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DIVISION OF CHEMISTRY

THE SALT OR SODIUM CHLORIDE CONTENT OF FEEDS

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BULLETIN No. 271. OCTOBER, 1920.

THE SALT OR SODIUM CHLORIDE CONTENT OF FEEDS

BY G. S. FRAPS AND S. LOMANITZ.

The Texas feed law requires the statement of the ingredients of many mixed feeds. Common salt or sodium chloride frequently appears among the ingredients stated. Sometimes common salt is placed in the feed, but the fact is not stated. Salt is useful to the animal, adds a flavor to the feed, and renders it more palatable, but, on the other hand, salt is much cheaper than feed, and is not a feeding stuff.

In estimating the salt in a feeding stuff, it is necessary not only to determine the chloride content of the feed, but also to allow for that naturally present in the feed, and this calls for a knowledge of the salt content of the ingredients used. The method of the Association of Official Agricultural Chemists for chloride in feeds is longer than is desirable in a method to be used for examining a large number of feeds. A more rapid method is desirable, even if it should be a little less accurate.

The work here presented includes two things: first, a rapid method for chlorides in feeds; and, second, a study of the chloride content of materials used in mixed feeds.

PRELIMINARY WORK ON LABORATORY METHODS.

A method was sought which would be more rapid than the official A. O. A. C. method for chlorides in feeds, but which would also give results that would compare closely with those obtained by the official method and thus enable one to single out those cases that ought, perhaps, to be checked up by the official method.

The use of a water extract of the feed was tried, together with a precipitant or clarifier, that would separate interfering substances, but would itself not interfere with the reagents used in the Volhard method for chlorine, and that would permit a distinct end-point even with highly colored feeds such as molasses feeds.

The water extracts of several kinds of feeds were treated with Stutzer's reagent, but it had little clarifying effect and the end-point was not distinct. Dilute nitric acid used for the extraction gave the same result as Stutzer's reagent. With alumina cream as a clarifier, the end-point was not clear.

Lead subacetate gave more promising results. The end-point was sharp, and the precipitate of lead sulphate formed when the ferric indicator was added, contributed towards a good end-point. But on testing the proposed method with extracts of various feeds to one portion of which sodium chloride was added, a considerable shortage was found, probably caused by precipitation as basic lead chloride.

After further preliminary work, which showed that lead acetate or carbon black gave satisfactory results, the method described below was adopted.

LABORATORY METHOD ADOPTED.

Reagents.

(1) *N/10 Silver Nitrate.*

Weigh out 34.5 gm. of pure crystallized silver nitrate that has been previously heated to 120° C. for 10 minutes. Dissolve and make up to 2000 c.c. Determine exact strength of solution, by titrating against 10 c.c. of N/5 hydrochloric acid which have been neutralized with pure, powdered calcium carbonate, using potassium chromate as indicator. 20 c.c. of the silver nitrate solution should equal 10 c.c. of the acid. After the N/10 sulphocyanate solution has been made up (see 2), check the silver nitrate solution against the N/5 hydrochloric acid as follows: Add an excess of the silver nitrate solution to 10 c.c. of the acid, filter precipitate of silver chloride on qualitative filter, washing precipitate about eight times with cold water. Add to the filtrate 5 c.c. ferric indicator (see 3), and 10 c.c. nitric acid free from lower oxides of nitrogen (see 4), and titrate excess of silver nitrate in filtrate with the N/10 sulphocyanate solution. The silver nitrate equivalent of sulphocyanate used, subtracted from the total silver nitrate added, gives the silver nitrate used by the 10 c.c. N/5 hydrochloric acid. Adjust nitrate solution if necessary. Keep in a dark-colored bottle.

(2) *N/10 Ammonium or Potassium Sulphocyanate.*

Dissolve about 16 gm. of the ammonium or 20 gm. of the potassium salt in 2000 c.c. water. Measure out 25 c.c. N/10 silver nitrate, add 5 c.c. ferric indicator (see 3) and 10 c.c. of the nitric acid (see 4), and run in slowly, while stirring, the sulphocyanate solution from a burette till a light brown color appears, which does not disappear on stirring. Adjust to exact strength, after final adjustment of the silver nitrate (see 1).

