1.3	-0.2	0.9	0.9
NaCl x NaCl	0.5	-0.2	0.0	0.1	-0.1
NaP x NaCl	-2.5	-0.2	-0.5	-1.4	-0.4
NaP x NaP	-1.1	-3.6	1.7	0.6	0.3
R^2	84.76	35.07	69.57	34.89	77.84
Soda					
Intercept	0.9	0.9	1.0	0.9	1.0
Sodium chloride (NaCl)	0.1	0.5	0.2	0.5	1.0
Sodium phosphates (NaP)	-1.0	-3.0	-0.6	0.7	1.5
NaCl x NaCl	0.0	-0.4	-0.1	-0.6	-0.5
NaP x NaCl	-0.6	2.2	0.6	3.0	0.1
NaP x NaP	6.5	2.8	2.1	-7.0	-4.3
R^2	39.82	82.34	59.41	65.1	91.32
Chemical					
Intercept	0.3	0.2	0.5	0.4	0.5
Sodium chloride (NaCl)	-0.1	-0.3	-0.5	-0.4	-0.9
Sodium phosphates (NaP)	-1.3	2.2	0.9	0.8	1.7
NaCl x NaCl	0.1	0.3	0.2	0.3	0.7
NaP x NaCl	-0.4	-1.3	0.2	-0.5	-1.6
NaP x NaP	4.1	-3.1	-2.2	-0.6	0.1
R^2	92.54	73.63	80.36	21.08	56.87
Browned					
Intercept	0.3	0.5	0.4	0.5	0.7
Sodium chloride (NaCl)	0.1	-0.2	0.1	-0.2	-0.5
Sodium phosphates (NaP)	0.5	-1.9	-0.9	-1.1	-1.8
NaCl x NaCl	0.3	0.4	0.1	0.2	0.1
NaP x NaCl	-2.7	-1.0	-0.3	-0.1	0.8
NaP x NaP	2.0	5.3	2.1	2.4	3.0
R^2	70.69	76.75	26.33	17.63	53.52

Attribute and Variable	Storage Time, days 0	7	14	21	28
Musty					
Intercept	0.3	0.0	0.1	0.1	0.1
Sodium chloride (NaCl)	-0.5	-0.1	-0.1	-0.3	-0.4
Sodium phosphates (NaP)	-0.4	1.3	1.4	0.6	0.1
NaCl x NaCl	0.3	0.1	0.0	0.2	0.4
NaP x NaCl	0.1	0.2	-0.6	-0.6	-2.0
NaP x NaP	0.8	-4.3	-2.5	0.3	6.4
R^2	46.37	36.46	65.63	18.09	56.15
Serum/bloody					
Intercept	0.0	0.1	0.1	0.2	0.5
Sodium chloride (NaCl)	0.1	-0.3	0.1	-0.1	-0.5
Sodium phosphates (NaP)	0.4	-0.4	-0.2	-0.1	-1.9
NaCl x NaCl	-0.1	0.3	-0.1	0.0	-0.2
NaP x NaCl	0.0	-0.4	-0.2	0.4	3.7
NaP x NaP	-0.9	2.6	2.9	-0.1	-2.3
R^2	30.51	85.68	44.59	7.79	92.5
Livery					
Intercept	0.0	0.0	0.0	0.0	0.1
Sodium chloride (NaCl)	0.0	0.0	0.0	0.0	-0.1
Sodium phosphates (NaP)	0.0	0.0	0.0	-0.1	-0.4
NaCl x NaCl	0.0	0.0	0.0	0.0	0.0
NaP x NaCl	0.0	0.0	0.0	0.1	0.3
NaP x NaP	0.0	0.0	0.0	0.1	0.4
R^2	66.78	100	.	15.58	85.29
Vinegar					
Intercept	0.0	0.0	0.0	0.0	0.2
Sodium chloride (NaCl)	0.0	0.0	0.0	0.0	-0.3
Sodium phosphates (NaP)	0.0	0.0	0.0	-0.3	-2.0
NaCl x NaCl	0.0	0.0	-0.1	0.0	0.0
NaP x NaCl	0.0	0.0	0.6	0.3	1.2
NaP x NaP	0.0	0.0	-0.8	0.5	4.6
R^2	66.78	100	46.08	10.45	94.83
Metallic					
Intercept	2.1	2.2	2.4	2.3	2.4
Sodium chloride (NaCl)	0.0	0.0	-0.6	-0.3	-0.2
Sodium phosphates (NaP)	-0.2	-0.1	-0.5	-0.2	0.0
NaCl x NaCl	0.0	0.0	0.1	0.1	0.0
NaP x NaCl	-0.3	0.3	2.1	0.5	1.4
NaP x NaP	1.3	-0.1	-2.0	-0.3	-2.5
R^2	27.62	3.39	34.28	6.95	31.95

Attribute and Variable	Storage Time, days				
	0	7	14	21	28
Astringent					
Intercept	2.0	2.6	2.6	2.5	2.8
Sodium chloride (NaCl)	0.2	-0.6	-0.4	-0.3	-0.5
Sodium phosphates (NaP)	2.2	-1.9	-0.2	-0.1	-0.9
NaCl x NaCl	0.0	0.5	0.1	0.2	0.1
NaP x NaCl	-1.3	0.3	1.1	0.0	1.5
NaP x NaP	-2.4	4.9	0.1	0.6	0.0
R^2	95.93	53.05	19.26	3.62	44.74
Sour					
Intercept	2.2	2.5	2.5	2.4	2.4
Sodium chloride (NaCl)	-0.1	-0.3	0.2	0.0	-0.1
Sodium phosphates (NaP)	-0.1	-1.5	-1.0	-0.6	0.7
NaCl x NaCl	0.1	0.0	-0.2	-0.1	0.0
NaP x NaCl	-0.3	2.3	0.9	0.9	0.6
NaP x NaP	1.9	0.3	0.0	0.0	-2.7
R^2	17.11	23.51	20.31	4.33	7.21
Bitter					
Intercept	2.5	2.4	2.7	2.7	3.1
Sodium chloride (NaCl)	-0.1	-0.1	-0.2	-0.4	-1.0
Sodium phosphates (NaP)	-1.1	1.1	1.1	-0.3	-3.0
NaCl x NaCl	0.0	-0.1	-0.1	0.1	0.5
NaP x NaCl	0.7	0.1	1.0	0.3	0.1
NaP x NaP	1.2	-3.7	-4.6	0.0	8.7
R^2	62.64	34.96	44.14	21.03	75.13
Sweet					
Intercept	0.2	0.1	0.1	0.1	-0.1
Sodium chloride (NaCl)	-0.5	0.6	-0.1	0.0	-0.2
Sodium phosphates (NaP)	0.9	0.8	1.1	0.9	1.3
NaCl x NaCl	0.7	-0.4	0.2	0.2	0.2
NaP x NaCl	-2.4	0.0	-1.6	-1.1	-0.5
NaP x NaP	3.0	-3.1	0.7	0.5	0.2
R^2	74.48	24.48	74.67	13.23	56.45
Salt					
Intercept	2.1	2.0	2.1	2.1	2.1
Sodium chloride (NaCl)	0.7	2.0	1.6	1.4	1.7
Sodium phosphates (NaP)	-0.7	-2.6	-3.4	-2.1	0.3
NaCl x NaCl	0.5	-0.6	0.0	0.1	-0.3
NaP x NaCl	0.0	0.5	-0.3	0.0	2.5
NaP x NaP	7.4	10.5	10.7	8.2	-5.8
R^2	97.65	96.6	96.79	90.42	94.99

