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Carcass and Meat Characteristics of Nilgai Antelope



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Carcass and Meat Characteristics of Nilgai Antelope

SUMMARY: *Nilgai antelope* (*Boselaphus tragocamelus*) seem to be a potential source of meats acceptable to the consumer public. Carcasses dress out at approximately 50 percent of live weight and have less than 1 percent fat trim and about 20 percent bone. Sensory evaluation panels rated round steaks and loin steaks below beef steaks in flavor and juiciness but similar in tenderness. Nilgai meats were not distinguishable from beef in various wiener formulations.

SOME SPECIES OF INTRODUCED WILD UNGULATES are potentially capable of increasing the efficiency of protein yields from rangelands in the Southwest. Millions of acres in brush are marginal or unsuited to economical production of domestic livestock. Production on many other ranges can be increased by a combination of species which more efficiently uses the vegetative complex.

Studies of ecological relationships including food habits, reproduction, habitat requirements, diseases and competition with domestic livestock have provided some of the information necessary for stocking non-native wild ungulates. However, recommendations must be based on knowledge of the suitability of a particular species as a source of meat acceptable to the consumer. The objectives of this study were to measure yields and composition of nilgai carcasses, to assess characteristics of the meats that are important to consumer acceptance, to determine the potential of substituting boneless nilgai meats in wiener formulations and to compare nilgai and beef using these criteria.

METHODS

Treatment of Carcasses

Three nilgai—one adult male, one adult female and one subadult male—were collected on King Ranch, Inc. The carcasses were weighed, field dressed, reweighed and transported to ranch headquarters where they were skinned, quartered and stored in a cooler. The following day they were wrapped in insulation

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and taken to the Meats Laboratory at Texas A&M University where they were held at a temperature of 32° to 34° F for 7 days. On the eighth day post mortem the carcasses were fabricated to provide cuts of lean meat for use in sensory evaluations and frankfurter emulsions.

Analysis of Meats

Ordinary Cuts

Sensory evaluations of three common cuts of meat (top round, bottom round and loin steaks) were performed by two expert panels of judges. An eight-member panel designated as the "satisfaction panel" rated the meats for flavor, tenderness and juiciness. Ratings were based on a scale of 1 to 9 (dislike extremely to like extremely). In addition, tenderness was assessed objectively with the Warner-Bratzler Shear which measures the force necessary to cut through a 0.5-inch core of meat. A second six-member panel, the "tenderness profile panel," rated the steaks according to the same 1- to 9-scale for eight characteristics related to tenderness.

Cooking procedures for meats used by the two panels differed slightly, though both were variations of the dry-heat, oven-broiling technique. Steaks for the satisfaction panel were cut 1 inch thick and cooked from the frozen state to an internal temperature of 70° C in an electric oven preheated to 163° C. The cooking time varied from 50 to 60 minutes. Steaks for the tenderness profile panel were also 1 inch in thickness but were cooked for 46 minutes in a gas oven preheated to 180° C.

For comparative purposes loin steaks from four USDA Choice and three USDA Good steers were cooked and evaluated by identical methods.

Wiener Formulations

Boneless nilgai meats were used at levels of 33 $\frac{1}{3}$ percent, 66 $\frac{2}{3}$ percent and 100 percent in the replacement of lean beef in typical wiener formulations. A control formulation consisting of only beef and pork was also prepared. In all preparations, those variables known to affect palatability were held as nearly constant as possible to permit detection of the differences in quantity of the nilgai.

Modified Babcock tests were performed on the raw ingredients to determine fat percentages before the final formulas were derived. The percentages of fat were lean beef, 9.5 percent; pork trim, 36.5 percent; and nilgai, 2 percent. To obtain the desired fat level in the final product, pork fat estimated to contain 95 percent fat was added to the formulation. In all preparations, a ratio of 40 percent beef and/or nilgai to 60 percent pork for the meat portion of the formulation was used. The remainder of the ingredients included spices, water and curing materials. The curing ingredients contained salt, dextrose, NaNO₃ and NaNO₂. A spice mixture, commercially processed and dried with soluble seasoning on a dextrose carrier, was added.

