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COMPOSITION OF AMERICAN HONEYS

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Composition of American Honeys

By Jonathan W. White, Jr., Mary L. Riethof, Mary H. Subers, and Irene Kushnir, Eastern Utilization Research and Development Division, Agricultural Research Service

Each year about 250 million pounds of honey is harvested by the beekeepers of the United States. This honey is produced by more than 5 million colonies of honeybees, owned by beekeepers whose operations range from the single hive of the hobbyist to that of the full-time commercial apiarist who may control many thousands of colonies.

Hundreds of plants are known to be attractive to bees as nectar sources. Many of these, either cultivated or in the wild state, occur in local concentrations large enough to be valuable as sources of surplus honey. Since honey is produced in each of the 50 States of this country, the possibilities for variation in its composition and properties are enormous. Added to the variety of nectar-secreting plants are the effects of beekeeping and farming practices, local climatic and environmental conditions, and soils, any or all of which might affect the composition of honey. It is apparent that honey is potentially an extremely variable commodity. This variability retards the extensive use of honey in many parts of the food industry. The trend appears to be toward standardization of ingredients and toward increasing use of materials of known composition. Honey, a most valuable carbohydrate that carries unique flavoring properties, is a relatively complex material whose composition, either in general or specifically, has been only imperfectly known and reported.

Although hundreds of honey types and blends are known, only 25 or 30 are of commercial significance. These are the bulk honeys of trade—the ones that are available from year to year and that provide most of the commercial beekeeper's income. Little or no information has been available on the variations in composition to be expected among these honeys.

Profound changes have taken place in agricultural practices in this country over the past few decades. These have been reflected in changes in the types of honey produced and also in the increased dependence of American agriculture on the honeybee for pollination of many crops. The last analytical survey of the composition of American honey was that of Browne, published in 1908 (*9*).[1] Honey samples studied were probably of the 1902 or 1903 crops. The procedures then used for carbohydrate analysis of honey have been employed ever since with only minor improvements (*12, 25*). Recently, innovations have been made (*50, 54*), and the resulting analyses are far less empirical than previous ones (*55*). Differences in results for carbohydrates between old and new methods are sufficiently large

[1] Numbers in parentheses refer to Literature Cited, p. 40.

that it is necessary to re-examine the carbohydrate composition of honey by the newer procedures.

A fuller knowledge of the composition of honey and its variation with floral source, age, production area, and crop year is essential to maintaining or improving its competitive position in the market and in the food industry. It is the objective of this bulletin to provide such information.

Only partial attainment of this objective is within our grasp. Physical limitations have confined our efforts to as complete an analysis as possible of 504 samples of honey and honeydew, representing 2 crop years. These samples originated in 47 States and represent 83 single floral types, 93 blends of known composition, and 4 honeydew types. Certainty regarding floral type(s) of the samples is not absolute by any means; further comment on this appears later. Samples of the more common and important types of honey yield some information on variation due to area of production.

REVIEW OF PREVIOUS WORK

Relatively little attention has been given to the composition of American honey in recent years. About 500 commercial "honey" samples were analyzed late in the 19th century during Wiley's crusade for the Pure Food Laws (*59*). At that time much of the honey on the market was adulterated with other carbohydrate materials. The analytical methods developed during that time were later used by Browne (*9*) and his report has remained the standard reference in this field. He analyzed 100 samples of honey and honeydew from 42 floral types representing 21 plant families. In addition to dextrose, levulose, sucrose, and dextrin, the amount of ash, free acidity, and the presence of tannin were also determined.

In 1908, Van Dine and Thompson (*45*) reported the analysis of 54 samples of Hawaiian honey and honeydew. Using a new procedure for dextrose determination in honey, Lothrop and Holmes in 1931 (*22*) published values for dextrose and levulose for 33 United States honey samples of 30 floral types. Three years later, Lynn, Milum, and Englis analyzed 25 samples of Illinois honey (*25*) representing 8 floral types and blends. All these analyses were largely empirical, though the analytical methods used by Lynn et al. and by Lothrop and Holmes resulted in more realistic values than those reported earlier.

Eckert and Allinger later (*12*) published analyses of 112 samples of California honey and honeydew. These represented 47 floral types and blends. The carbohydrate methods they used were essentially those of Browne, which have appeared in the Official Methods of the Association of Official Agricultural Chemists (*1*) since 1916. Ellegood and Fisher (*14*) analyzed four samples of fireweed honey by these methods in 1940.