Attribute and Variable	Storage Time, days				
	0	7	14	21	28
Aftertaste sour					
Intercept	0.4	1.2	1.2	0.9	0.8
Sodium chloride (NaCl)	0.4	-1.2	-0.2	0.1	1.0
Sodium phosphates (NaP)	0.7	-0.6	-1.0	0.5	1.2
NaCl x NaCl	-0.3	0.6	0.1	-0.2	-0.8
NaP x NaCl	1.0	2.2	0.3	1.7	1.5
NaP x NaP	-3.2	-0.8	0.3	-4.8	-8.1
R^2	49.65	50.26	16.02	8.79	46.07
Aftertaste salty					
Intercept	0.0	0.1	0.3	0.2	0.2
Sodium chloride (NaCl)	0.5	0.7	1.3	0.7	0.8
Sodium phosphates (NaP)	0.6	-2.1	-2.3	-1.1	0.9
NaCl x NaCl	0.1	0.3	-0.4	0.1	-0.2
NaP x NaCl	0.3	-1.0	1.8	0.4	2.4
NaP x NaP	1.0	9.0	3.6	3.0	-8.0
R^2	96.84	75.84	93.67	83.03	97.59
Aftertaste bitter					
Intercept	1.1	1.2	1.8	1.5	1.6
Sodium chloride (NaCl)	-0.2	-0.4	-1.0	-0.3	0.0
Sodium phosphates (NaP)	0.8	3.2	1.8	1.5	-0.2
NaCl x NaCl	0.1	0.2	0.2	0.0	-0.3
NaP x NaCl	-0.7	-1.7	1.5	0.0	1.2
NaP x NaP	-1.6	-4.1	-9.0	-4.6	-1.7
R^2	51.55	73.2	96.07	23.98	40.43
Aftertaste soda					
Intercept	0.2	0.3	0.1	0.3	0.4
Sodium chloride (NaCl)	0.3	0.7	1.1	0.9	1.7
Sodium phosphates (NaP)	2.3	1.1	-0.2	1.2	2.3
NaCl x NaCl	0.0	-0.4	0.0	-0.2	-0.8
NaP x NaCl	-2.1	1.8	-3.5	1.5	-0.2
NaP x NaP	-0.3	-5.4	6.3	-0.7	-8.9
R^2	60.09	78.84	82.76	43.27	94.02
Aftertaste metallic					
Intercept	0.9	1.2	1.4	1.3	1.6
Sodium chloride (NaCl)	0.1	-0.3	-0.4	-0.4	-1.1
Sodium phosphates (NaP)	-2.3	-0.7	-2.2	-1.1	-1.3
NaCl x NaCl	-0.1	-0.2	0.2	0.0	0.2
NaP x NaCl	0.2	2.7	0.6	1.4	3.2
NaP x NaP	5.3	-2.3	4.5	-0.1	-2.7
R^2	80.27	39.56	10.26	13.61	96.73

Attribute and Variable	Storage Time, days 0	7	14	21	28
Aftertaste musty					
Intercept	0.0	0.0	0.0	0.0	0.0
Sodium chloride (NaCl)	0.0	0.0	-0.2	-0.1	-0.2
Sodium phosphates (NaP)	0.2	0.5	0.8	0.2	-0.2
NaCl x NaCl	0.0	0.1	0.2	0.1	0.2
NaP x NaCl	-0.2	-0.3	-0.7	-0.5	-1.0
NaP x NaP	-0.1	-1.1	-0.4	0.5	4.1
R^2	65.84	52.49	66.78	15.18	64.17
Aftertaste other					
Intercept	0.0	.	0.0	0.0	0.0
NaCl x NaCl	0.0	.	.	0.0	0.0
Sodium chloride (NaCl)	0.0	.	.	0.0	0.0
Sodium phosphates (NaP)	0.0	.	.	0.1	0.4
NaP x NaP	0.0	.	.	0.0	0.1
NaP x NaCl	0.0	.	.	-0.1	-0.5
R^2	6.68	.	1.00	6.00	32.46
Muscle Fiber Tenderness					
Sodium chloride (NaCl)	0.0	1.5	0.8	0.6	0.0
Sodium phosphates (NaP)	5.5	5.5	6.0	6.4	7.6
NaCl x NaCl	1.1	-0.4	0.2	0.4	0.0
NaP x NaCl	-8.6	-4.5	-6.2	-4.6	4.8
NaP x NaP	2.0	-4.8	-3.7	-5.9	-24.4
R^2	40.54	58.03	73.19	43.86	84.43
Juiciness					
Intercept	4.2	4.3	4.7	4.2	4.0
Sodium chloride (NaCl)	0.5	1.8	0.7	1.2	1.6
Sodium phosphates (NaP)	5.6	0.5	3.3	4.0	6.3
NaCl x NaCl	0.4	-0.5	-0.3	-0.2	-1.2
NaP x NaCl	-5.9	-4.0	-1.8	-3.4	4.3
NaP x NaP	-2.1	6.0	-5.9	-3.1	-23.5
R^2	54.43	82.38	54.14	38.85	72.29
Processed meat-like texture					
Intercept	7.7	7.0	8.0	7.2	6.4
Sodium chloride (NaCl)	1.5	5.7	1.8	3.0	4.3
Sodium phosphates (NaP)	13.7	15.3	15.8	15.2	18.5
NaCl x NaCl	1.7	-1.8	0.3	0.0	-2.8
NaP x NaCl	-19.3	-17.2	-11.0	-12.1	8.4
NaP x NaP	3.3	-4.9	-21.2	-12.5	-56.6
R^2	42.98	73.27	68.21	50.24	90.29

