connection with the analytical work of this investigation.

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(CONTRIBUTION FROM DIVISION OF FOODS, BUREAU OF CHEMISTRY,
U. S. DEPARTMENT OF AGRICULTURE.)

COMPOSITION OF SCUPPERNONG, CONCORD, AND CATAWBA GRAPE JUICES, WITH SOME NOTES ON THE DETERMINA- TION OF TOTAL ACID.¹

By H. C. GORE.

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The use of unfermented grape juice is increasing, and fairly complete analyses of juices prepared from American varieties of grapes will probably be of interest to many. The juices considered here differ from the fresh musts in that they have been sterilized by heat and allowed to stand for at least several weeks before analyzing. During this time considerable quantities of sediment were usually deposited consisting largely of crystals of potassium bi-tartrate. The supernatant liquor constitutes the grape juice. This method of allowing the juice to stand after having been sterilized, then racking off, is followed in the preparation of grape juice on a commercial scale.

All samples have been prepared by the writer or under his immediate direction and on as large a scale as practicable, so that the results might be strictly comparable with those which would be obtained under commercial conditions. In all cases at least 200 pounds of grapes were employed. In the case of Catawba grape juice several tons of grapes were used, and although one analysis only of Catawba juice is given, the sample is probably thoroughly representative of the Catawba juice of this year in the Northern Ohio grape district. A statement of the general character of the three varieties of grapes as furnished by Mr. Geo. C. Husmann, Pomologist in charge of Viticultural Investigations of this Department, is given below.

Scuppernong.—A variety of the *Rotundifolia* species. The designation "Scuppernong" is at present usually applied to all the lighter colored varieties of the *Rotundifolia* species and often even to the entire species. It is esteemed for its eating and wine-making qualities. Bunch of from six to twelve berries; berries large, thick skin, pulpy, fairly sweet, sprightly with a musky scent and flavor. It is esteemed by some, repugnant to others.

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Very vigorous and productive in the South Atlantic and Gulf states.

Mish.—A variety of the *Rotundifolia* species. Supposed to have been discovered by Mr. Albert Mish near the middle of the last century in the vicinity of Washington, N. C. It is at present one of the most extensively grown of the dark colored varieties of this species. Bunches small and straggling; berries ovoid, juicy; flavor delicious and distinct; skin black, with numerous lighter colored specks. One of the best of the dark *Rotundifolias* for wine purposes. Very productive.

James.—Variety of the *Rotundifolia* species. It was discovered by Mr. B. M. W. James, of Grindool, N. C., about 1866 near Grindool Creek, Grindool Post Office. Bunch, like all *Rotundifolias*, small and rather loose. Berries large, showy, round, juicy, slightly pulpy, sprightly, with the peculiar flavor of the *Rotundifolia*. Very prolific. It is one of the most extensively grown of the dark varieties.

Concord.—A variety of the *Labrusca* species. It originated with Mr. E. W. Bull, of Concord, Mass. He exhibited it for the first time in September, 1853. Bunch above medium size, globular, black, thickly covered with beautiful blue bloom; skin moderately thin, tender, cracks easily; flesh moderately sweet, pulpy, tender. Time of ripening medium to late. Fruit of fair keeping quality, becoming insipid soon after being gathered. More fruit of this variety is sold as a table grape in our markets than of all other American varieties combined. At least 75 per cent. of the unfermented grape juice made from native species is of this variety. It makes a light red wine of fair quality and a white wine can also be made by pressing the grapes immediately after they are crushed. This is unquestionably the best known and most extensively grown variety of our native species.

Catawba.—A variety of the *Labrusca* species. Native of North Carolina and has its name from the Catawba River. Introduced to notice by Major John Adlum, Georgetown, D. C., in 1825. It was for many years the standard wine grape of the country. On account of it being very subject to mildew, black rot and a so-called blight, and its late ripening in the northern and northeastern states it is not so much grown now as formerly. Bunch medium size, fairly compact, shouldered. Berries medium size, round, deep red, covered with lilac bloom; skin moderately thick, flesh slightly pulpy, sweet and juicy with a rich vinous somewhat

musky flavor, a good grower, and in favorable seasons and localities productive.