The beef and/or antelope was chopped for 2 minutes in a Silent Cutter. Pork trim, seasonings and ice were then added, and the mixture was chopped for an additional 8 minutes. After the chopping and mixing, the emulsion was stuffed into cellulose casings which were subsequently linked and placed in the smokehouse. The cycle for the smokehouse was 140° F for 15 minutes, 155° F for 15 minutes, 170° F for 30 minutes and 185° F for 15 minutes.

Emulsion stability was determined microscopically by measuring the average size of the droplets of fat and the distance between them. Larger sized droplets and more diffuse distribution indicate that an emulsion has more instability than one with small droplets and greater concentration of droplets.

For sensory evaluations, the wieners were placed in polyvinylidene chloride bags to which a vacuum was applied and then heated in 90° C water for 20 minutes. The vacuum packages were used to prevent flavor leaching or commingling that might occur in immersion of unprotected wieners in water. After

TABLE 1. CARCASS CHARACTERISTICS OF THREE NILGAI ANTELOPE (WEIGHTS ARE IN POUNDS)

	Adult ♀	Subadult ♂	Adult ♂
Live weight	360	356	568
Field dressed wt	234	227	392
Dressed wt	185	175	300
Dressing out percentage	51.4	49.1	52.8
Hindquarter wt	42.3	40.1	62.8
Forequarter wt	40.7	40.0	78.4
Side wt	83.0	80.1	141.2
Forequarter/side (%)	49.0	49.9	55.5
Hindquarter/side (%)	51.0	50.1	44.5

TABLE 2. COMPARISON OF NILGAI AND STEER CUTTING DATA

	Nilgai			Steer	
	Adult ♀	Subadult ♂	Adult ♂	Choice	Good
Bone (%)	19.15	25.09	19.75	12.6	12.5
Fat trim (%)	1.44	0.02	0.21	18.5	18.3
Lean (%)	79.03	74.15	79.88	68.9	69.2

being heated, the wieners were removed and cut into five pieces, each approximately 0.75 inch in length.

Three different sensory panels made taste evaluations—a large untrained consumer panel (n=59), a small untrained panel (n=20) and a small trained panel (n=10). The consumer panel evaluated the individual wieners for overall satisfaction only, while the other two panels evaluated flavor, juiciness and tenderness in addition to overall satisfaction. All evaluations were done on the basis of the nine-point scale described previously.

Product tenderness was evaluated also in samples subjected to an Allo-Kramer shear press. For this test, wieners were cut into pieces weighing approximately 20 grams each.

RESULTS

Carcass Characteristics

Adult female and subadult male nilgai dressed out at approximately 50 percent of live weight, while the adult male dressed out slightly heavier (Table 1). This weight characteristic is easily discerned among live animals—older adult males are more massive than younger adults of equal height and have forequarters considerably heavier than hindquarters. Younger nilgai have a larger percentage of bone than adults (Table 2); the bone percentage of nilgai exceeds that of beef by approximately 67 percent. Fat trim on all nilgai is slight, however, and the amount of lean on a nilgai carcass is greater than on a beef animal of equal size. Nilgai have very low amounts of intramuscular fat deposits, even on carcasses of animals in excellent condition.

Characteristics of the Meats

Ordinary Cuts

Results of the satisfaction panel's palatability ratings are presented in Figures 1-3. As expected, loin steaks received higher overall scores than round steaks. The scores for flavor, juiciness and tenderness of all cuts were somewhat lower than those for Good or Choice beefsteaks but well within acceptable limits and comparable with those of standard beef. Loin steaks from the adult male were judged to have the most desirable flavor, but top and bottom round steaks from the subadult male were most flavorful. Evidently, on the basis of flavor, males are superior to females, a situation existing also in beef. Juiciness of bottom round steaks was comparable to that of