Attribute and Variable	Storage Time, days 0	7	14	21	28
Color					
Intercept	2.4	2.4	2.1	2.4	2.2
Sodium chloride (NaCl)	0.0	-0.4	-0.3	-0.5	-0.5
Sodium phosphates (NaP)	-0.1	-1.4	-1.6	-2.0	-4.6
NaCl x NaCl	0.9	0.4	0.9	0.8	0.6
NaP x NaCl	-3.4	2.6	-3.0	-0.9	0.7
NaP x NaP	10.6	2.1	14.0	11.0	17.3
R^2	94.35	64.66	90.22	52.38	73.31
Amount of discoloration					
Intercept	1.2	1.5	1.4	1.4	1.4
Sodium chloride (NaCl)	2.0	0.7	1.9	1.0	0.2
Sodium phosphates (NaP)	5.2	2.2	1.0	1.2	-1.2
NaCl x NaCl	-1.2	0.8	-1.5	-0.2	0.3
NaP x NaCl	-2.1	-10.3	1.9	-3.0	-2.6
NaP x NaP	-12.4	10.2	-9.7	-0.7	5.5
R^2	73.23	85.38	77.31	27.53	70.12
Package purge					
Intercept	.	6.57	8.44	9.43	10.66
Sodium chloride (NaCl)	.	-2.75	-4.37	-1.99	-3.96
Sodium phosphates (NaP)	.	1.55	5.49	1.00	0.45
NaCl x NaCl	.	2.09	1.51	-0.17	1.51
NaP x NaCl	.	-11.34	-2.13	-4.41	-8.57
NaP x NaP	.	21.58	-7.26	-5.70	5.76
R^2	.	75.32	96.64	94.84	92.99
*a**					
Intercept	5.797	8.575	9.299	8.715	9.217
Sodium chloride (NaCl)	-3.461	-3.175	-3.898	-1.612	-3.101
Sodium phosphates (NaP)	-6.785	-6.474	-8.500	-15.060	-6.834
NaCl x NaCl	2.704	1.610	2.780	2.031	1.522
NaP x NaCl	-4.322	-0.018	-3.651	-11.597	-1.747
NaP x NaP	16.319	15.334	22.689	52.076	14.582
R^2	73.41	63.16	99.55	97.93	85.59
*b**					
Intercept	2.778	5.185	6.661	5.261	5.951
Sodium chloride (NaCl)	-1.724	-0.662	-3.602	0.152	-1.668
Sodium phosphates (NaP)	2.672	-0.920	-6.332	-6.640	-1.456
NaCl x NaCl	1.369	-0.169	1.798	-0.014	-0.057
NaP x NaCl	-5.708	-1.861	0.464	-7.570	2.844
NaP x NaP	-3.927	-1.925	7.990	23.072	-10.454
R^2	92.91	47.51	89.07	88.40	77.45

APPENDIX AAF

REGRESSION EQUATIONS FOR VARIABLES WITH TREATMENT X STORAGE DAY INTERACTIONS IN EXPERIMENT 3

	Storage Time, days				
Attribute and Variable	0	7	14	21	28
Pork lean/brothy					
Intercept	6.0	5.5	5.4	5.8	4.9
Sodium lactate (NaL)	0.3	0.5	0.6	0.4	0.7
Sodium phosphate (NaP)	2.4	6.4	4.7	-2.0	7.1
NaL x NaL	0.0	-0.1	-0.2	-0.1	-0.1
NaP x NaL	-0.7	-0.9	-0.6	-0.5	-1.1
NaP x NaP	-3.1	-8.9	-6.3	7.6	-13.0
R^2	34.01	70.99	60.53	91.19	76.03
Pork fat					
Intercept	1.7	1.7	1.3	2.7	1.4
Sodium lactate (NaL)	0.1	0.3	0.3	-0.3	0.4
Sodium phosphate (NaP)	0.9	2.3	5.3	-3.1	3.3
NaL x NaL	0.0	0.0	-0.1	0.1	-0.1
NaP x NaP	-0.9	-0.7	-0.9	0.1	-0.1
NaP x NaL	2.3	-1.4	-6.5	7.1	-6.3
R2	54.38	71.34	78.84	53.66	82.66
Chemical					
Intercept	0.2	0.2	0.3	0.1	0.7
Sodium lactate (NaL)	-0.1	0.0	-0.1	-0.1	0.0
Sodium phosphate (NaP)	-0.5	-0.3	-0.6	4.5	-0.1
NaL x NaL	0.0	0.0	0.0	0.0	0.0
NaP x NaP	-0.1	-0.2	-0.2	-0.6	0.8
NaP x NaL	2.0	0.2	2.4	-7.6	-3.2
R^2	75.27	82.56	14.41	84.83	27.68
Browned					
Intercept	0.2	70.3	1.0	0.5	0.0
Sodium lactate (NaL)	0.0	0.0	-0.2	0.0	0.3
Sodium phosphate (NaP)	0.3	-0.4	-1.8	-5.7	1.6
NaL x NaL	0.0	0.0	0.0	0.0	-0.1
NaP x NaL	0.0	0.1	0.3	0.2	-0.1
NaP x NaP	-0.4	0.4	2.8	16.9	-4.1
R^2	28.75	85.29	64.60	83.11	69.77
Metallic					
Intercept	2.3	2.3	2.6	2.2	2.6
Sodium lactate (NaL)	0.0	0.0	0.1	0.1	0.0
Sodium phosphate (NaP)	1.4	-3.6	-1.0	3.5	0.9
NaL x NaL	0.0	0.0	-0.1	0.0	0.0
NaP x NaL	0.0	-0.3	1.5	-0.3	0.9
NaP x NaP	-3.8	10.8	-5.3	-5.9	-5.3
R^2	57.09	38.94	71.15	85.89	75.63