This year (1908) was a favorable one for the development of sugar in grapes in the localities from which the fruit was obtained. This fact must be taken into account in comparing these analyses with others which may be made in other years. All grapes employed were sound and fully ripe. The Scuppernong varieties were obtained from the Medoc vineyards at Enfield, North Carolina. A small proportion of these grapes showed the peculiar mellowness or softening of the pulp which occurs in this species after picking. The Concord grapes were obtained late in the season at the local market and came from the Keuka Lake region, New York. They were very ripe, but entirely sound and of excellent quality. The Catawba grapes were grown near Danbury in Northern Ohio. They were well colored and flavored. This fruit was ground, stemmed and pressed in a winery at Sandusky, Ohio.

The methods of analysis employed were those of the Association of Official Agricultural Chemists¹ with the exceptions as noted below. The specific gravity was determined with a Brix spindle which when checked with a pycnometer was found to give correct results. The readings were taken at 20° C. and corrected to 17.5° C. The alkalinity of the ash was determined by extracting the ash on a filter with hot water and titrating as directed. For phosphoric acid the ash was moistened with nitric acid, taken up with water, and finished by the official method. Digestion by the Neumann² method with nitric and sulphuric acids which has been shown by LeClerc and Leavitt³ to be necessary in case of the ash of wheat, was found not to be required in case of the ash of these juices.

Total acid was determined by titrating 10 cc. samples, using litmus as indicator. A discussion of the method comprises the latter portion of this paper. Total tartrates were run by the official method, employing a modification necessitated by the viscous nature of the cooked Concord juice, which probably contains a considerable amount of pectin formed from the disintegrating pulp cells during the heating. When alcohol is added as required in the method, a slimy precipitate forms, making it impossible to use a Gooch filter as directed. A four-inch Büchner funnel was substituted, using nine cm. filter papers. This was

¹ U. S. Dept. Agr., Bur. Chem., Bull. 107, revised.

² Zeit. physiol. Chem., 37, 115.

³ J. Am. Chem. Soc., 30, 391 and 617.

Variety.	Description	Sediment strain interval days.	Corrected Brix reading.	Specific gravity from Brix reading.	Ash.	Alkalinity of ash as K ₂ CO ₃ . Per cent.	Total phosphoric acid, P ₂ O ₅ . Per cent.	Total acid as tartaric. Per cent.	Total tartrates as tartaric acid. Per cent.	Protein N × 6 1/4. Per cent.	Reducing sugar as invert. Per cent.	Total sugar as invert. Per cent.	Direct. Per cent.	Invert. Per cent.	Sucrose by reduction. Per cent.	Sucrose by polarization. Per cent.	Tannin and coloring matter. Per cent.	Undetermined solids. Per cent.
Scuppernong	Cold pressed, very pale yellow.	75	14.77	1.0603	0.16	0.11	0.015	0.72	0.45	0.07	13.42	13.42	—4.65	—5.10	0.07	0.34	0.026	0.30
Mish	Cold pressed, pale yellow.	61	16.57	1.0681	0.22	0.16	0.014	0.81	0.53	0.14	12.88	14.88	—2.05	—4.60	1.90	1.85	0.027	0.49
James	Cold pressed, light red.	61	13.47	1.0547	0.19	0.12	0.012	0.44	0.30	0.07	12.33	12.13	—4.65	—4.65	none	none	0.035	0.40
Concord	Cold pressed, dark red.	31	20.37	1.0849	0.27	0.19	0.026	0.68	0.56	0.30	18.60	18.34	—7.7	—7.8	none	0.10	0.056	0.46
Concord	Cold pressed, dark red.	23	19.97	1.0831	0.29	0.19	0.031	0.78	0.60	0.27	17.89	17.77	—7.7	—7.6	none	none	0.058	0.68
Concord	Cold pressed, dark red, macerated 16 hours.	30	19.27	1.0800	0.32	0.22	0.031	0.82	0.61	0.39	17.04	16.86	—6.7	—7.35	none	0.47	0.070	0.63
Concord	Hot pressed, very dark red, unstemmed.	31	22.07	1.0926	0.32	0.22	0.046	0.89	0.68	0.42	18.60	18.40	—7.5	—7.5	none	none	0.402	1.44
Concord	Hot pressed, very dark red, stemmed.	31	20.67	1.0864	0.29	0.21	0.037	0.86	0.70	0.45	17.85	17.35	—7.15	—6.8	none	none	0.363	0.86
Concord	Hot pressed, very dark red, stemmed.	23	22.17	1.0931	0.32	0.21	0.048	1.02	0.71	0.41	18.95	18.69	—7.5	—7.6	none	0.10	0.437	1.03
Catawba	Cold pressed, light brownish yellow.	41	20.07	1.0836	0.27	0.17	0.026	0.93	0.67	0.42	17.98	17.74	—7.1	—7.2	none	0.10	0.061	0.41

TABLE I.—ANALYSES OF GRAPE JUICES.