A critical study of methods of sugar analysis applicable to honey was made in 1952 by White, Ricciuti, and Maher (*57*). None of five methods generally in use or proposed for honey analysis, including the Official Methods, gave results reflecting the true composition of

the sample. Later White and Maher (*54*) developed an entirely new procedure for carbohydrate analysis of honey, which they applied to 19 domestic honey samples (*55*). Using this method they found a new category of honey sugars, the reducing disaccharides; the method also provided more accurate values for dextrose, levulose, and higher sugars than did older methods. This method has been used in analyzing the samples in this report. It has been subjected to collaborative testing (*48, 50*) and accepted as first action by the Association of Official Agricultural Chemists (*28*). It has also been used in Canada (*3*), Chile (*7*), and South Africa.[2]

HONEY SAMPLES

PROCUREMENT

Samples of honey for the crop years 1956 and 1957 were solicited personally and by mail from beekeepers and producer organizations. Special emphasis was placed on obtaining samples of known source and history. Where local conditions and practices produced complex blends, these were identified as such and are characterized by location, area of production, and time of harvest. Instructions were given on proper sampling and as much detail as possible was requested regarding area of production, floral type or blend information, and type of processing. While unheated samples were preferred, samples of known heating history were accepted. During the 2-year period, 516 samples of honey and honeydew were obtained, of which 12 were not analyzed for various reasons. The locations from which samples were obtained are shown on the map (fig. 1).

TREATMENT AND STORAGE

Procedures for handling samples on arrival were occasionally modified during the work. Approximately the first 200 samples were handled as follows:

If the sample was liquid [3] or only slightly granulated when received, it was mixed and a 2-ounce subsample removed and graded for color. This was then stored at −20° C. (−4° F.) within 1 day of arrival. The remainder of the sample was kept at room temperature (23°–28° C., 73°–82° F.) in a dark cabinet until analysis.

If the sample was partly or completely granulated upon receipt, it was heated with cap tight in a water bath at 60° C. (140° F.) for 30 minutes. If this did not liquefy the sample, the temperature was raised to 65° C. (149° F.) and heating was continued until liquefaction was complete. The sample was cooled, a 2-ounce subsample was graded for color, and stored at −20° C. (−4° F.). The rest of the sample was kept at room temperature as indicated previously.

[2] ANDERSON, R. H. SOME CHEMICAL AND PHYSICAL PROPERTIES OF SOUTH AFRICAN HONEYS. Thesis, Univ. of Stellenbosch, Stellenbosch, South Africa, 1958.

[3] Determined by a honey polariscope (*52*).

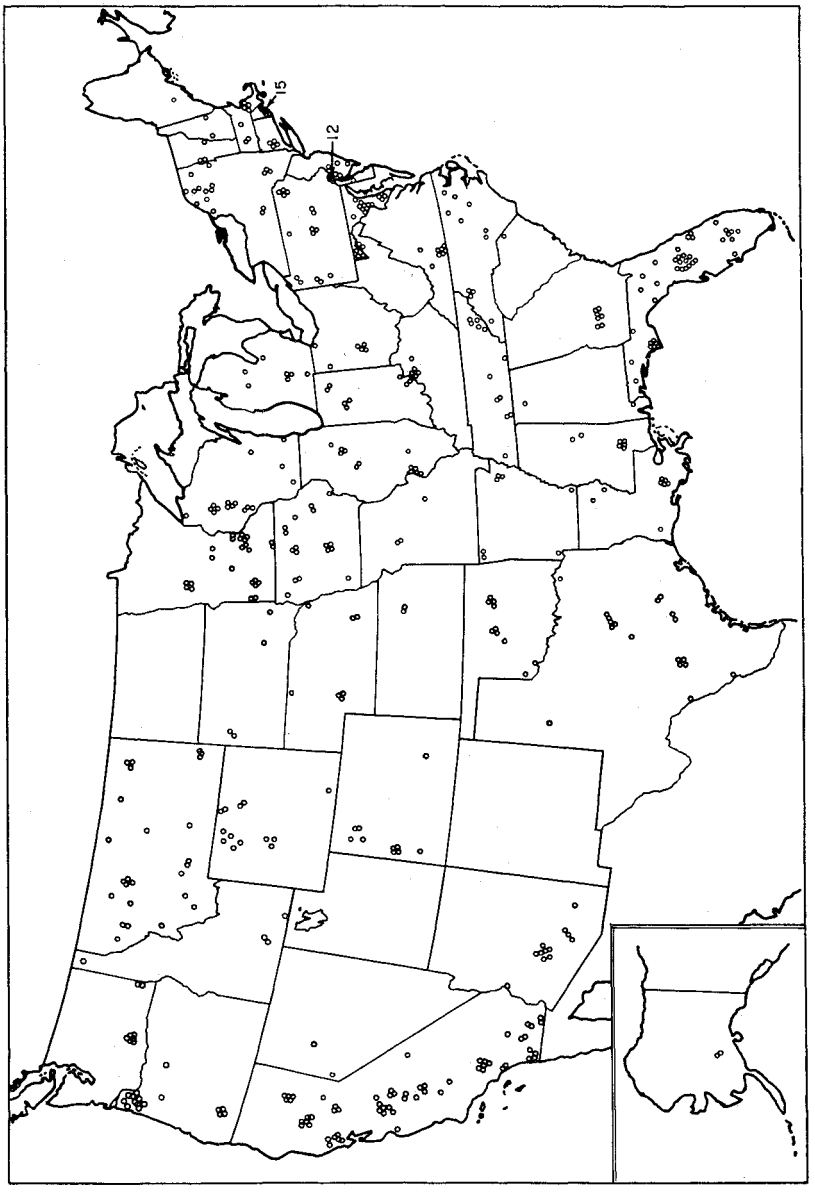

FIGURE 1.—Origin of honey and honeydew samples.