Attribute and Variable	Storage Time, days				
	0	7	14	21	28
Astringent					
Intercept	2.3	2.4	2.5	2.5	2.5
Sodium lactate (NaL)	0.1	0.0	0.3	0.1	0.1
Sodium phosphate (NaP)	1.5	-2.0	0.9	3.3	3.8
NaL x NaL	0.0	0.0	-0.1	0.0	0.0
NaP x NaL	0.2	-0.4	0.7	-0.8	0.0
NaP x NaP	-4.9	7.9	-6.3	-3.6	-7.8
R^2	63.39	20.65	52.95	71.57	83.49
Sour					
Intercept	2.1	1.9	2.3	2.0	2.3
Sodium lactate (NaL)	0.1	0.3	0.1	0.2	0.2
Sodium phosphate (NaP)	2.0	1.3	0.3	5.4	1.9
NaL x NaL	0.0	-0.1	0.0	0.0	0.0
NaP x NaL	0.6	-0.1	0.3	-0.9	0.2
NaP x NaP	-7.5	-2.5	-1.7	-8.0	-5.0
R^2	89.21	92.77	45.48	75.74	41.95
Soda					
Intercept	1.2	1.3	0.8	0.8	1.0
Sodium lactate (NaL)	0.3	0.2	0.8	0.4	0.7
Sodium phosphate (NaP)	4.1	1.5	4.2	5.4	4.9
NaL x NaL	-0.1	0.0	-0.2	0.0	-0.2
NaP x NaL	0.6	-0.2	0.1	-1.8	-0.3
NaP x NaP	-11.7	-1.2	-8.7	-1.0	-9.6
R^2	82.9	62.94	87.23	96.2	97.11
Salt					
Intercept	2.3	2.1	2.4	2.7	2.8
Sodium lactate (NaL)	0.9	0.9	1.5	1.1	1.7
Sodium phosphate (NaP)	9.7	7.7	5.3	11.3	12.8
NaL x NaL	-0.2	-0.1	-0.2	-0.1	-0.4
NaP x NaL	1.6	-1.4	-1.9	-3.9	-0.3
NaP x NaL	-26.9	-10.6	-2.4	-2.2	-24.9
R^2	92.82	83.55	60.26	85.63	86.65
Bitter					
Intercept	2.5	3.1	2.4	2.6	2.7
Sodium lactate (NaL)	-0.3	-0.4	0.0	-0.3	-0.2
Sodium phosphate (NaP)	0.3	-3.5	-1.3	0.4	-0.3
NaL x NaL	0.1	0.0	-0.0	0.1	0.0
NaP x NaL	0.8	1.2	-0.0	0.3	0.8
NaP x NaL	-3.7	1.5	3.5	-0.9	-4.5
R^2	70.81	82.11	22.83	71.06	59.13

Attribute and Variable	Storage Time, days 0	7	14	21	28
Aftertaste sour					
Intercept	0.5	0.5	0.7	0.2	1.1
Sodium lactate (NaL)	0.0	0.1	0.2	0.2	0.2
Sodium phosphate (NaP)	4.7	-0.1	1.2	7.8	1.2
NaL x NaL	0.0	0.0	0.0	0.0	-0.1
NaP x NaL	0.1	0.3	0.2	-2.0	1.2
NaP x NaP	-10.7	-0.8	-5.9	-8.7	-10.4
R^2	75.69	21.98	79.21	80.15	70.72
Aftertaste salty					
Intercept	0.4	0.7	0.5	0.6	0.2
Sodium lactate (NaL)	0.6	0.5	1.2	0.9	1.4
Sodium phosphate (NaP)	5.4	3.8	4.9	7.3	11.4
NaL x NaL	-0.1	-0.1	-0.2	-0.2	-0.3
NaP x NaL	0.8	-1.3	-1.2	-1.1	-0.6
NaP x NaP	-14.2	-2.2	-6.4	-9.0	-23.3
R^2	91.13	55.49	96.51	71.71	88
Aftertaste bitter					
Intercept	1.4	1.2	1.0	1.8	1.4
Sodium lactate (NaL)	-0.4	-0.3	0.0	-0.7	-0.4
Sodium phosphate (NaP)	-0.9	0.4	-1.2	0.9	0.6
NaL x NaL	0.1	0.0	-0.1	0.1	0.1
NaP x NaL	0.1	1.1	1.1	0.8	0.8
NaP x NaP	0.3	-7.6	-3.2	-4.6	-3.4
R^2	68.07	77.46	40.50	75.01	43.12
Aftertaste soda					
Intercept	0.7	0.8	0.7	0.5	0.6
Sodium lactate (NaL)	0.0	0.1	0.5	0.5	0.6
Sodium phosphate (NaP)	-0.9	-0.2	1.8	6.3	4.6
NaL x NaL	0.0	0.0	-0.1	0.0	-0.1
NaP x NaL	0.3	-0.2	-0.3	-1.9	0.0
NaP x NaP	1.4	2.1	-1.9	-4.9	-9.6
R^2	78.93	73.17	92.23	90.58	89.51
Muscle Fiber Tenderness					
Intercept	5.9	6.2	5.6	6.4	6.2
Sodium lactate (NaL)	0.8	0.5	0.7	0.2	0.4
Sodium phosphate (NaP)	-7.4	0.0	6.0	1.0	4.7
NaL x NaL	-0.1	-0.1	-0.2	0.0	-0.2
NaP x NaL	-1.8	-0.2	-0.8	-1.7	1.5
NaP x NaP	22.1	-0.2	-10.4	9.1	-15.1
R^2	48.04	19.06	46.53	80.70	71.54

Attribute and Variable	Storage Time, days 0	7	14	21	28
Juiciness					
Intercept	4.4	4.6	4.2	4.6	4.3
Sodium lactate (NaL)	0.4	0.3	0.5	0.3	0.3
Sodium phosphate (NaP)	-1.0	1.2	4.6	3.7	4.1
NaL x NaL	-0.1	-0.1	-0.2	-0.1	-0.1
NaP x NaL	0.3	-0.2	0.4	-1.7	0.4
NaP x NaP	0.1	-1.7	-13.0	-0.8	-11.6
R^2	16.51	35.15	69.25	62.62	54.57
Processed meat-like texture					
Intercept	7.5	7.7	6.7	8.5	7.3
Sodium lactate (NaL)	1.2	1.3	1.7	0.9	2.0
Sodium phosphate (NaP)	-8.9	3.3	17.6	7.6	16.9
NaL x NaL	-0.2	-0.3	-0.4	-0.2	-0.6
NaP x NaL	-3.4	0.6	-2.7	-4.2	1.6
NaP x NaP	34.1	-13.2	-25.5	8.5	-42.2
R^2	32.76	13.78	54.03	84.46	83.72
Color					
Intercept	2.4	2.4	1.9	2.7	1.8
Sodium lactate (NaL)	0.7	0.5	0.4	0.1	0.4
Sodium phosphate (NaP)	0.8	-1.3	-2.1	-2.7	4.5
NaL x NaL	-0.2	0.0	0.1	0.0	0.0
NaP x NaL	0.7	-0.8	-3.1	0.1	-2.2
NaP x NaP	-4.9	7.3	20.7	5.5	0.6
R^2	70.36	94.57	85.73	13.24	67.08
Amount of discoloration					
Intercept	1.5	1.9	1.7	1.3	1.7
Sodium lactate (NaL)	0.1	-0.2	-0.1	-0.1	0.0
Sodium phosphate (NaP)	4.6	4.1	5.7	2.1	2.4
NaL x NaL	0.0	0.1	0.0	0.1	-0.2
NaP x NaL	-1.0	-1.5	-0.1	-2.0	3.0
NaP x NaP	-7.0	2.0	-10.0	17.6	-16.0
R^2	85.82	48.05	53.99	81.55	78.66
Cook loss					
Intercept	12.98	17.63	22.08	23.05	17.33
Sodium lactate (NaL)	1.21	-1.47	-2.45	-5.04	-3.30
Sodium phosphates (NaP)	25.63	31.82	-19.11	-26.81	-19.00
NaL x NaL	0.12	-0.11	0.70	0.86	0.23
NaP x NaL	-10.84	2.61	-2.98	8.51	8.54
NaP x NaP	-17.14	-88.74	46.10	21.17	21.98
R^2	19.74	72.1	74.48	75.04	81.29
Package purge					
Intercept	.	5.67	7.49	5.47	8.05
Sodium lactate (NaL)	.	-0.66	-1.86	-0.46	-2.17
Sodium phosphates (NaP)	.	-0.02	-10.34	2.94	-13.91
NaL x NaL	.	0.08	0.25	0.01	0.41
NaP x NaL	.	0.31	3.37	2.93	2.62
NaP x NaP	.	-17.17	4.29	6.68	-31.07
R^2	.	75.92	89.30	33.98	92.22