(3) *Ferric Indicator.*

Use a saturated solution of ferric alum; or take 100 gr. ferrous sulfate (copperas), add about 300 c.c. water, 50 c.c. concentrated nitric acid, and 25 c.c. sulfuric acid, adding the latter slowly, while stirring. Evaporate to pasty consistence, to drive off nitrous fumes. Dissolve in water to a solution of about 10 per cent. Use 5 c.c. for each titration.

(4) *Nitric Acid, Free from Lower Oxides of Nitrogen.*

Add 400 c.c. water to 1200 c.c. pure concentrated nitric acid in a large flask, containing a few small pieces of broken glass or porcelain. Boil until colorless. Keep in dark place. Use 10 c.c. for each titration.

(5) *Dilute Nitric Acid.*

Take 200 c.c. of the acid prepared as in (4) and make up to 1500 c.c. Use for acidifying.

(6) *Carbon Black.*

Ascertain the equivalent, in teaspoon capacity, of about 1 gram, and add this quantity as directed below.

Run blanks on all reagents; also when new lot of any reagent is made up.

DETERMINATION.

Weigh 5.85 gm. of the feed into a 200-c.c. volumetric flask. Add water and make up to volume. Let stand an hour, during which time the flask should be shaken three or four times. Pour off 70-80 c.c. into a dry Erlenmeyer flask. Add 1 gm. carbon black, seeing to it that the liquid wets the carbon black thoroughly. This is obtained most quickly by giving the Erlenmeyer a rotary motion. Let stand for about one hour, stirring occasionally. One gram dry lead acetate may be used in place of the carbon black. Stir contents of Erlenmeyer and filter through a dry 11-cm. qualitative filter into dry 6-oz. bottle, rejecting the first few c.c. of the filtrate. Take 50 c.c. (with pipette) of filtrate, acidify slightly with nitric acid (5), and add from a burette an excess of N/10 silver nitrate solution. Five c.c. is usually sufficient. Stir well while the silver nitrate is being run into the beaker. Add 5 c.c. ferric indicator and 10 c.c. nitric acid (4) and titrate the excess of silver nitrate with the N/10 sulphocyanate solution (2). The end-point is marked by the appearance of a light brown to reddish color through the whole contents of the breaker. As the end-point approaches, the precipitate forms larger floccules, and the liquid seems to be getting slightly clearer.

C.c. N/10 silver nitrate, less c.c. N/10 sulphocyanate solution, $\times$ 0.4 = % of sodium chloride.

NOTE.—Even when the liquid containing the excess silver nitrate is somewhat yellowish there should be no difficulty in noticing end-point, as the transition into the sharper light brown to reddish is pretty clearly defined. Keep the work always protected from fumes of hydrochloric acid, chlorine, and chlorides.

TESTS OF THE LABORATORY METHOD.

The method was tested in three ways: (1) by checking the recovery of known amounts of sodium chloride added to feeds and treated by the method; (2) by comparing filtering off the silver chloride, which is recommended for the Volhard method, against non-filtering, as used in this method; (3) by comparing the results of the short method with the A. O. A. C method of ignition with sodium carbonate, on the same feeds.

Recovery of Sodium Chloride.—In order to test the recovery of added salt, several molasses feeds were selected, weighed out, and varying amounts of salt added, in the form of a N/10 solution of sodium chloride. The salt was added by a different person from the analyst, who did not know what quantities had been added. The determinations were completed by the method described above, with the exception

of the modifications mentioned. The results are contained in Tables 1, 2, and 3.

Table 1.—Salt recovered from Molasses Feeds, using 2 gm. Lead Acetate or Carbon Black as clarifiers.

Addition	Lead Acetate, Total	Carbon Black, Total	Salt recovered: Lead Acetate	Salt recovered: Carbon Black	Gain or loss of salt: Lead Acetate	Gain or loss of salt: Carbon Black
22403 None	1.52	0.96				
1.0% salt	2.08	2.32	.56	1.36	a—0.44	a +0.36
22405 None	0.60	0.60				
0.6%	1.32	1.28	0.72	0.68	+0.12	+0.08
22425 None	0.44	0.44				
0.4%	0.80	0.88	.36	.44	—0.04	+0.04
22445 None	0.56	0.64				
1.50%	2.04	2.16	1.48	1.52	—0.02	+0.02
22451 None	0.88	0.96				
1.20%	2.08	2.20	1.20	1.24	0.00	+0.04
22483 None	0.60	0.56				
2.00%	2.52	2.64	1.92	2.08	—0.08	+0.08
Average					—0.004	+0.052

a—Omitted from average.