After experience with this procedure it was noted that some unheated samples showed signs of fermentation during storage. These were immediately pasteurized at 60° C. (140° F.) for 30 minutes. The last 300 samples received were therefore handled as follows:

Two-ounce subsamples were removed from producer-unheated liquid samples as before, color graded, and stored at −20° C. (−4° F.). The remainder of the sample was pasteurized as above before storage at room temperature. Liquid samples that had been heated by the producer were not stored in the cold, and the bulk of the sample was pasteurized in the laboratory. Samples requiring liquefaction were handled as before except no subsample was stored at −20° C. (−4° F.).

Some samples were received in the comb. These were crushed in a beaker, warmed to 50° C. (122° F.), and strained through two layers of cheesecloth. They were then treated as described for liquid honey unheated by the producer. Extracted honey samples were strained through two layers of cheesecloth before storage if they contained any extraneous material.

The analytical work on these samples was carried out over a period of about 30 months; therefore, many samples required several heatings to liquefy them so that subsamples would be properly representative. All analyses, except the diastase determination and the storage study (*58*), were carried out on the samples stored at ordinary temperature. Attempts were made to minimize heat exposure of samples by subsampling for as many determinations as possible at one time.

ANALYTICAL METHODS

Details of all methods used appear in the appendix. This section is limited to the general principles of the various procedures.

Moisture was determined by measuring refractive index on an Abbé refractometer at 20° C. (68° F.) and use of the Chataway table (*1*).

Color of all samples was determined by the U.S. Department of Agriculture color classifier (*8*). Each of the six United States color standards for extracted honey (*43*) was visually split into two zones, light and dark, so that samples were classified into 13 groups ranging from "light Water-White" to "Dark Amber." The classes and their code numbers follow.

Code No.	Color group	Pfund value[1]
		(Millimeters)
0	Light half of Water White	Less than 4
1	Dark half of Water White	4–8
2	Light half of Extra White	8–12
3	Dark half of Extra White	12–17
4	Light half of White	17–27
5	Dark half of White	27–34
6	Light half of Extra Light Amber	34–42
7	Dark half of Extra Light Amber	42–50
8	Light half of Light Amber	50–70
9	Dark half of Light Amber	70–85
10	Light half of Amber	85–104
11	Dark half of Amber	104–114
12	Dark Amber	114 and more
13	Blue	----------

[1] The Pfund values for the official grade limits are accurately determined by our procedure; however, the values for the boundaries between the light and dark portions of each class are only approximate.

"Granulation," as recorded in appendix table 27, was estimated empirically as follows: After analysis, the completely liquid sample of honey remained undisturbed for 6 months after its last heating. At this time, its degree of granulation was judged visually and with the polariscope (appendix). It was assigned to 1 of 10 groups, as follows:

Code No.	*Degree of granulation*
0	None.
1	Few scattered crystals.
2	Layer on bottom 1/16 to 1/8 inch.
3	Few clumps of crystals.
4	Layer on bottom 1/4 to 1/2 inch.
5	1/4 of depth granulated.
6	1/2 of depth granulated.
7	3/4 of depth granulated.
8	Complete soft granulation.
9	Complete hard granulation.

For carbohydrate analysis, the sample was dissolved in dilute alcohol and passed through a column of activated charcoal under controlled conditions. The column was then washed with two solvents of higher alcohol content, with the result that three solutions were obtained from each sample. Dextrose was determined by hypoiodite oxidation and levulose was determined directly, after hypoiodite destruction of dextrose, by a micro copper-reduction method.

On another fraction from the charcoal column, reducing disaccharide sugars were determined directly by the micro copper-reduction method and reported as maltose. In the same fraction, sucrose was determined by increase in reducing power after a mild acid hydrolysis. Where sample identity or high sucrose and higher sugar values (each over 1 percent) indicated its desirability, true sucrose was estimated by invertase hydrolysis, and melezitose was calculated from the difference between apparent "sucrose" and true sucrose.

A third fraction collected from the charcoal column contained all other sugars from the sample, i.e., most trisaccharides and higher sugars. These carbohydrates were hydrolyzed by acid and determined collectively as dextrose by copper reduction.

A portion of each fraction analyzed for all samples was evaporated to dryness and subjected to paper chromatography to monitor the efficiency of the charcoal column separation and to detect any departure from normal of the distribution of the several sugars within each fraction.

The "undetermined" value is the difference between 100 and the total sugars plus the moisture content. Its significance is discussed later.

A study of the accuracy of the selective adsorption method is given in detail in the appendix.

For determination of free acid, lactone, total acidity, and pH, a recently developed procedure was used (*56*). A honey sample was diluted, its pH noted, and a rapid electrometric titration used to determine free acidity. A back-titration following the addition of an excess of alkali measured lactone content. The total acidity is the sum of these two values.