Attribute and Variable	Storage Time, days				
	0	7	14	21	28
Drip loss					
Intercept	7.02	6.81	7.16	4.39	4.01
Sodium lactate (NaL)	-1.48	-0.11	-0.89	-0.12	0.58
Sodium phosphates (NaP)	-7.91	-17.60	-6.97	4.89	3.53
NaL x NaL	0.04	0.13	-0.07	0.05	-0.20
NaP x NaL	4.64	-4.07	3.70	-1.54	0.14
NaP x NaP	-5.85	40.84	-7.12	-5.47	-20.36
R^2	89.41	88.30	88.81	60.73	70.68
*L**					
Intercept	54.274	55.786	54.724	55.079	57.520
Sodium lactate (NaL)	-3.130	-2.672	-2.324	-1.118	-2.497
Sodium phosphates (NaP)	-2.672	-9.468	-0.570	3.193	-17.903
NaL x NaL	0.630	0.407	0.170	0.264	0.166
NaP x NaL	-0.028	1.872	4.189	0.691	10.072
NaP x NaP	7.173	12.641	-12.308	-22.874	3.012
R^2	86.79	91.2	88.96	29.79	87.73
*b**					
Intercept	3.244	4.946	5.166	4.870	5.200
Sodium lactate (NaL)	-0.781	-0.647	-1.596	-1.151	-1.200
Sodium phosphates (NaP)	-0.465	-7.076	-8.774	-7.953	-9.343
NaL x NaL	0.131	0.105	0.254	0.300	0.234
NaP x NaL	-0.006	-0.308	1.834	0.572	0.769
NaP x NaP	1.934	10.755	12.725	8.696	16.456
R^2	38.71	82.75	86.27	65.48	78.62

APPENDIX AAG

REGRESSION EQUATIONS FOR VARIABLES WITH TREATMENT X STORAGE DAY INTERACTIONS IN EXPERIMENT 4

	Storage Time, days				
Attribute and Variable	0	7	14	21	28
Pork fat					
Pork fat					
Intercept	1.9	1.9	1.6	1.7	1.6
Potassium lactate (KL)	0.1	0.1	0.3	0.3	0.3
Sodium phosphates (NaP)	-0.3	0.9	1.7	1.4	3.5
KL x KL	0.0	0.0	-0.1	0.0	0.0
NaP x KL	-0.1	0.2	-0.3	-0.7	-1.4
NaP x NaP	0.9	-3.5	-3.0	0.8	-1.2
R^2	42.38	62.53	34.68	78.19	77.14
Soda					
Intercept	1.2	1.2	0.9	1.1	1.0
Potassium lactate (KL)	0.8	0.4	0.5	0.4	0.5
Sodium phosphates (NaP)	1.2	3.3	7.2	5.2	5.4
KL x KL	-0.4	0.0	-0.1	0.0	-0.1
NaP x KL	-3.4	-1.6	-0.7	-1.8	-1.0
NaP x NaP	6.9	-3.8	-14.1	-2.7	-7.1
R^2	75.37	83.59	72.85	89.07	71.6
Chemical					
Intercept	0.5	0.2	0.4	0.3	0.5
Potassium lactate (KL)	-0.3	0.2	0.0	0.3	0.2
Sodium phosphates (NaP)	0.1	-0.5	-0.2	-0.1	0.8
KL x KL	0.1	0.0	0.0	-0.1	0.0
NaP x KL	-1.0	-0.7	0.1	0.0	-1.3
NaP x NaP	3.8	3.3	-0.8	-1.3	4.2
R^2	62.18	57.85	32.29	65.88	49.11
Browned					
Intercept	0.4	0.3	0.7	0.8	0.7
Potassium lactate (KL)	-0.4	0.0	-0.1	0.2	-0.1
Sodium phosphates (NaP)	-0.2	-0.8	0.1	0.2	-3.2
KL x KL	0.1	0.0	0.0	0.0	0.0
NaP x KL	0.5	-0.8	0.4	-0.2	0.1
NaP x NaP	-1.4	7.1	-2.6	-3.3	8.7
R^2	67.87	79.59	66.84	53.97	66.83
Metallic					
Intercept	2.6	2.2	2.2	2.4	2.2
Potassium lactate (KL)	0.1	0.2	0.1	0.0	0.0
Sodium phosphates (NaP)	-0.4	1.3	2.2	-0.7	2.9
KL x KL	0.0	0.0	0.0	0.0	0.0
NaP x KL	-0.1	-0.4	0.3	-0.2	0.2
NaP x NaP	-1.3	-2.1	-8.6	1.0	-8.4
R^2	85.74	89.38	59.39	46.68	74.26