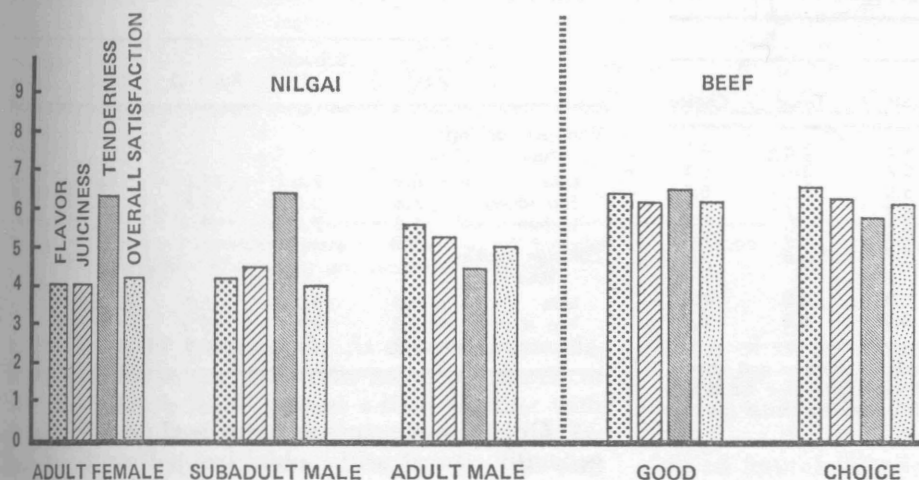


Figure 1. The satisfaction panel's analysis of nilgai and beef loin steaks.

beef, but both loin and top round steaks were drier, though not excessively so. This is to be expected on the basis of low amounts of intramuscular fat (Table 3). Nilgai steaks, except from the adult male, were equal or greater in tenderness than beef, and steaks from the adult were not objectionally tough.

TABLE 3. CHEMICAL ANALYSES OF NILGAI MEATS

	Adult ♀	Subadult ♂	Adult ♂
H ₂ O (%)	71.4	73.2	75.6
Fat (%)	5.2	1.5	0.8
Protein (%)	22.1	23.2	22.2

On overall satisfaction, nilgai was rated lower than beef, mainly on the basis of flavor. Some panel members objected to the flavor of nilgai. Flavor is a totally subjective criterion and subject to great individual variation.

Tenderness is one of the most important attributes of meat and the one most likely to influence

consumer acceptance. Tenderness can be modified somewhat by cooking method or treatment of the meat prior to cooking but is essentially an inherent characteristic of the meat (Cover and Hostetler, 1960).¹ The physical qualities which contribute to tenderness were examined (Tables 4-6).

Criteria for evaluating tenderness were developed. Softness T&C and Softness TC refer to the way the meat feels to tongue and cheek and to the ease with which the teeth sink into the meat, respectively. Fragmentation refers to the ease or difficulty of biting across the grain. Mealiness is a term used to describe texture of the meat when being chewed. Meat that is mealy crumbles into small fragments. Excessive mealiness is considered undesirable. Adhesion refers to the apparent tendency of muscle fibers to stick together. Amount connective tissue and Softness (CT)

¹Cover, Sylvia, and R. L. Hostetler. 1960. Beef tenderness by new methods. Bull. No. 947, Tex. Agr. Exp. Sta., College Station, 24 pp.

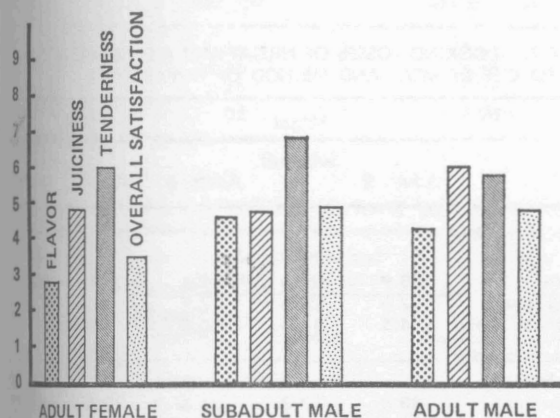


Figure 2. The satisfaction panel's analysis of top-round steaks from nilgai.