Diastase was determined on all samples stored at −20° C. (−4° F.) and also on a limited number of other samples. The procedure used was that described by Schade, Marsh, and Eckert (*32*), as adopted by the Association of Official Agricultural Chemists (*28, 50*). It has also been used by Duisberg and Gebelein (*11*). Two advantages over the old modified Gothe procedure are the objectivity of the method and its provision of a continous scale of diastase activity rather than a limited number of discrete "steps."

For the ash determination, honey samples were slowly dried and charred under infrared heating lamps, then subjected to the usual ashing process. This prevented loss of sample by foaming.

A micro-Kjeldahl method was used for determination of nitrogen.

RESULTS

The results of the analyses are presented in detail in appendix tables 26 and 27, and graphically in figures 2 to 4. The figures show the relative spread of values for all the characteristics listed in appendix table 27. The complete range of values is divided into a number of intervals and the number of samples in each interval is shown. The average values for each characteristic are also indicated on the graphs. Honeydew samples (Nos. 492 to 505) are not included in these distributions.

CHARACTERIZATION OF INDIVIDUAL TYPES OF HONEY AND HONEYDEW

Table 1 shows the average values obtained for the honey samples analyzed, the highest and lowest values found, and the standard deviation for each constituent.

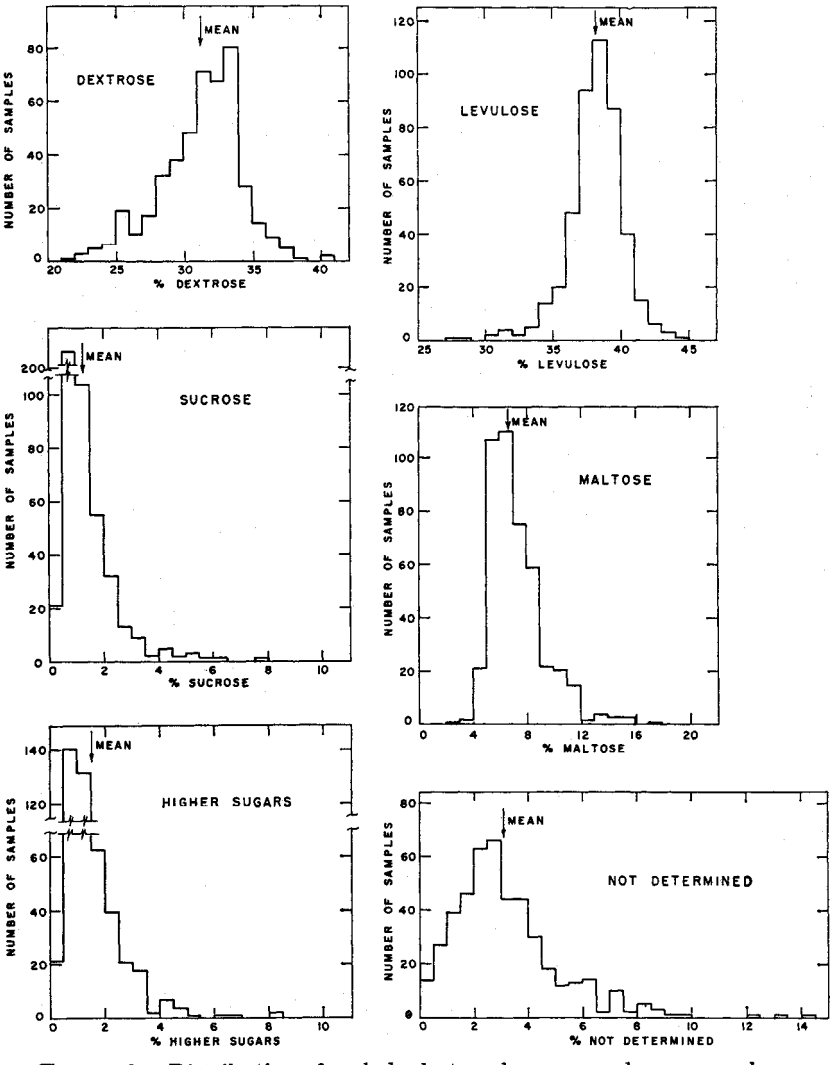

FIGURE 2.—Distribution of carbohydrate values among honey samples.