Attribute and Variable	Storage Time, days 0	7	14	21	28
Astringent					
Intercept	2.5	2.2	2.3	2.4	2.3
Potassium lactate (KL)	0.4	0.3	0.1	0.1	0.1
Sodium phosphates (NaP)	-0.6	1.8	3.9	1.1	3.4
KL x KL	0.0	-0.1	0.0	0.0	0.0
NaP x KL	-1.2	-0.5	-0.2	-0.7	-0.5
NaP x NaP	3.8	-3.2	-9.4	1.7	-5.6
R^2	66.38	92.49	68.06	80.24	68.19
Sour					
Intercept	2.4	2.2	2.1	2.3	2.3
Potassium lactate (KL)	0.2	0.3	0.3	0.0	0.2
Sodium phosphates (NaP)	-0.8	1.1	1.9	0.7	2.8
KL x KL	0.0	0.1	-0.1	0.0	0.0
NaP x KL	-0.7	-0.2	-0.2	0.6	-0.7
NaP x NaP	2.8	-2.8	-4.9	0.8	-4.7
R^2	47.91	60.72	50.84	39.52	66.71
Salt					
Intercept	2.2	1.9	1.8	2.3	1.8
Potassium lactate (KL)	2.4	2.1	1.6	1.7	2.1
Sodium phosphates (NaP)	8.9	12.1	20.9	13.0	24.7
KL x KL	-0.1	-0.3	-0.2	-0.1	-0.4
NaP x KL	-10.0	-3.6	-3.2	-6.2	-3.9
NaP x NaP	11.5	-21.9	-42.5	1.8	-40.4
R^2	95.24	94.28	72.49	72.75	78.18
Aftertaste sour					
Intercept	0.4	0.5	0.7	0.9	0.7
Potassium lactate (KL)	0.4	0.1	0.0	-0.3	-0.2
Sodium phosphates (NaP)	1.7	1.0	2.8	-1.1	3.6
KL x KL	-0.1	0.0	-0.1	0.1	0.1
NaP x KL	-0.4	0.4	0.9	0.1	-1.3
NaP x NaP	-2.3	-4.4	-11.1	1.6	-0.2
R^2	81.25	11.97	41.38	54.5	62.09
Aftertaste salty					
Intercept	0.6	0.3	0.6	0.6	0.2
Potassium lactate (KL)	1.4	1.4	0.7	1.1	1.0
Sodium phosphates (NaP)	7.6	8.8	9.1	7.4	12.0
KL x KL	-0.1	-0.3	-0.1	-0.1	-0.1
NaP x KL	-5.5	-1.1	-1.9	-3.3	-2.9
NaP x NaP	-0.6	-22.5	-14.2	1.3	-13.7
R^2	95.23	94.02	77.48	75.35	63.37

Attribute and Variable	Storage Time, days				
	0	7	14	21	28
Aftertaste bitter					
Intercept	1.4	0.7	1.2	1.7	1.5
Potassium lactate (KL)	0.1	0.4	-0.5	-0.2	-0.2
Sodium phosphates (NaP)	-1.3	-1.2	-1.4	-2.6	0.6
KL x KL	0.0	-0.1	0.1	0.1	0.1
NaP x KL	0.0	-0.1	1.1	0.5	-0.3
NaP x NaP	0.5	2.7	-1.5	4.0	-1.1
R^2	81.19	63.34	54.96	72.25	60.78
Aftertaste soda					
Intercept	0.4	0.9	0.6	0.7	0.6
Potassium lactate (KL)	0.6	0.2	0.4	0.5	0.5
Sodium phosphates (NaP)	0.7	0.6	6.2	4.9	4.5
KL x KL	0.0	0.0	0.0	0.0	0.0
NaP x KL	-2.5	-0.6	-0.9	-1.6	-1.6
NaP x NaP	7.0	-0.5	-10.8	-3.8	-2.8
R^2	64.78	66.29	80.59	91.53	83.72
Muscle Fiber Tenderness					
Intercept	4.7	4.7	4.9	5.5	5.3
Potassium lactate (KL)	1.4	1.0	1.2	0.6	0.8
Sodium phosphates (NaP)	7.0	11.1	6.5	4.4	8.5
KL x KL	-0.1	-0.1	-0.1	0.0	-0.2
NaP x KL	-4.7	-3.2	-3.4	-2.4	-1.9
NaP x NaP	-0.2	-16.5	-3.9	-0.9	-9.0
R^2	93.09	87.22	95.68	81.16	62.25
Juiciness					
Intercept	3.8	4.0	3.6	4.2	3.7
Potassium lactate (KL)	1.0	0.3	0.6	0.1	0.3
Sodium phosphates (NaP)	2.5	4.9	3.1	0.7	5.7
KL x KL	-0.2	0.0	-0.1	0.1	0.0
NaP x KL	-0.8	-0.8	-2.0	-1.7	-0.6
NaP x NaP	-4.1	-11.2	0.1	6.7	-8.5
R^2	99.29	80.69	62.92	58.81	68.03
Processed meat-like texture					
Intercept	4.6	3.7	4.3	6.5	5.8
Potassium lactate (KL)	3.7	2.9	3.9	1.9	1.8
Sodium phosphates (NaP)	18.0	26.4	23.1	15.8	26.5
KL x KL	-0.4	-0.2	-0.5	-0.1	-0.3
NaP x KL	8.6	-10.1	-9.2	-6.4	-3.3
NaP x NaP	-16.9	-29.4	-20.0	-9.3	-39.9
R^2	91.2	89.63	94.48	97.63	63.31

Attribute and Variable	Storage Time, days 0	7	14	21	28
Color					
Intercept	2.3	1.9	2.2	1.9	2.1
Potassium lactate (KL)	1.0	0.6	0.4	0.5	0.5
Sodium phosphates (NaP)	3.6	4.7	3.2	7.8	6.8
KL x KL	-0.1	0.0	-0.1	0.0	0.0
NaP x KL	-2.2	-1.6	0.9	-1.5	-1.9
NaP x NaP	3.0	-4.7	-15.4	-16.2	-11.2
R^2	73.68	55.25	86.92	72.99	75.50
Amount of discoloration					
Intercept	2.4	1.3	1.4	2.9	2.7
Potassium lactate (KL)	-0.4	0.6	0.4	-0.5	-0.5
Sodium phosphates (NaP)	-1.2	5.9	2.4	1.3	-0.7
KL x KL	0.1	-0.1	-0.1	0.0	0.0
NaP x KL	-0.2	-1.6	-1.3	0.9	1.4
NaP x NaP	3.3	-7.0	0.7	-2.3	-2.5
R^2	44.3	77.07	39.27	72.71	53.81
Color of Discoloration					
Intercept	2.9	2.3	3.5	2.0	2.9
Potassium lactate (KL)	0.3	-0.1	0.0	0.1	-0.3
Sodium phosphates (NaP)	-1.2	1.0	-7.6	4.3	-1.2
KL x KL	-0.2	0.0	-0.2	0.0	0.0
NaP x KL	1.7	1.3	4.5	0.2	1.6
NaP x NaP	-11.2	-6.7	-3.0	-15.4	-4.8
R^2	43.96	59.26	94.58	69.53	34.78
Cook time					
Intercept	22.6	20.1	20.5	23.2	19.9
Potassium lactate (KL)	-3.2	0.0	-1.5	-1.7	-1.8
Sodium phosphates (NaP)	-6.5	33.9	43.6	24.6	-6.0
KL x KL	0.9	-0.1	0.2	0.2	0.2
NaP x KL	-6.1	-1.3	3.5	0.9	2.8
NaP x NaP	43.5	-72.4	-111.4	-60.3	16.3
R^2	87.16	47.77	64.77	78.49	40.46
Cook loss					
Intercept	20.56	22.17	22.77	23.20	20.67
Potassium lactate (KL)	-3.07	-3.85	-3.02	-2.61	-2.68
Sodium phosphates (NaP)	-3.61	-4.34	14.51	-2.80	-16.58
KL x KL	0.92	0.62	0.01	0.02	-0.41
NaP x KL	-5.07	2.12	8.93	5.53	13.76
NaP x NaP	19.03	6.49	-76.27	4.64	-37.56
R^2	90.00	89.58	35.01	57.52	93.74