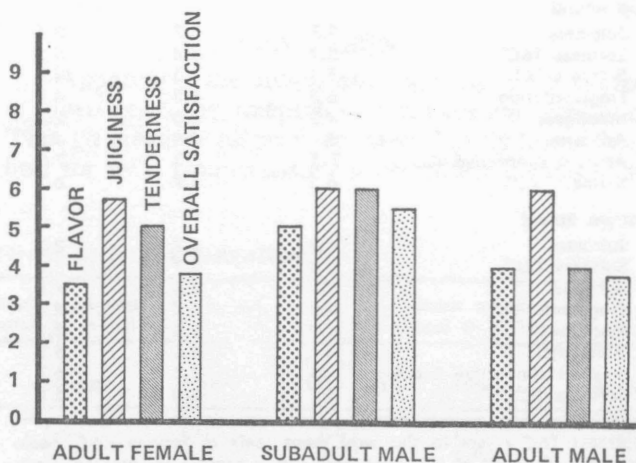


Figure 3. The satisfaction panel's analysis of bottom-round nilgai steaks.

TABLE 4. RATINGS FOR CHARACTERISTICS OF LOIN STEAKS WHICH AFFECT TENDERNESS (TENDERNESS PROFILE PANEL)

	Nilgai			Beef	
	Adult ♀	Subadult ♂	Adult ♂	Good	Choice
Juiciness	3.3	3.2	4.8	5.6	4.5
Softness T&C ¹	5.2	5.0	5.7	5.4	5.1
Softness TC ¹	5.8	6.2	5.5	5.5	5.1
Fragmentation	6.7	6.7	5.7	5.7	5.3
Mealiness	4.3	3.8	2.5	2.3	2.7
Adhesion	7.0	7.2	5.7	5.8	5.1
Amount connective tissue	9.0	9.0	8.3	8.8	8.7
Softness CT ¹	9.0	9.0	8.0	8.8	8.7

¹Softness T&C refers to the way meat feels to tongue and cheek; Softness TC refers to the ease with which teeth sink into the meat; Softness CT refers to the ease with which connective tissue (gristle) can be chewed.

refer to the amount and softness of connective tissue (popularly known as gristle). High scores on these two characteristics mean small amounts of connective tissue that are soft and easily chewed.

Loin steaks of adult male nilgai and both grades of beef were similar for all criteria tested (Table 4). Values for ease of fragmentation, mealiness and adhesion of muscle fibers were slightly higher for the female and the subadult male than for the male and were probably associated with greater dryness of these two samples. Both top and bottom round steaks scored generally lower than loin (Tables 4 and 5). They contained larger amounts of connective tissue and were less easily masticated. Data for beef (Cover and Hostetler, 1960) compared with that for nilgai show bottom round to be more mealy and similar in softness and to have slightly tougher connective tissue than bottom round for nilgai.

TABLE 5. CHARACTERISTICS OF NILGAI ROUND STEAKS WHICH AFFECT TENDERNESS

	Adult ♀	Subadult ♂	Adult ♂
Top Round			
Juiciness	3.7	3.7	3.5
Softness T&C ¹	5.2	4.8	5.2
Softness TC ¹	5.8	5.5	4.7
Fragmentation	6.3	6.3	4.8
Mealiness	4.2	4.0	2.3
Adhesion	6.8	6.5	4.8
Amount connective tissue	7.5	7.3	7.3
Softness TC ¹	6.5	6.7	6.7
Bottom Round			
Juiciness	4.2	4.7	3.2
Softness T&C ¹	6.3	5.7	5.0
Softness TC ¹	6.8	5.8	4.8
Fragmentation	6.8	6.2	4.8
Mealiness	4.0	1.5	3.2
Adhesion	6.7	6.0	5.2
Amount connective tissue	6.3	8.3	6.7
Softness TC ¹	5.7	8.0	5.8

¹Softness T&C refers to the way meat feels to tongue and cheek; Softness TC refers to the ease with which teeth sink into the meat; Softness CT refers to the ease with which connective tissue (gristle) can be chewed.

TABLE 6. WARNER-BRATZLER SHEAR VALUES OF NILGAI AND BEEF

	Nilgai			Beef	
	Adult ♀	Subadult ♂	Adult ♂	Good	Choice
Variable cooking time					
Loin	6.9	7.6	13.1	7.3	7.5
Top round	7.8	8.0	9.8		
Bottom round	9.2	7.7	9.5		
Constant cooking time					
Loin	7.0	8.2	11.0		
Top round	8.2	8.4	12.2		
Bottom round	8.2	8.6	10.8		

Objective measurements for tenderness (Table 6) generally agreed with subjective judgments of the panels. Loin steaks of the female and young male were equivalent to beefsteaks in tenderness, whereas the adult male was tougher. Shear-force values of 7.3 to 9.0 for beef (Cover and Hostetler, 1960) indicate that the younger nilgai is similar in tenderness to beef while the older animal is tougher. It would be of interest to compare meat of older nilgai in these tests with that of a bull of equivalent age.