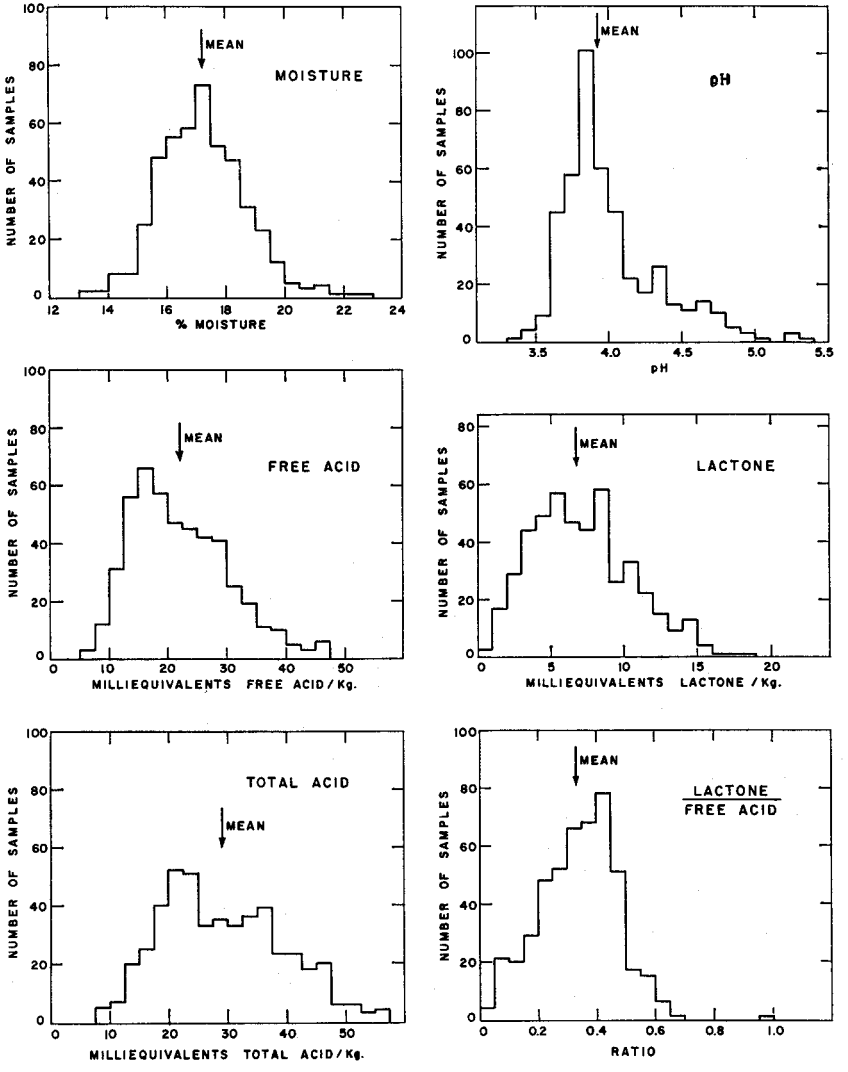

FIGURE 3.—Distribution of moisture, acidity, and pH values among honey samples.

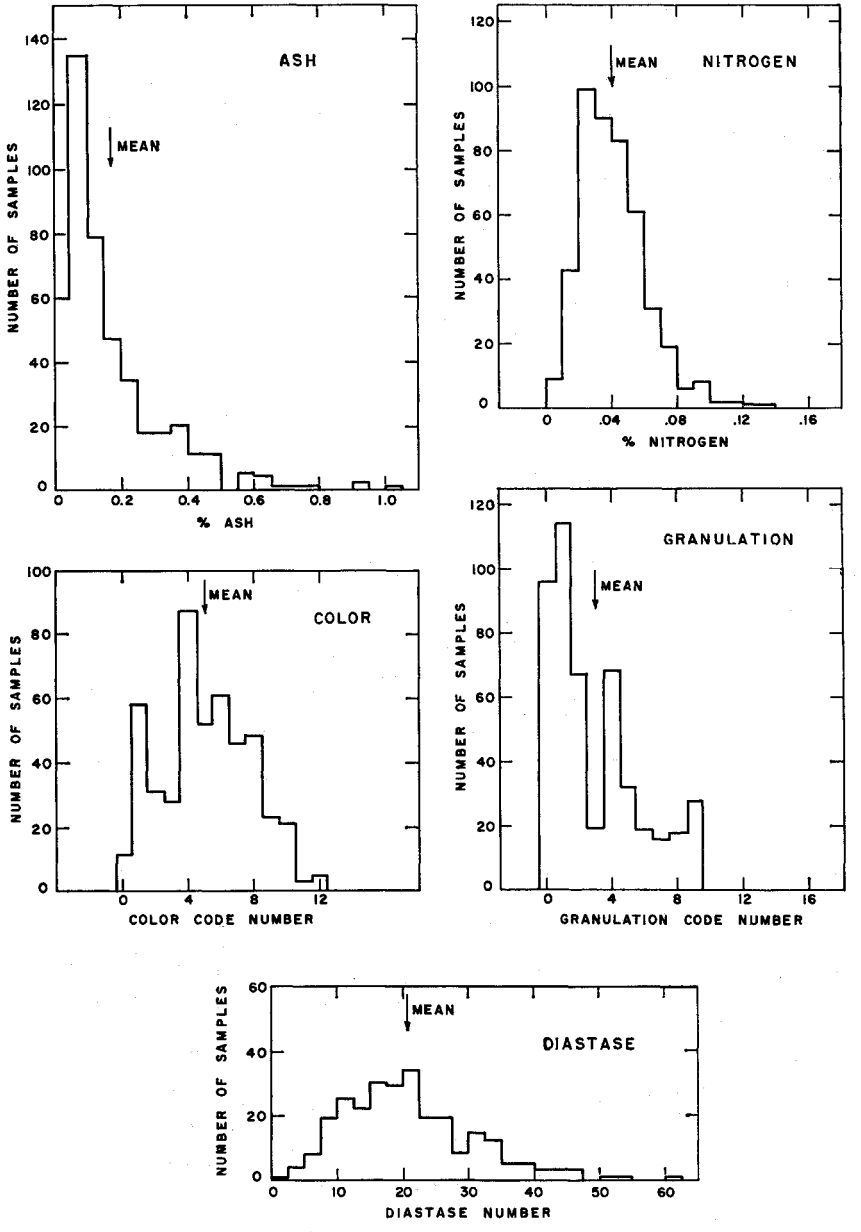

FIGURE 4.—Distribution of ash, nitrogen, and diastase values and of color and granulation tendency among honey samples.