Polarization at 20°
C. Normal weight
in 200 mm. tube.

found much more convenient to use than the Gooch crucible, and its use can introduce no appreciable error. When working with cooked Concord juice it was found advisable to throw the alcoholic precipitate which floats on the surface on to the filter paper first. This is sucked as dry as possible, and washed with small portions of the washing mixture. This paper is then removed, a fresh paper substituted, and the main crop of crystals collected.

Beaker and precipitate are well rinsed with successive small portions of washing mixture, both papers returned to the beaker, and the determination finished as usual.

Total nitrogen was determined by the Nitrogen Laboratory of this Bureau. Sugars were estimated, using the method of Munson and Walker.¹ The juices were clarified for sugar determination by first adding calcium carbonate, then solution of neutral lead acetate, making up to volume, filtering, precipitating excess of lead acetate with dry potassium oxalate and again filtering. The undetermined matter shown in the table is the total solids (corrected Brix reading) less the sum of the ash, acid, protein, sugar, and tannin and coloring matter.

An inspection of the results indicates that the Scuppernong juices are considerably less rich than the other varieties in sugar, ash, alkalinity of ash, phosphoric acid, total tartrates calculated as tartaric acid, protein, and tannin and coloring matter. A unique feature of these juices is the fact that they contain sucrose even after standing for weeks. In the case of Mish juice nearly two per cent. of cane sugar was found by reduction and polarization methods and more undoubtedly existed in the juice as it came from the press. The Scuppernong grape juice was shown to contain cane sugar and its presence was verified by a special determination made by Dr. C. S. Hudson, of this Bureau, on the day that the juice was pressed. According to his observations, inverting by use of invertase, 0.69 per cent. of sucrose was present.

Three lots of the Concord grapes were pressed without previous heating and three lots were heated before pressing by bringing to the boiling-point with constant stirring in a steam-jacketed kettle. One of the cold-pressed samples was allowed to stand after crushing for a period of 16 hours to determine what effect, if any, would be produced. The effect of this maceration seems

to consist in a slight lowering of the specific gravity of the juice, a slight increase in nitrogen, and a decrease in the sugar. Fermentation had not started as a special determination showed the absence of alcohol.

In the case of the hot-pressed Concord juices a contrast is shown between juices prepared from the stemmed and the unstemmed grapes pressed on the same day. The juice of the unstemmed grapes is higher in solids, ash, phosphoric acid and sugar than that from the stemmed grapes. It is also higher in tannin. These differences, may, however, be due to slight differences in the heat treatment.

Comparing the cold- and hot-pressed juices it will be noted that there is a considerable increase in the solids of the hot-pressed juices and that this increase is not due to increase in sugar but is due to a slight increase in ash, total acid, and total tartrates, an increase in nitrogen, and a decided increase in undetermined solids, and tannin and coloring matter.

The Catawba grape juice is similar in composition to the cold-pressed Concord juice but higher in total acids, total tartrates and protein.

NOTES ON THE DETERMINATION OF TOTAL ACID.

Results obtained by Hortvet¹ have led him to regard phenolphthalein as far superior to litmus as an indicator for the commonly occurring organic acids of wines. Working with the pure acids not only did he find the end point to be unsatisfactory with litmus, but that only 90 to 95 per cent. of various acids were titrated, while with phenolphthalein the end point was sharp and practically 100 per cent. was found. That the latter indicator is most suitable when the organic acids are not associated with coloring matter, is generally recognized, but if, as Hortvet states, it is greatly superior for general use, it is quite remarkable that litmus is still retained. The difficulties in using phenolphthalein with colored products appear to be well recognized. Litmus is preferred by Windisch² in the titration of wines and by Schüle³ in case of strongly colored distilled liquors and vinegars.

The grape juices analyzed above afforded a good opportunity for studying the action of the two indicators in the determination of total acid.

¹ "The Determination of Total, Fixed and Volatile Acid in Wines," *THIS JOURNAL*, 1, 31.

² Lunge, *Chem. Techn. Unters. Meth.*, 5th ed., Vol. 3, p. 606.