The effects of cooking technique and different cooking requirements of the various cuts are apparent in Table 6. Steaks cooked for a variable time attained an internal temperature of 70° C and then were removed from the oven; the others were cooked for a constant time (46 minutes) in a 180° C oven. The implication: for maximum tenderness, do not overcook. A possible exception is loin steak from the older animal which seemed to be more tender if cooked at a constant temperature. Since those steaks cooked for a constant length of time had considerably higher shrinkage values (Table 7), they possibly were cooked longer than necessary.

Wiener Formulations

The fat percentages of the final products varied little from one formulation to another (Table 8) and were much less than the maximum level of 30 percent

TABLE 7. COOKING LOSSES OF NILGAI AND BEEF STEAKS ACCORDING TO CUT OF MEAT AND METHOD OF PREPARATION

	Nilgai			Beef	
	Adult ♀	Subadult ♂	Adult ♂	Good	Choice
Variable cooking time					
Loin	23.9	20.6	22.5	24.5	23.9
Top round	22.6	23.6	17.9		
Bottom round	14.5	14.6	20.0		
Constant cooking time					
Loin	33.8	33.3	32.6	32.3	33.0
Top round	36.0	39.0	36.1		
Bottom round	35.4	32.6	34.2		

TABLE 8. EMULSION INGREDIENTS¹

Formula number	Beef (lb.)	Beef (as % beef in formula 1)	Antelope (lb.)	Antelope as % beef in formula 1	Pork (lb.)	Total meat (lb.)	Percent fat in chilled wiener
TAMU 1	4	100			6	10	25.02
TAMU 2	2.7	66 $\frac{2}{3}$	1.3	33 $\frac{1}{3}$	6	10	24.20
TAMU 3	1.3	33 $\frac{1}{3}$	2.7	66 $\frac{2}{3}$	6	10	23.56
TAMU 4			4.0	100	6	10	23.92

¹Curing and seasoning ingredients were as follow for all formulations: salt—90 grams, dextrose—22.6 grams, wiener seasoning—22.6 grams, Prague powder—17.0 grams and moisture—3 pounds.

set by the federal government. As expected, the relatively leaner antelope (2 percent fat as contrasted to 9.5 percent fat for beef) yielded a final product with a lesser amount of fat. Although 1 pound of pork fat was added to the final formulation, the low fat content of all the raw ingredients contributed to the small amount of fat in the wieners.

Shrinkage (Table 9) did not differ drastically among formulations. The product with 66 $\frac{2}{3}$ percent antelope had the least shrinkage (5.21 percent) while the 33 $\frac{1}{3}$ -percent antelope wiener sustained the greatest (6.69 percent).

The results of the emulsion stability tests (Table 10) were inconsistent in that figures obtained for average droplet size and distance between droplets were varied. A large size droplet generally indicates an unstable emulsion as does a diffuse distribution

of droplets. In this experiment, in some instances, the droplets were small with a large distance between droplets; in other cases, the droplet-distance relationship was the reverse. A slight amount of fating out in all formulations indicated that an imperfect emulsion had been formed in all instances.

The sensory panel evaluations for overall satisfaction (Table 11) revealed no significant differences among the various levels of antelope and the control. The untrained panels rated the product with 33 $\frac{1}{3}$ percent antelope highest, while the trained panel gave the highest scores to the control and to the product with 100 percent antelope. No significant differences in flavor were detected by the small untrained and the trained panels. Both preferred the flavor of the 33 $\frac{1}{3}$ -percent antelope wiener.