Attribute and Variable	Storage Time, days 0	7	14	21	28
Package purge					
Intercept	.	6.55	8.09	7.33	7.26
Potassium lactate (KL)	.	-0.92	-2.15	-1.38	-1.86
Sodium phosphates (NaP)	.	-15.36	-21.14	-16.75	-13.98
KL x KL	.	0.04	0.24	0.08	0.27
NaP x KL	.	2.93	4.91	5.16	3.42
NaP x NaP	.	24.11	29.04	15.31	14.33
R^2	.	64.62	90.01	75.87	68.93
*b**					
Intercept	3.003	2.883	4.668	6.011	5.772
Potassium lactate (KL)	0.372	-0.037	-1.284	-1.564	-1.219
Sodium phosphates (NaP)	-10.852	-0.712	-9.123	-14.516	-21.372
KL x KL	0.009	0.152	0.037	0.226	0.125
NaP x KL	-1.315	-2.720	5.048	3.134	5.047
NaP x NaP	35.448	14.729	-0.778	16.149	28.872
R^2	72.47	13.35	90.91	70.6	90.16

APPENDIX AAH

REGRESSION EQUATIONS FOR VARIABLES WITH TREATMENT X STORAGE DAY INTERACTIONS IN EXPERIMENT 5

	Storage Time, days				
Attribute and Variable	0	7	14	21	28
Pork lean/brothy					
Intercept	5.1	5.3	5.7	5.6	5.7
Sodium diacetate (NaDi)	-0.6	4.9	11.2	7.1	12.3
Sodium phosphates (NaP)	2.2	5.9	5.9	5.1	6.4
NaDi x NaDi	8.0	1.3	-34.5	-17.3	-45.3
NaP x NaDi	-18.8	-39.5	-37.3	-29.0	-22.9
NaP x NaP	0.6	-6.2	-5.7	-4.9	-8.4
R^2	34.63	62.53	79.73	15.27	72.33
Pork fat					
Intercept	1.5	1.5	1.6	1.6	1.7
Sodium diacetate (NaDi)	2.7	6.3	2.8	3.3	2.7
Sodium phosphates (NaP)	1.1	2.3	1.2	1.2	1.7
NaDi x NaDi	-8.6	-24.1	-10.5	-8.1	-7.4
NaP x NaDi	-4.7	-3.5	-5.2	-5.7	-1.7
NaP x NaP	-1.5	-5.6	-1.7	-2.0	5.5
R^2	31.79	80.28	54.34	35.26	80.98
Vinegar					
Intercept	0.1	0.1	0.0	0.0	-0.1
Sodium diacetate (NaDi)	2.0	2.6	1.9	2.1	1.6
Sodium phosphates (NaP)	-0.6	1.7	0.1	0.5	0.0
NaDi x NaDi	-4.8	-19.0	-13.6	-4.4	13.6
NaP x NaDi	-2.6	13.2	14.3	1.8	-7.8
NaP x NaP	1.3	-5.6	-3.4	-1.4	2.7
R^2	55.66	55.2	90.84	34.65	74.16
Metallic					
Intercept	2.0	1.7	1.7	1.6	0.8
Sodium diacetate (NaDi)	5.1	0.0	10.6	-0.3	-5.0
Sodium phosphates (NaP)	4.1	3.7	-1.6	2.1	6.9
NaDi x NaDi	-19.9	40.0	-0.6	29.1	53.2
NaP x NaDi	-2.3	-35.8	-37.5	-23.6	-33.3
NaP x NaP	-9.3	-0.8	13.9	2.1	-6.7
R^2	66.53	43.41	72.23	16.26	63.78
Astringent					
Intercept	2.6	2.5	2.6	2.5	2.5
Sodium diacetate (NaDi)	2.2	3.1	3.5	3.9	3.2
Sodium phosphates (NaP)	0.9	0.9	0.4	1.0	1.0
NaDi x NaDi	-12.5	0.1	-20.5	-12.5	-5.2
NaP x NaDi	7.4	-12.2	6.8	-1.3	-3.3
NaP x NaP	-4.2	0.9	-2.2	-2.0	-0.1
R^2	41.79	34.68	36.00	31.38	58.31

Attribute and Variable	Storage Time, days 0	7	14	21	28
Sour					
Intercept	2.5	2.7	2.3	2.5	2.7
Sodium diacetate (NaDi)	-0.5	6.1	6.3	4.2	2.5
Sodium phosphates (NaP)	-0.3	0.3	1.6	0.1	-0.8
NaDi x NaDi	8.7	-14.0	-25.3	-10.2	-3.5
NaP x NaDi	3.4	-14.9	0.5	-3.3	0.9
NaP x NaP	1.0	2.2	-4.4	0.3	2.6
R^2	79.16	43.03	76.52	27.92	55.14
Salt					
Intercept	2.8	2.8	3.4	3.0	2.9
Sodium diacetate (NaDi)	11.5	22.7	31.5	27.3	23.1
Sodium phosphates (NaP)	11.7	12.3	10.1	11.4	9.4
NaDi x NaDi	32.9	-26.8	-116.5	-45.0	-12.1
NaP x NaDi	-81.8	-104.6	-45.9	-87.5	-85.2
NaP x NaP	-7.0	-4.5	-11.8	-5.5	4.5
R^2	66.25	79.89	68.89	47.76	74.03
Aftertaste salty					
Intercept	0.9	1.0	1.2	1.0	0.9
Sodium diacetate (NaDi)	9.1	12.1	16.4	16.1	16.0
Sodium phosphates (NaP)	6.9	5.4	5.8	6.3	4.1
NaDi x NaDi	0.8	-1.2	-59.4	-32.6	-15.4
NaP x NaDi	-43.2	-69.4	-24.7	-47.8	-56.4
NaP x NaP	-5.4	3.4	-8.1	-2.9	8.3
R^2	66.08	86.48	59.34	50.53	83.79
Aftertaste soda					
Intercept	0.7	1.4	0.9	1.1	1.0
Sodium diacetate (NaDi)	10.8	5.1	13.0	10.8	11.7
Sodium phosphates (NaP)	4.7	2.2	4.2	3.6	3.9
NaDi x NaDi	-31.0	4.8	-32.2	-30.3	-31.4
NaP x NaDi	-19.8	-34.7	-26.2	-21.8	-23.5
NaP x NaP	-5.8	3.7	-3.3	-3.2	-2.7
R^2	89.63	67.08	79.37	60.31	72.54
Aftertaste chemical					
Intercept	0.1	0.0	0.2	0.2	0.3
Sodium diacetate (NaDi)	1.3	-0.1	1.3	0.4	-1.6
Sodium phosphates (NaP)	-1.1	0.0	0.8	-0.4	-0.6
NaDi x NaDi	-0.1	-3.5	-12.0	-3.3	16.7
NaP x NaDi	-3.9	6.3	7.0	3.1	-3.1
NaP x NaP	3.3	-1.2	-3.0	0.8	3.6
R^2	76.61	50.99	68.52	4.23	68.98