³ *Ibid.*, pp. 566 and 590.

¹ *U. S. Dept. Agr., Bull.* 107, revised, and *J. Am. Chem. Soc.*, 28, 663.

Titration of dilute solutions of organic acids have also been made. The litmus used was purified by one of the methods found in the standard text-books which direct the removal of the coloring matters other than the azolitmus by extraction with hot alcohol. In titrating, a dilute solution of litmus of neutral tint was placed in small drops on a white glass plate and was thus used as an outside indicator. This method, including the precaution of employing a litmus which has been thoroughly extracted with hot alcohol, is due to Mr. C. S. Ash,¹ chemist of the California Wine Association. In titrating a dilute solution of an organic acid, the end point is essentially the same as when the indicator is used inside. In the titration of a colored grape juice the end point is satisfactory and much sharper than by either using lit-

To understand the difficulties of using phenolphthalein as an indicator in colored grape juices it is necessary to consider the color changes which ensue as such a juice is gradually made alkaline. With a cold-pressed Concord juice, for example, working under the conditions mentioned below, the red color gradually fades and, as ordinarily viewed by reflected light, entirely disappears shortly before the point where the juice is neutral to litmus. After this neutral point is reached, if a few tenths of a cc. of alkali are added, a green color develops which up to now has been observed during the titration where there has existed in the solution a momentary local excess of alkali. If more alkali is added the green color deepens, soon approaching a maximum. Viewed by transmitted light, this green is found to be mixed with a red

TABLE II.—SHOWING THE RESULTS OF TITRATION OF ORGANIC ACIDS, USING LITMUS AND PHENOLPHTHALEIN.

Acid.	Description.	Concentration.	Tenth-normal soda required				Per cent. of acid indicated by litmus.
			Used for titration, cc.	using litmus, cc.	using phenolphthalein, cc.	Differences, cc.	
Tartaric	B. & L. C. P.	0.5 gr. in 100 cc.	10	6.45	6.65	0.2	97
"	"	" " " "	20	13.0	13.4	0.4	97
"	"	" " " "	20	13.0	13.4	0.4	97
"	"	1.0 gr. in 100 cc.	10	12.95	13.35	0.4	97
Potassium bitartrate	"	" " " "	10	5.1	5.2	0.1	98
"	"	" " " "	10	5.0	5.3	0.3	94
"	"	" " " "	20	10.4	10.6	0.2	98
Acetic	"	0.5 gr. " "	10	16.25	16.45	0.2	99
"	"	" " " "	10	16.30	16.4	0.1	99
"	"	" " " "	20	33.3	33.6	0.3	99
"	"	" " " "	20	32.4	32.75	0.35	99
Lactic	"	1.0 gr. " "	10	7.9	8.1	0.2	98
"	"	" " " "	20	15.8	16.3	0.5	97
"	"	" " " "	20	15.9	16.25	0.35	98
Malic	Merck's, C. P.	" " " "	10	14.8	15.0	0.2	99
"	"	" " " "	10	14.85	14.95	0.1	99
Citric	B. & L. non-hydrated	1.0 gr. in 100 cc.	10	14.25	14.2	0.05	100.4
"	"	" " " "	10	14.2	14.2	0.0	100.0
"	"	" " " "	20	28.65	28.55	0.10	100.3
Succinic	E. & A. C. P.	" " " "	10	16.75	16.9	0.15	99
"	"	" " " "	20	33.80	33.9	0.1	99
Benzoic	Merck's C. P.	" " 1000 cc.	100	7.9	8.15	0.25	97
"	"	" " " "	100	8.0	8.2	0.2	98

mus inside or outside on paper. After exposure to the air for a few moments on the white plate the drops of neutral tinted litmus become blue, and very slight amounts of free acid in the drops of the solution being titrated are easily detected by the reddish tinge imparted. If the sample is greatly diluted—say one part of the juice to forty parts of water—somewhat low results may be expected, but there will probably be found no occasion for great dilutions as it is found that the natural colors even of the very dark, hot-pressed Concord juices, do not interfere with the sharpness of the end point, duplicates agreeing usually within 0.1 cc.

¹ Verbally communicated.

whose presence is readily verified by viewing the solution through a direct vision spectroscope.