Two grams of lead acetate or carbon black were used with the feeds in Table 1. The silver chloride was filtered off, as prescribed in the original Volhard method, to secure the results of Tables 1 and 2. The results in Table 3 were secured without filtering off the silver chloride, as given in the method described above.

The recovery of salt was excellent, except for sample 22403 in Table 1 and sample 22483 in Table 3, in which some error was evidently made. The carbon black gave slightly higher results than the lead acetate.

Table 2.—Salt recovered from Molasses Feeds, using 1 gm. Lead Acetate or Carbon Black.

Addition	Lead Acetate, Total	Carbon Black, Total	Salt recovered: Lead Acetate	Salt recovered: Carbon Black	Gain or loss of salt: Lead Acetate	Gain or loss of salt: Carbon Black
22403 None	1.12	1.24				
1.00% salt	2.08	2.20	.96	.96	—0.04	+0.04
22405 1.40% salt	2.00	2.00	1.44	1.44	+0.04	+0.04
None	0.56	0.56				
22425 0.7% salt	1.08	1.16				
3% salt	3.24	.....	2.16	.....	—0.14	.....
22445 None	0.56	0.56				
1.60% salt	2.00	2.24	1.44	1.68	—0.16	+0.08
22451 1.3% salt	2.04	2.12	1.20	1.20	—0.10	—0.10
None	0.84	0.92				
22483 1.0% salt	1.40	1.48				
3.4% salt	3.68	3.96	2.28	2.48	— .12	+ .08
Average					—0.076	+0.012

Table 3.—Salt recovered from Molasses Feeds without filtering off of silver chlorides, using 1 gm. Lead Acetate or Carbon Black.

Addition	Lead Acetate, Total	Carbon Black, Total	Salt recovered		Gain or loss of salt	
			Lead Acetate	Carbon Black	Lead Acetate	Carbon Black
22403 1.0% salt	2.04	2.20	0.96	1.00	—0.04	0.00
None	1.08	1.20				
22405 0.50% salt	1.00	1.04				
1.00% salt	1.48	1.56	.48	.52	— .02	+ .02
22425 2.10% salt	2.40	2.52	2.04	2.12	—0.06	+0.02
None	0.36	0.40				
22445 0.80% salt	1.28	1.32				
1.00% salt	1.40	1.56	.12	.24	+0.02	+0.12
22492 None	0.56	0.60				
1.50% salt	1.96	2.08	1.40	1.48	—0.10	—0.02
22483 1.00% salt	1.36	1.48	.76	1.00	a—0.24	0.00
None	0.60	0.48				
Average					—0.040	+0.023

a—Omitted from average.

Filtering Off the Silver Chloride.—While we thought that the analytical method might be slightly less accurate if the silver chloride was not filtered off, yet the factor of error in applying the results to mixtures of feeds would be so much greater than the analytical error, on account of the variation in salt content of the ingredients, that we would be justified in shortening the method in this way, since the results would still be within the limits of error of the application of the method.

Table 4 gives a comparison of filtering and not filtering in which lead subacetate was used as a clarifier. The difference between filtering and not filtering is small.

Table 4.—Salt in Feeds, using lead subacetate as clarifier, with and without filtration of silver chloride.

	No addition		Salt added	
	Filtered	Not filtered	Filtered	Not filtered
21707	1.25	1.23	1.72	1.69
21714	0.03	0.05	0.53	0.49
21723	0.03	0.03	0.53	0.49
21725	0.15	0.15	0.53	0.53
21732	0.26	0.23	0.76	0.73
21922	0.23	0.23	0.82	0.76

COMPARISON OF SHORT METHOD WITH A. O. A. C. METHOD.

Table 5 contains a comparison of the short method with the A. O. A. C. method of ignition with sodium carbonate. The results of the comparison show that the short method is satisfactory from an analytical standpoint. They also show that the chlorides in feeds are easily soluble in water.

Table 5.—Chlorine (calculated to NaCl) in feeds by A. O. A. C. and by short method.