Attribute and Variable	Storage Time, days 0	7	14	21	28
Muscle Fiber Tenderness					
Intercept	6.2	6.0	6.2	6.4	7.3
Sodium diacetate (NaDi)	3.9	13.0	13.1	8.0	1.0
Sodium phosphates (NaP)	2.2	7.3	4.9	2.4	-2.8
NaDi x NaDi	-21.4	-50.4	-70.2	-42.2	-44.8
NaP x NaDi	11.3	-22.6	-10.2	1.0	36.7
NaP x NaP	-7.7	-15.1	-10.8	6.7	-1.6
R^2	41.58	55.12	54.23	16.75	62.39
Juiciness					
Intercept	3.7	4.0	4.1	4.1	4.0
Sodium diacetate (NaDi)	-0.3	11.5	10.8	6.6	7.2
Sodium phosphates (NaP)	1.4	5.0	2.4	2.5	2.5
NaDi x NaDi	4.0	-31.3	-65.4	-18.7	-19.9
NaP x NaDi	2.3	-24.6	0.0	-12.3	-5.5
NaP x NaP	-2.5	-10.2	-2.9	-3.2	-4.4
R^2	28.14	61.13	55.74	11.95	36.08
Processed meat-like texture					
Intercept	6.8	8.0	7.7	8.3	9.3
Sodium diacetate (NaDi)	23.4	36.4	30.0	23.8	17.9
Sodium phosphates (NaP)	10.9	18.5	10.9	9.1	3.7
NaDi x NaDi	9.8	-81.4	-112.9	45.6	-103.1
NaP x NaDi	-108.7	-115.4	-44.3	-67.3	31.0
NaP x NaP	2.7	-27.5	-9.0	-4.7	-9.5
R^2	83.73	47.66	50.88	25.37	38.77
Color					
Intercept	2.4	2.0	2.3	2.1	2.1
Sodium diacetate (NaDi)	10.3	7.2	10.1	8.9	6.8
Sodium phosphates (NaP)	8.6	7.0	4.0	7.3	8.6
NaDi x NaDi	-39.0	7.9	-44.3	-24.7	-42.6
NaP x NaDi	-20.6	-46.7	-5.0	-22.7	0.3
NaP x NaP	-17.3	-8.0	-7.2	-12.6	-19.0
R^2	57.64	66.15	61.36	49.11	73.61
Amount of discoloration					
Intercept	2.2	1.7	2.2	2.1	2.2
Sodium diacetate (NaDi)	-1.0	4.4	-1.0	-0.1	1.6
Sodium phosphates (NaP)	-0.8	-4.0	-7.4	-5.1	-10.3
NaDi x NaDi	38.3	42.0	49.0	41.9	23.7
NaP x NaDi	-19.5	-63.9	-21.7	-33.9	-22.6
NaP x NaP	9.8	31.0	22.8	23.2	31.4
R^2	82.61	61.57	71.84	34.11	68.09

Attribute and Variable	Storage Time, days				
	0	7	14	21	28
Color of Discoloration					
Intercept	2.0	1.7	1.7	1.6	0.8
Sodium diacetate (NaDi)	5.1	0.0	10.6	-0.3	-5.0
Sodium phosphates (NaP)	4.1	3.7	-1.6	2.1	6.9
NaDi x NaDi	-19.9	40.0	-0.6	29.1	53.2
NaP x NaDi	-2.3	-35.8	-37.5	-23.6	-33.3
NaP x NaP	-9.3	-0.8	13.9	2.1	-6.7
R^2	42.77	56.9	91.44	10.83	50.97
*L**					
Intercept	55.6	53.3	58.3	58.5	57.6
Sodium diacetate (NaDi)	-72.2	-8.5	55.3	38.6	-54.5
Sodium phosphates (NaP)	-32.8	16.4	-19.9	-49.7	-52.4
NaDi x NaDi	269.9	-95.1	128.8	49.7	126.3
NaP x NaDi	140.9	167.4	150.1	97.9	183.4
NaP x NaP	61.1	-5.6	11.5	113.6	87.6
R^2	75.98	44.23	72.37	78.71	86
*b**					
Intercept	4.2	4.9	5.4	5.9	6.9
Sodium diacetate (NaDi)	-9.8	-5.4	-24.9	-26.1	-38.2
Sodium phosphates (NaP)	-15.2	-11.2	-18.4	-23.4	-31.7
NaDi x NaDi	1.9	-43.8	59.4	68.1	142.7
NaP x NaDi	70.0	90.1	75.5	68.9	75.3
NaP x NaP	21.8	5.4	25.7	48.7	57.5
R^2	92.58	75.03	81.95	83.74	90.81
pH					
Intercept	5.6	5.7	5.5	5.7	15.8
Sodium diacetate (NaDi)	0.1	0.9	0.9	-0.3	0.0
Sodium phosphates (NaP)	1.0	0.6	-0.1	0.9	0.5
NaDi x NaDi	-7.4	2.2	-3.3	-0.1	2.1
NaP x NaDi	4.8	-8.2	-1.4	-2.5	-5.4
NaP x NaP	-3.4	0.1	1.1	-1.0	1.0
R^2	28.61	39.69	39.88	41.50	58.27

VITA

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