If phenolphthalein is present its effect at the time the end point for this indicator is reached, is slightly to change the shade of the solution. This occurs just after the green begins to develop. As the titration progresses from the point where the green color first appears, the green deepens and at the same time the red, due to the phenolphthalein, begins to develop and it is impossible to detect with certainty at just what point a change in color, due to phenolphthalein, occurs unless the somewhat cumbersome device is employed of titrating a blank, that is, a grape juice solution to which no indicator has been added, side by side with the

solution containing phenolphthalein, using another burette. The slight amount of red naturally occurring in the neutralized or alkaline grape juice probably renders the change in shade due to slight amounts of phenolphthalein red still more difficult to recognize. By titrating a blank simultaneously, however, adding exactly the same amount of alkali as employed in titrating the solution when phenolphthalein is used, the true end point may be found quite as sharply as could be desired. This method was followed with the titrations of grape juices given below except in case of the Scuppernong and Mish juices, which were practically free from coloring matter.

from 96 to 98 per cent. of the acids were indicated by litmus. These juices were low in tannin and coloring matter, and after treatment with carbon black, which was found to remove a considerable proportion of the acid as well as the tannin and color, practically the same percentages of the organic acids were titrated as before.

The end points indicated by litmus and phenolphthalein were found to be wide apart in the titrations of the hot-pressed Concord juices which were rich in tannin and coloring matter. Apparently only from 85 to 90 per cent. of the organic acids are indicated by litmus. When decolorized by carbon black the end points were very much nearer

TABLE III.—SHOWING THE RESULTS OF TITRATING GRAPE JUICES, USING LITMUS AND PHENOLPHTHALEIN.

Variety	Description	Before treating with carbon black.				Color removed by carbon black. ¹			
		Tenth-normal soda required		Differences, cc.	Per cent. of acid indicated by litmus.	Tenth-normal soda required		Differences, cc.	Per cent. of acid indicated by litmus.
		using litmus, cc.	using phenolphthalein, cc.			using litmus, cc.	using phenolphthalein, cc.		
Scuppernong	Cold pressed	9.6	9.9	0.3	97	9.15	9.4	0.25	97
"	"	.....	.....	.....	..	9.05	9.35	0.3	97
Mish	"	10.8	11.15	0.35	97	10.65	11.05	0.4	96
"	"				..				..
James	"	5.8	5.95	0.15	97	5.15	5.4	0.35	95
"	"	.....	.....	.....	..	5.2	.....	.....	..
Concord	"	9.1	9.5	0.4	96	8.85	9.05	0.2	98
"	"	9.05	9.45	0.4	96	8.8	.....	.....	..
"	"	10.3	10.5	0.2	98	10.2	10.45	0.25	98
"	"	10.35	.....	.....	..	10.15	.....	.....	..
"	"	11.0	11.3	0.3	97	10.65	10.9	0.25	98
"	"	10.85	.....	.....	..	10.6	.....	.....	..
"	Hot pressed unstemmed	11.7	13.75	2.0	85	9.65	10.0	0.35	97
"	"	11.8	.....	.....	..	9.55	10.0	0.45	96
"	Hot pressed stemmed	11.45	12.25	1.3	90	9.3	9.6	0.3	97
"	"	11.60	.....	.....	..	9.25	9.5	0.25	97
"	"	13.65	15.35	1.7	89	10.95	11.3	0.35	97
"	"	.....	.....	.....	..	10.8	11.2	0.4	96
Catawba	Cold pressed	12.35	12.6	0.25	98	11.85	12.2	0.35	97
"	"	12.35	.....	.....	..	11.8	.....	.....	..

¹ Fifty cc. samples were diluted to 250 cc. and digested in the cold with carbon black for about one hour except in case of the hot pressed juices which required repeated treatment with carbon black. Aliquots of 50 cc. were filtered off and titrated.

Each solution was prepared for titrations as follows: About 100 cc. of distilled water in a 150 cc. beaker were heated to boiling and 10 cc. or more of the sample added from a pipette. The beaker was covered with a watch-glass, the mixture brought just to boiling and then removed. The titration was made at once, using tenth-normal soda which contained a small proportion of barium hydroxide.