	Per cent NaCl	
	A. O. A. C.	Short
17486 Molasses	1.00	1.00
17470 Cocoanut meal	0.99	1.00
23964 Mixed feed	1.60	1.64
24012 Dairy feed	0.94	0.84
24013 Cow feed	1.45	1.36
24025 Mixed feed	0.80	0.84
24027 Mixed feed	0.61	0.56
24029 Dairy feed	0.45	0.48
17757 Molasses	1.20	1.20
17801 Molasses	1.06	1.08
17798 Molasses	1.25	1.20
17792 Molasses	1.43	1.40
17793 Molasses	3.80	3.88
17794 Molasses	1.22	1.04
17802 Molasses	1.29	1.29
24054 Mixed feed	1.12	1.16
24139 Mixed feed	0.82	0.80
24448 Wheat mixed feed and screenings	0.11	0.12
24038 Mixed feed	0.46	0.44
17467 Cocoanut oil meal	0.99	1.00
17481 Meat meal	2.95	2.96
17437 Tankage	2.04	2.00
17472 Blood (dried)	0.80	0.80
17471 Meat scraps	0.64	0.64
24358 Shrimp scrap	1.35	1.24
24367 Meat scraps	0.51	0.60
24199 Blood meal	0.71	0.72
16347 Alfalfa hay	0.74	0.80
17499 Alfalfa hay	0.64	0.64
17084 Alfalfa hay	1.61	1.64
17595 Alfalfa hay	1.17	1.20
17596 Alfalfa hay	1.13	1.20
17458 Alfalfa hay	1.89	1.92
17489 Alfalfa hay	1.20	1.24
17498 Alfalfa hay	0.61	0.64
17799 Alfalfa meal	0.42	0.40

APPLICATION OF THE METHOD TO FEED MIXTURES.

A short analytical method for estimating the sodium chloride (or salt) content of feeds has been described in the preceding pages, but this method alone does not allow us to state how much salt has been added to a mixed feed, since the ingredients of the mixture may naturally contain chlorides. This is especially true of molasses and alfalfa. On account of the natural variation of the salt in the feeds used in the mixture, the exact amount of salt added cannot be stated. The exact salt content of the feeds entering into the mixture is not known. Any opinion must be based upon a knowledge of the variation of the chloride content of the feeds which enter into a mixed feed. The salt or sodium chloride content of the mixture can then be calculated either from the average composition, or from such a maximum salt content of the ingredients as may appear advisable. The excess of salt found over that calculated, is due to an addition.

SALT CONTENT OF FEEDS.

The chloride was determined in a number of feeds by the A. O. A. C. method of igniting with sodium carbonate, and the results calculated to sodium chloride. Of course, we recognize that some of the chlorine may have been combined with potash or lime, but this is not material to the object of this work.

The results are given in Table 6. Each determination represents a separate feed. The salt content is low in all of the feeds except molasses, alfalfa, and packing house products.

Table 6.—Percentage of chlorides expressed as sodium chloride.