Texture parameters of juiciness and tenderness were also investigated. Juiciness ratings (Table 11) among formulations by the two sensory panels were not significantly different. The untrained panel chose the 33 $\frac{1}{3}$ -percent antelope product as the juiciest, while the trained panel selected the control and the 100-percent antelope product as juiciest. Organoleptic evaluations for tenderness among the formulations (Table 12) were not significantly different. Both the untrained and trained panels gave the highest ratings to the 66 $\frac{2}{3}$ -percent antelope wiener. Allo-Kramer shear press values indicated that the 33 $\frac{1}{3}$ -percent antelope product was the tenderest.

DISCUSSION

Apparently the nilgai antelope can be a source of meats generally acceptable to the consumer public. Though meats of nilgai were rated slightly lower than beef for most characteristics which affect palatability,

TABLE 9. SHRINKAGE

Formula number	Weight in smokehouse (lb.)	Weight after 6-hour chill (lb.)	Percent shrinkage
TAMU 1	12.10	11.45	5.40
TAMU 2	12.70	11.85	6.69
TAMU 3	11.50	10.90	5.21
TAMU 4	12.70	12.00	5.51

TABLE 10. EMULSION STABILITY COMPONENTS

Formula number	Average droplet size (μ)	Average distance between droplets (μ)
TAMU 1	.68	2.37
TAMU 2	2.60	3.35
TAMU 3	2.43	3.43
TAMU 4	.85	4.94

TABLE 11. SATISFACTION RATINGS BY THREE SENSORY PANELS FOR WIENERS OF EACH FORMULATION

Formula number	Large untrained consumer panel (n = 59)			Small untrained panel (n = 20)			Small trained panel (n = 10)		
	Overall satisfaction	Juiciness	Flavor	Overall satisfaction	Juiciness	Flavor	Overall satisfaction	Juiciness	Flavor
TAMU 1	5.19			6.00	6.40	6.00	7.00	7.10	6.70
TAMU 2	5.75			6.25	6.80	6.45	6.90	6.60	7.22
TAMU 3	5.24			5.90	6.55	5.80	6.70	6.60	6.40
TAMU 4	5.40			5.50	6.20	5.55	7.00	7.10	6.70

TABLE 12. TENDERNESS RATINGS FOR WIENERS OF EACH FORMULATION

Formula number	Rating by untrained panel (n = 20)	Rating by trained panel (n = 10)	Allo-Kramer values in psi
TAMU 1	6.75	7.30	6.555
TAMU 2	6.50	7.30	5.950
TAMU 3	6.85	7.70	7.305
TAMU 4	6.25	7.30	8.115

none of these ratings was objectionably low. Values for tenderness compare favorably with those of beef, while values for flavor and juiciness were lower. Since flavor is a subjective criterion, a comparison of nilgai with beef flavor may not have been justified. Dryness is an attribute of most wild game meat and seems associated with small amounts of intramuscular fat. Proper cooking methods can partially or wholly offset this deficiency.

In some respects nilgai meats have advantages over beef. Although nilgai have a larger percentage of bone, the proportion of lean is greater than in beef, and the amount of fat is approximately 5 percent that of beef. The leaner nilgai meats are thus well suited for combining with fat trim from pork or beef in sausage-like products. Nilgai can be substituted completely for lean beef in wieners, and palatability factors and color of the product pose no barrier to consumer acceptance. Any objectionable flavors that might be present are masked by spices and other components. The only potential problem is an esthetic one of labeling. Since federal regulations require the labeling of all components of processed

meats, the stigma of having game animal meats in the final product may have to be combated. Furthermore, processing of antelope may create problems associated with inspection and higher unit costs.

Methods of preparing meats of any kind influence the table qualities of the cuts. Many recommended recipes for game meats require so many adulterants and lengthy techniques that they are not practicable on a routine basis. Cooking methods were not examined in detail in this study, but the tendency toward dryness of nilgai meats suggests use of a moist-heat method of cooking. A variation of the moist-heat method has been successful:

Nilgai steaks or roasts are seared in a lightly greased skillet, placed in aluminum foil, covered with canned mushrooms and ordinary canned onion soup, the foil sealed and the package placed in an oven preheated to 325° F. Cooking time varies with size of cut but usually takes from 30 to 90 minutes. The desired degree of doneness depends on individual tastes, but overcooking should be avoided. Meats thus prepared are juicy and compare favorably with beef prepared similarly.

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