The results show that litmus readily titrates 96 to 99 per cent. of the organic acids in dilute solution in water, the amount shown by phenolphthalein being taken as 100 per cent.¹ In case of all of the juices except the hot-pressed Concord,

¹ In case of citric acid slightly more acid was indicated by litmus than by phenolphthalein, but this was possibly due to some impurity in the acid.

together, from 96 to 97 per cent. being now shown by litmus. This fact demonstrates a most serious objection to phenolphthalein—that the tannin and coloring matters are at least partly titrated when it is used, thus causing these substances to be partly or wholly estimated as constituents of the total acid, when unquestionably they should not be so included. This objection to the indicator is sustained by the observation of Hortvet¹ that whereas but 14.3 per cent. of gallotannic acid was titrated using litmus, 78.8 per cent. was estimated using phenolphthalein. Results on highly colored grape and other juices, and on many red wines, will probably be much too high if the latter indicator is used.

¹ *Loc. cit.*

SUMMARY.

(1) A slight change in the method of determining total tartrates, consisting in employing a 4-inch Büchner funnel instead of a Gooch crucible for collecting the crop of crystals, was found necessary when dealing with hot pressed Concord grape juice.

(2) The Scuppernong grape juices were considerably less rich than the other varieties in all constituents except total acid, and two out of the three varieties analyzed contained sucrose.

(3) The maceration of the cold-pressed Concord juice for sixteen hours had little effect on its composition.

(4) The hot-pressed Concord juices were considerably richer in solids than the cold-pressed, and this difference was due to slight increase in ash, total acids and total tartrates, an increase in nitrogen and decided increases in undetermined solids, and tannin and coloring matter.

(5) The Catawba grape juice was similar in composition to the cold-pressed Concord, but higher in total acids, total tartrates and protein.

(6) A method of using litmus due to C. S. Ash was found very useful. This method consists in employing a litmus which has been thoroughly exhausted with hot alcohol, and using a dilute neutral solution placed in small drops on a white glass surface as an outside indicator.

(7) With red grape juices using phenolphthalein it is shown that it is necessary to run a blank side by side with the sample being titrated in order to detect the change in shade due to the indicator.

(8) When dilute solutions of the commonly occurring organic acids were titrated, litmus was found to indicate from 96 to 99 per cent. of the acids, the amounts shown by phenolphthalein being taken as 100 per cent.

(9) When grape juice low in tannin and coloring matter was titrated, litmus indicated from 96 to 98 per cent. of the acids present.

(10) When juices high in tannin and coloring matter were titrated, but from 85 to 90 per cent. of the acids apparently present were indicated by litmus. After removing the tannin and coloring matter litmus indicated from 96 to 97 per cent. of the amounts of acid shown by phenolphthalein.

(11) Litmus is to be preferred to phenolphthalein in the titration of total acid in products containing appreciable quantities of tannin and coloring matter since by its use these substances are not appreciably titrated.

AMERICAN MOLASSES FEEDS: THEIR MANUFACTURE AND COMPOSITION.

By J. E. HALLIGAN.

Received February 25, 1909.

The manufacture of molasses feeds in this country started about twelve years ago and since that time the demand for this class of feed has steadily increased until to-day it is one of the standard mixed feeds found on the American market. On account of the popularity for such a feed many mills are turning out molasses feeds exclusively.

The capacity of the mills vary from 50 to 500 tons per day, and they average about 100 to 150 tons a day.

There are several different methods employed in compounding these feeds for the trade, among which may be mentioned the following:

1. The molasses is mixed with the primary products (such as grain, chopped hay, etc.), without subjecting any of the materials to heat.

2. Cold molasses is added to the kiln-dried primary products and thoroughly mixed.

3. Hot molasses is mixed with cold primary products.

4. Hot molasses is mixed with artificially dried primary products.

Some manufacturers vary the above-mentioned methods by artificially drying their mixtures after the molasses has been thoroughly incorporated with the balance of the feed.

The temperature to which the molasses is heated varies in different factories but it is generally just warmed, although the best results are obtained when the molasses is brought to the boiling point.

Of the above methods, No. 4 has given fine results, both in lowering the moisture content and in preventing the feed from decomposing when put on the market. In the manufacture of wet feeds method No. 2 is often followed.

It is difficult to secure a good mechanical mixture when a small quantity of molasses is employed unless the molasses is heated before introducing it into the balance of the feed. The heating of the molasses before mixing allows of a more even distribution and drives off some of the water present in the molasses. Those feeds manufactured by using small amounts of cold molasses are liable to be lumpy and especially is this true when finely ground products such as cottonseed meal, rice polish, etc., are contained in the feed.

Most factories use a mixture of beet and cane molasses. There are some concerns that employ