	Average
Alfalfa Hay (western)—0.62, 1.89, 1.20, 0.61, 0.42, 1.78, 0.86, 0.81, 0.99, 1.09, 0.74, 0.83, 0.50, 1.28	.98
Barley Chops—0.17, 0.19, 0.18, 0.17, 0.14, 0.17, 0.15, 0.17, 0.22, 0.19, 0.18, 0.15, 0.20, 0.13, 0.10, 0.16, 0.11, 0.15, 0.15, 0.26, 0.19	.16
Beans, Velvet—0.03, 0.03, 0.01, 0.04, 0.01, 0.02	.03
Dried Beet Pulp—0.37, 1.47, 0.77	.87
Dried Blood—0.75	.75
Dried Brewers' Grain—0.06, 0.05, 0.04	.05
Cocoanut Meal or Cake—1.15, 0.87, 1.07, 0.84, 1.73, 1.10, 1.17, 0.93, 1.68, 1.08, 0.91, 0.99, 0.99, 1.12	1.11
Corn Bran—0.17, 0.07, 0.06, 0.07, 0.12, 0.11, 0.14, 0.02, 0.06, 0.12, 0.07, 0.10, 0.13, 0.07, 0.12	.10
Corn Chops—0.08, 0.14, 0.12, 0.08, 0.07, 0.09, 0.08, 0.07, 0.09, 0.09, 0.13, 0.09, 0.07, 0.07, 0.13, 0.09, 0.10, 0.09, 0.09, 0.07, 0.09	.09
Corn Feed Meal—0.08, 0.11, 0.10	.10
Ground Corn and Cobs—0.12, 0.13, 0.23	.16
Ear Corn Chops with Shucks—0.11, 0.12, 0.21	.15
Cold-Pressed Cottonseed—0.09, 0.06, 0.07, 0.06, 0.07, 0.07, 0.05, 0.07, 0.05, 0.08, 0.07, 0.06, 0.16, 0.10, 0.05	.07
Ordinary Cottonseed Meal or Cake—0.07, 0.07, 0.08, 0.15, 0.08, 0.06, 0.05, 0.12, 0.06, 0.07, 0.06, 0.07, 0.05, 0.06, 0.08, 0.09, 0.08, 0.09, 0.07, 0.12, 0.07, 0.06, 0.08, 0.08, 0.09, 0.14, 0.09, 0.07, 0.10	.07
Prime Cottonseed Cake or Meal—0.06, 0.07, 0.07, 0.08, 0.06, 0.05, 0.06, 0.07, 0.07	.06
Cracked or Ground Cottonseed Feed No. 4—0.10, 0.08, 0.06	.08
Feterita—0.14, 0.19, 0.11	.15
Fish Meal—0.48, 0.48, 0.76	.57
Flour—0.13	.13
Flour, Graham—0.12	.12
Flour, Rye—0.13	.13
Hominy Feed—0.31, 0.07, 0.22, 0.07, 0.30, 0.07, 0.30, 0.07, 0.07, 0.06, 0.14, 0.13, 0.09, 0.08, 0.08, 0.08, 0.12, 0.10, 0.11	.12
Kafir Chops—0.06, 0.07	.07
Kafir Head Stems—0.13	.13
Linseed Meal—0.06, 0.04, 0.06, 0.05, 0.06	.05
Meat Meal—2.58, 2.95	2.77
Meat Scraps—0.79, 0.78, 0.77, 0.72, 0.58, 3.37, 1.54, 1.91	1.31
Milo Chops—0.13, 0.11, 0.13, 0.07, 0.09, 0.08, 0.09, 0.13, 0.15, 0.15, 0.11, 0.11, 0.10, 0.08, 0.09, 0.08, 0.09, 0.12, 0.12, 0.09, 0.06, 0.11, 0.05, 0.08, 0.09, 0.09	.10
Milo Head Chops, or Ground—0.13, 0.15, 0.15	.14
Milo and Kafir Head Chops—0.15	.15
Molasses—0.96, 1.07, 1.35, 0.99, 0.94, 0.97, 0.90, 1.06, 1.22, 1.30, 1.19, 1.09, 1.41, 1.24	1.12
Ground Oats—0.11, 0.12, 0.25, 0.12, 0.15, 0.11, 0.15, 0.09, 0.15, 0.17, 0.16, 0.17, 0.16, 0.24, 0.09	.14
Rolled Oats—0.09, 0.17	.13
Oat Chops—0.19	.19
Ground Oat Hulls—0.15, 0.10	.13
Oat Meal Mill By-product—0.10, 0.10, 0.12, 0.10, 0.10, 0.11	.10
Peanut Feed No. 4—0.06, 0.05, 0.15, 0.06	.08
Peanut Hulls—0.08, 0.09, 0.08	.08
Peanut Meal or Cake, Prime—0.06, 0.04	.05
Ordinary Peanut Meal or Cake—0.05, 0.05, 0.05, 0.06, 0.17, 0.04, 0.06, 0.05	.06
Peanut Stems—0.20	.20
Peanuts, Whole Pressed—0.09, 0.05, 0.03, 0.07, 0.07, 0.10	.06
Rice Bran—0.11, 0.12, 0.11, 0.09, 0.11, 0.09, 0.14, 0.11, 0.17, 0.09, 0.11, 0.09, 0.09, 0.10, 0.19, 0.11, 0.10, 0.19, 0.11 0.10, 0.12, 0.14, 0.18, 0.13, 0.13, 0.10, 0.09, 0.09, 0.11, 0.08, 0.11	.11
Cracked Rough Rice—0.10	.10
Rice Hulls—0.13	.13
Rice Polish—0.05, 0.08, 0.05, 0.06, 0.12, 0.10, 0.08, 0.07, 0.07, 0.06, 0.06, 0.09, 0.07, 0.05, 0.07, 0.06, 0.07, 0.06, 0.07, 0.12, 0.06	.07
Rye Chops—0.13	.13
Ground Screenings—0.41	.41
Sorghum Fodder—0.08	.08
Sorghum Silage, Dried—0.54	.54
Tankage—1.66, 1.93, 1.81, 0.23, 0.62, 0.31, 2.76, 2.99	1.53
Wheat, Ground—0.13, 0.20	.16
Wheat Bran—0.16, 0.15, 0.08, 0.16, 0.11, 0.10, 0.14, 0.09, 0.10, 0.12, 0.16, 0.09, 0.15, 0.16, 0.12, 0.06, 0.11	.12
Wheat Bran and Screenings—0.13, 0.12, 0.14, 0.18, 0.13, 0.17, 0.16	.14