TABLE 1.—*Average composition of 490 samples of honey and range of values*

Characteristics measured	Average	Standard deviation	Range
Color [1]	5	2.8	0 –12
Granulation [1]	3	2.8	0 – 9
Age, months	12	5.6	1 –33
Composition:			
Moisture, percent	17.2	1.46	13.4 –22.9
Levulose, do	38.19	2.07	27.25 –44.26
Dextrose, do	31.28	3.03	22.03 –40.75
Sucrose, do	1.31	.95	.25 – 7.57
Maltose, do	7.31	2.09	2.74 –15.98
Higher sugars, do	1.50	1.03	.13 – 8.49
Undetermined, do	3.1	1.97	.0 –13.2
pH	3.91		3.42 – 6.10
Free acid, meq./kg	22.03	8.22	6.75 –47.19
Lactone, do	7.11	3.52	.00 –18.76
Total acid, do	29.12	10.33	8.68 –59.49
Lactone/free acid	.335	.135	.000– .950
Ash, percent	.169	.15	.020– 1.028
Nitrogen, do	.041	.026	.000– .133
Diastase value	20.8	9.76	2.1 –61.2

[1] See p. 6 for explanation of color and granulation codes.

To facilitate comparisons between various floral types of honey, table 2 shows how 74 floral types and 4 honeydew types compare with these average values. A plus sign in table 3 indicates that the characteristic or constituent is appreciably higher than the average for the type of honey under consideration.[4] A minus sign indicates that the value is appreciably lower than the average. No mark shows that the honey is about average. An "n" means insufficient data were available for comparison. For example, in general, alfalfa honey granulates more than the average of all honeys analyzed, and is higher in glucose, sucrose, and lactone/free acid ratio. It is lower than the average in higher sugars, undetermined material, ash, and nitrogen. Other values are near the average. Moisture content was intentionally omitted from the table, since we do not believe it is a characteristic of the floral type of honey, but rather depends largely on other factors. No honey was listed minus for granulating tendency unless it was essentially nongranulating in our test. Those marked plus in granulation are particularly prone to granulate. Honeys not marked are average in granulating tendency under the conditions we used—in 6 months' storage after heating, they would deposit thin layers (up to ¼ inch) or clumps of crystals in a jar.

[4] Statistical tests were not applied to determine significance of these differences.

TABLE 2.—*Characteristics of various types of honey and honeydew*

[+ means higher than average values; − means lower than average; n means insufficient data to permit valid comparison]

Type of honey or honeydew	Color	Granulation	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acidity	Lactone	Total acidity	Lactone/free acid	Ash	Nitrogen	Diastase
HONEY																
Alfalfa		+		+	+		−	−					+	−	−	
Aster	+	−			−	+			+		−		−	+		n
Athel tree	+	+	+	+			−							+	+	n
Bamboo, Japanese			−			+										n
Basswood														−	−	
Bergamot	+		+								+	+				n
Blackberry	+	−		−		+	+		+				−	+		−
Blueberry	+					+			+							n
Blue Curls		+	−	+					−		+					n
Bluevine			−	−												n
Boneset	+		+	−								+			+	
Buckwheat	+		−		+					+		+				+
Canteloupe		+		+							+	+			−	−
Cape vine			−				−								−	
Chinquapin	+	−	−	−		+	+	+	+		−		−			
Clover, crimson	−								−					−	−	
Clover, hubam	−			+			−							−	−	n
Clover, sweet yellow	−		+		+					−		−	+	−	−	n
Coralvine	+	−	−	−			+	+	+	+		+		+	+	n
Cotton		+		+		−	−		+					+		
Cranberry	+	−	−	−			+	+	+					+		
Gallberry		−	+						+						−	
Goldenrod				+	−		−		+		−		−			+

TABLE 2.—*Characteristics of various types of honey and honeydew*—Con.