Table No. 6.—Percentage of chlorides expressed as sodium chloride—Continued.

	Average
Wheat Bran and Screenings—0.20, 0.12, 0.11, 0.07, 0.10, 0.16, 0.16, 0.10, 0.16, 0.14, 0.19, 0.11, 0.11, 0.17, 0.11, 0.18, 0.10, 0.19	.14
Wheat Bran Screenings and Scourings—0.06	.06
Wheat Bran, Shorts and Screenings—0.10	.10
Wheat Brown Shorts and Ground Wheat Screenings—0.13	.13
Wheat Chops—0.18, 0.25, 0.13, 0.12, 0.11, 0.14	.15
Wheat Gray Shorts—0.18, 0.11, 0.12, 0.13, 0.15, 0.15, 0.12, 0.09, 0.12, 0.14, 0.13, 0.11, 0.12, 0.11, 0.09, 0.10, 0.11, 0.12, 0.19	.12
Wheat Gray Shorts and Screenings—0.16, 0.12	.14
Wheat Mixed Feed—0.15, 0.42	.29
Wheat Mixed Feed and Corn Bran—0.16	.16
Wheat Brown Shorts—0.09, 0.14, 0.11, 0.13, 0.10, 0.08, 0.16, 0.12, 0.14	.11
Wheat Shorts—0.15, 0.10, 0.09, 0.15, 0.17	.13
Wheat Screenings—0.13, 0.21, 0.34, 0.13, 0.17	.20
Wheat White Shorts—0.12, 0.13, 0.13	.13
Grass "Poor Joe"—0.37	
Prairie Senna—0.39	
Tumble Weed—0.38	
Dried Prickley Pear—1.21	
Bear Grass—0.13	
Bear Grass Silage, Dried—0.59	
Sacchuista Grass—0.22, 0.16	
Sacchuista Grass used in D. E. 110 Sample No. 2—0.21	

SALT CONTENT OF MIXED FEEDS.

The chloride content of a number of mixed feeds was determined, and the results compared with those calculated from the averages in Table 6. These results are given in Table 7. A quick method for judging the salt content of a mixed feed when animal products are absent, is to subtract 1 per cent. of the sum of the alfalfa and molasses from the salt content calculated to sodium chloride. This assumes that these feeds contain 1 per cent. salt.

Table 7.—Salt in mixed feeds.

No.		Found	Calculated
22143	Corn chops 25%, wheat bran 20%, oat middlings 4%, oat hulls 22%, ordinary cottonseed meal 5%, molasses 20%, salt 0.5%, oat shorts 4%	0.59	0.80
21163	Oats 2%, corn chops 10%, alfalfa meal 20%, corn screenings 28%, lintless cottonseed hulls 20%, molasses 20%	0.53	0.47
22109	Corn 25%, oats 7%, alfalfa meal 15%, oat middlings 1.5%, oat shorts 1.5%, oat hulls 7%, ordinary cottonseed meal 9%, rice bran 5%, ground cottonseed hulls 10%, molasses 20%	0.66	0.43
21201	Rye flour 30%, ordinary cottonseed meal 10%, alfalfa meal 20%, molasses 10%, cottonseed hulls 29.5%, salt .5%	0.59	0.88
21891	Cocoanut meal 50%, ground barley 50%	0.68	0.64
21611	Cracked corn 5%, alfalfa meal 10%, clipped oat by-products (chiefly oat hulls) 55%, molasses 24.5%, salt .5%, cottonseed meal 5%	2.13	0.94
21585	Wheat bran 20%, ground wheat screenings 20%, alfalfa meal 20%, molasses 20%, oat hulls 15%, oat shorts 2.5%, oat middlings 2.5%	0.68	0.51
21972	Alfalfa meal 45%, ground whole barley 10%, corn meal 7%, wheat bran 10%, ground and bolted wheat screenings 8% cane molasses 19.5%, salt .50%	0.86	1.22
21988	Ordinary cottonseed meal 30%, wheat bran 10%, wheat brown shorts 15%, rice bran 10%, corn feed meal 5%, velvet bean feed 30%, linseed oil meal 5%	1.91	0.08
22073	Corn chops 25%, oats 20%, molasses 17%, alfalfa meal 25%, sorghum head chops 6%, corn and oat screenings 6%, salt 1%	1.22	1.50
21436	Cracked shelled corn 15%, oats 5%, alfalfa meal 25%, ground sorghum leaves 24.5%, molasses 30%, salt .5%	0.83	1.13
21612	Corn 13%, oats 8%, alfalfa meal 50%, molasses 29%	0.72	0.83

Table 7.—Salt in mixed feeds—Continued.

No.		Found	Calculated
22116	Corn 20%, alfalfa meal 39%, oats 10%, molasses 30%, salt 1%	1.74	1.75
22120	Corn 15%, oats 35%, alfalfa and molasses 25%	0.42	0.34
22027	Corn 17%, alfalfa meal 20%, oats 5%, oat middlings 1.5%, shorts 1.5%, oat hulls 12%, ordinary cottonseed meal 8%, ground cottonseed hulls 10%, rice bran 5%	0.55	0.27
22985	Cracked corn 35%, crushed oats 15%, alfalfa meal 25%, molasses 20%, salt .5%	1.06	1.02
21609	Tankage 5%, gluten feed 20%, corn feed meal 25%, ground barley 15%, alfalfa meal 20%, molasses 15%	0.60	0.52
22091	Corn feed meal 5%, wheat bran 10%, velvet bean feed 20%, rice bran 15%, digester tankage 5%, linseed oil meal 4.5%, ground wheat screenings 40%, salt .5%	0.80	0.71
22101	Cracked corn 20%, crushed oats 5%, alfalfa meal 49.5% molasses 25%, salt .5%	3.37	1.30
22102	Cracked corn 30%, crushed oats 10%, alfalfa meal 39.5%, molasses 20%, salt .5%	3.21	1.15
21159	Corn 30%, oat feed 10%, rice bran 15%, molasses 14%, ground cottonseed feed No. 6 8%, ground rice hulls 8%, alfalfa meal 15%	0.52	0.39
21154	Ground corn screenings 10%, alfalfa meal 5%, ordinary cottonseed meal 10%, cane molasses 20%, ground wheat straw 15%, delinted cottonseed hulls 15%, ground oat hulls 25%	1.83	0.34
21454	Corn 30%, oat feed (oat middlings, oat shorts, oat hulls) 10%, rice bran 15%, ground rice hulls 8%, alfalfa meal 15%, molasses 14%, ground cottonseed feed No. 6, containing not more than 22%, cottonseed hulls 8%	0.65	0.40
21956	Alfalfa meal 30%, corn chops 35%, oats 15%, blackstrap molasses 20%	1.23	0.56
21236	New Process cocoanut meal 33 1-3%, barley chops 60%, oat chops 6 2-3%	0.55	0.48
21253	Cracked corn 15%, crushed oats 20%, cottonseed meal 5%, alfalfa meal 30%, ground grain screenings, molasses 15% oat meal mill by-product 15%	0.56	0.52
21248	Rice bran 95%, molasses 5%	0.33	0.16
21262	Gluten feed 20%, corn feed meal 10%, hominy feed 39%, oat meal mill by-product 30%, salt 1%	0.85	1.11
21189	Alfalfa 35%, ground corn cobs 35%, molasses 30%	0.73	0.73
22067	Corn chops 10%, alfalfa meal 15%, rice bran 30%, molasses 19.5%, cottonseed hulls 25%, salt .5%	2.32	0.93
22075	Corn chops 20%, alfalfa meal 25%, rice bran 30%, molasses 19%, salt 1%, ground oat screenings 5%	2.90	1.51
21557	Corn chops 10%, alfalfa meal 15%, cottonseed hulls 25%, rice bran 30%, molasses 19.5%, salt .5%	1.60	0.93
21190	Corn 5%, ordinary cottonseed meal 5%, alfalfa meal 40%, cottonseed hulls 20%, molasses 30%	0.75	0.76
22405	Ground corn cobs 60%, molasses 40%	0.55	0.55
22425	Alfalfa meal 35%, molasses 25%, cracked corn 15%, oats crushed 25%	0.40	0.67
22445	Oats 5%, ground cottonseed feed No. 4, containing not more than 10%, excess cottonseed hulls 13%, alfalfa 32%, cottonseed hulls 10%, ground corn cobs 20%, molasses 20%	0.56	0.59
22451	Alfalfa meal 60%, ground sorghum leaves 15%, molasses 25%	0.88	0.88
22492	Corn chops 25%, alfalfa meal 25%, molasses 25%, ground oats 5%, ground cottonseed hulls 20%	0.62	0.58
22711	Corn 15%, cottonseed hulls 15%, oat hulls 30%, molasses 20%, alfalfa meal 5%, hay and straw and chopped alfalfa 15%	1.24	0.48
22722	Milo head chops 50%, chopped alfalfa 50%	0.20	0.56
22727	Corn cracked 25%, No. 1 green alfalfa 16%, molasses 32%, clipped oat by-product (chiefly oat hulls) 27%, weed seeds	1.76	0.59
22861	Rice bran 35%, rice polish 10%, wheat bran 15%, digester tankage 8%, molasses 32%	1.00	0.55
22863	Alfalfa meal 18%, corn chops 12%, oats 2%, rice bran 10%, oat hulls 16%, oat middlings 1%, oat shorts 1%, ordinary peanut meal 2%, molasses 37%, salt 1%	1.60	1.64