[+ means higher than average values; − means lower than average; n means insufficient data to permit valid comparison]

Type of honey or honeydew	Color	Granulation	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acidity	Lactone	Total acidity	Lactone/free acid	Ash	Nitrogen	Diastase
HONEY																
Grape	+	−	−	−		+						+			+	n
Holly	+	−		−		+	+		+							n
Horsemint				+			−		−		+	+	+			
Locust		−	+	−						−		−		−	−	−
Manzanita		+	−	+						−		−			−	n
Marigold				+			−		−		+		+	−		+
Mesquite		+	+	+			−				−				−	n
Mexican clover	+	−								+		+				+
Mint	−			+	+			−							−	
Mountain laurel	−	−	−	−	−	+	+	+	+	−	−	−	−			+
Mustard	+	−		−		+			+					+	+	
Orange									−		+		+	−		n
Orange-grapefruit					+									−	−	−
Palmetto		−				+			+	−		−			−	−
Palmetto, saw	+										+	+	+	+	−	−
Pepperbush	+		−					+			+			+		−
Peppermint	+		+						+				−	+		n
Peppervine	+	−	−	−		+									−	−
Poison oak		−		−		+	+	+						+	+	n
Privet	+						−		−	+	+	+				n
Prune	+	+	−	−		+	−		+	−	−	−	−	+	+	n
Raspberry	+	−	−	−			+					+		+	+	−
Rhododendron	−	−	−	−		+		+	+	−	−	−			−	+

TABLE 2.—*Characteristics of various types of honey and honeydew*—Con.

[+ means higher than average values; − means lower than average; n means insufficient data to permit valid comparison]

Type of honey or honeydew	Color	Granulation	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acidity	Lactone	Total acidity	Lactone/free acid	Ash	Nitrogen	Diastase
HONEY																
Sage		−	+	−												n
Snowbrush	+									+		+				+
Sourwood		−		−		+	+		+		−	−			−	
Spanish needle	+	−	+	−							+	+	+	+	+	+
Spearmint			+											+		n
Sumac	+		−	−			+	+	+	+		+	−	+	+	+
Sunflower	+	−						−			+	+			+	−
Thistle, blue	−		−							−		−		−		n
Thistle, star			−		+		+		−		+	+	+			+
Thyme	+								+					+	+	n
Titi	+						−		+	−	−	−	−	+	−	
Titi, spring	+	−	+	−				+	+	−	−	−	−			n
Trefoil	−											−		−	−	−
Tulip tree	+	−	−	−		+	+	+	+	+	−	+	−	+	+	
Tupelo		−	+	−					−		+		+	−		
HONEYDEW																
Alfalfa	+	+	−							+	−	+	−	+	+	n
Cedar	+	−	−	−		−	+	+	+	+		+	−	+		n
Hickory	+	−	−	−	+		+	+	+	+	−	+	−	+		n
Oak	+	−	−	−		+		+	+	+		+	−	+	+	n

NOTE: The following were near average in all above characteristics except diastase, which differs as shown in parentheses: Wild buckwheat, (+); clover, alsike; clover, sweet; clover, white; and crotalaria (−); cucumber, eucalyptus, fireweed, and heartsease (n); palmetto, cabbage; and pentstemon (n); purple loosestrife (n); rosinweed (+); vetch and vetch hairy (−).

A plus sign indicates an increase in pH value, which means a decrease in hydrogen ion concentration.

While honey is generally considered to be the sweet exudations of plant nectaries, gathered, modified, and stored in the comb by the honeybee, other sources of carbohydrates are similarly used by the bees. The principal one is honeydew, which includes the secretions of certain insects that feed on plants (aphids, leafhoppers, scale insects). Under certain conditions, honeydew may be gathered and stored in the hive. It may ordinarily be detected in honey by its strong, molasseslike taste.

Among the samples received from producers were several floral blends containing honeydew, so identified in appendix tables 26 and 27. In addition, there were 14 honeydew samples, representing 4 known and 3 unknown types. They are listed as Nos. 492 to 505 in tables 26 and 27, and their average values are given.

Table 3 gives the average composition, standard deviation, and range of these honeydew samples. Table 2 compares the average characteristics of honeydews with floral types of honey. They are distinctly different from the averages for honey. The honeydews are dark in color, usually nongranulating, quite low in dextrose and levulose, high in higher sugars and undetermined material, of high pH value, especially high in free and total acid, and low in lactone/free acid ratio. They are also high in ash content.

Flavors of different floral types of honey are quite characteristic; however, no effort was made in this project to describe flavor. Flavor expression is highly subjective and difficult to communicate. Few people are familiar with more than a very limited range of honey

TABLE 3.—*Average composition of 14 samples of honeydew and range of values*

Characteristic measured	Average	Standard deviation	Range
Color [1]	10	1.1	7 –12
Granulation [1]	2	2.3	0 – 8
Composition:			
Moisture, percent	16.3	1.74	12.2 –18.2
Levulose, do	31.80	4.16	23.91 –38.12
Dextrose, do	26.08	3.04	19.23 –31.86
Sucrose, do	.80	.22	.44 – 1.14
Maltose, do	8.80	2.51	5.11 –12.48
Higher sugars, do	4.70	1.01	1.28 –11.50
Undetermined, do	10.1	4.91	2.7 –22.4
pH	4.45	----------	3.90 – 4.88
Free acid, meq./kg	49.07	10.57	30.29 –66.02
Lactone, do	5.80	3.59	.36 –14.09
Total acid, do	54.88	10.84	34.62 –76.49
Lactone/free acid	.127	.092	.007– .385
Ash, percent	.736	.271	.212– 1.185
Nitrogen, do	.100	.053	.047– .223
Diastase [2]	31.9	----------	6.7 –48.4

[1] See p. 6 for explanation of color and granulation codes.
[2] Based on 4 samples only.

flavors, and individuals vary widely in their reactions to flavors. This does not imply that flavor is unimportant; on the contrary, it may be considered the most valuable single characteristic of honey.