Salt in Alfalfa.—The high quantity of salt in alfalfa was surprising, and the question arose whether it was high in alfalfa grown in the East as well as that grown in the West. Several samples were collected and analyzed for chlorides. The results are given in Table 8. Two samples from Geneva, New York, contain 1.08 and 1.10 per cent. chlorides as sodium chloride, but the average of 12 is 0.38 per cent., which may be compared with 0.98 per cent. average for samples secured in Texas. The salt content of alfalfa varies decidedly. Eight analyses

are reported in Wolff's Aschen Analysen. Two samples contain chlorides equal to 1.10 and 1.15 per cent. salt and the other six vary from .08 to 0.48 per cent. salt.

Table 8.—Alfalfa hay, Eastern United States.

Laboratory No.	Origin	Sodium Chloride
17814	Geneva, New York	1.10
17815	Geneva, New York	1.08
17816	Geneva, New York	0.15
18136	Indiana, Pa	0.13
17833	Rhode Island	0.50
18334	State College, Pa	0.19
18335	State College, Pa	0.17
18336	State College, Pa	0.15
18152	State College, Pa	0.17
18106	Massachusetts	0.43
18107	Massachusetts	0.17
18108	Amherst, Mass	0.28

Another question arises. Does the salt in alfalfa serve a useful purpose, and would additions of salt to some soils be of advantage to alfalfa? We have, at present, no information on this point.

Salt in Meat Products and Molasses.—The question of salt in meat products requires further study. Some of it may come from blood, and some may be added. Tankage contains 0.23 to 2.99 per cent. salt,—average 1.53. Meat scraps contain 0.58 to 3.37 per cent.,—average 1.31 salt.

The average of fourteen analyses for molasses is 1.13 per cent. salt. Jones and Fuller at the Indiana Station found an average of 1.38 per cent. chlorides calculated as sodium chloride in nine samples of cane molasses, and 1.09 per cent. average for ten samples beet molasses.

SUMMARY AND CONCLUSIONS.

(1) A rapid method for the estimation of chlorides in feeds is described.

(2) The chloride content of a number of feeds is given.

(3) All the unmixed feeds are low in chlorides, except alfalfa, molasses, and some meat products.

(4) Eastern alfalfa is lower in chlorides than Western alfalfa.

(5) The question as to whether the chlorides in alfalfa are useful, and whether an addition of salt to some alfalfa soils would help it, cannot yet be answered.

(6) The added salt of a mixed feed may be approximately estimated by subtracting 1 per cent. of the alfalfa and molasses present from the chloride calculated to sodium chloride, and more closely by comparison with the average salt content of the ingredients.

(7) The chlorides of feeds are soluble in water.