IDENTITY OF HONEY SUGARS

In addition to the predominating levulose and dextrose, and the long-known sucrose, honey has recently been shown to contain a number of relatively minor sugars, some rare. The occurrence of maltose, isomaltose, maltulose, turanose, and nigerose was demonstrated by White and Hoban (*51*). Watanabe and Aso have recently found kojibiose in honey (*47*). These are all reducing disaccharide sugars and are reported as "maltose" in this work, with the exception of the kojibiose which reacts essentially as a nonreducing disaccharide and therefore is in the "undetermined" category.

When subjected to paper chromatography, the disaccharides of honey give a characteristic pattern of spots (*51*). All samples analyzed in this project were chromatographed and all showed numerically identical spot patterns.

Considerable variation was seen in the relative intensities of the chromatographic spots among the various samples, particularly of the disaccharide sugars. Samples listed as honeydews or containing honeydew showed a characteristic chromatographic pattern in their higher sugar fraction, including spots or streaks, or both, to the origin of the papergram.

The monosaccharide fractions of all samples analyzed showed only dextrose and levulose. There was considerable relative variation in the amounts of the disaccharide sugars listed, but all samples contained all the sugars as far as could be determined.

ACIDITY OF HONEY

Gluconic acid, which can be formed from dextrose by certain enzymes, has recently been found to be the predominating acid in honey (*42*). Many other acids have been reported to occur in honey. It has not been established whether the lactone material, which is measured by the titration procedure used in this work, is entirely gluconolactone or if additional lactones are present. The presence of lactone is a general characteristic of honey.

Only two samples (Nos. 336 and 406) contained no measurable lactone. When the variable proportion of lactone in honey was noted (expressed as the ratio of lactone to free acid), it was believed that low values of the ratio indicated the presence of honeydew. The average value of the ratio for all floral honeys is 0.355, and for honeydew is 0.127. The data indicated a possible relationship between the lactone-acid ratio and the pH of the sample. This would be logical, since the equilibrium position of the reaction gluconic acid $\rightleftarrows$ gluconolactone $+H_2O$ would be expected to depend on the pH of the medium. The smaller the pH value (greater acidity), the greater the proportion present as lactone, and the higher the lactone/free acid ratio. An analysis of variance for regression of pH on lactone/free acid ratio confirmed this at better than the 1-percent probability level.

Thus, the lower value of the ratio for honeydews (and the two previously mentioned samples 336 and 406, with pH values of 5.01 and 6.10) reflects the generally higher pH values of honeydew.

These higher pH values for honeydew might at first appear to imply a lower acid content. Honeydews, however, have a considerably greater titratable acidity than honey but also a higher ash content. The pH reflects the buffering action of the inorganic cation constituents on the organic acids present, with the pH value depending on the relative amounts of cationic material.

Both anionic and cationic mineral constituents are included in the ash determination reported here. However, an analysis of variance for regression of pH on ash content, and also on total acidity, was calculated using all honey and honeydew samples. A significant relationship (F greater than required for 1-percent probability level) was found between pH and ash, and none was found between pH and total acidity. Thus, the amount of titratable acid does not determine pH, which rather is a result of the natural buffering action of the mineral constituents on the acids.

Effect of Crop Year on Composition

The last two lines of data in appendix table 27 give the average analysis of all honey samples for the years 1956 and 1957. The 1957 samples are somewhat lighter in average color than the 1956 samples, slightly lower in granulating tendency, slightly higher in levulose, lower in undetermined material, but otherwise the averages for the 2 years are very similar. The two averages are not made up of corresponding samples, however, and their values are dependent on the sample response from producers for the 2 years.

Two other types of comparisons of data can be made to examine the differences in honey between 1956 and 1957. There are seven floral types and blends (totaling 110 samples) in tables 26 and 27 for which samples were numerous enough to allow averaging of data for the individual crop year. The 7 pairs of averages are all of legume honey, 50 samples from 1956 and 60 from 1957. There are also 11 pairs of samples, 1 for each year, for the same floral type, from the same producer and location.

A comparison of the appropriate 1956 and 1957 averages in table 27 indicates that they differ in composition. In nearly all cases, this difference is less than differences among samples of the same crop year and of the same floral type. Several of these sets of data were examined by statistical procedures. For sweet clover–alfalfa honey, for example, granulating tendency of the 1957 samples is significantly less than that of the 1956 samples (1-percent probability level). The dextrose content is significantly lower (5-percent probability level) for the 1957 samples. None of the other constituents differed significantly with the year of production. For the clover samples, granulating tendency was significantly less for the 1957 samples (5-percent probability level). No other significant differences were found.

The second type of comparison of data is that of 22 samples, 1 each year for 11 floral types, from the same producer and location. This type of comparison should reflect differences in the "same" honey

over the 2 years, since the individual samples are comparable for the 2 years. The 110 samples making up the averages described above were not necessarily from the same parts of the country for the 2 years, and the comparisons must be considered as indicative only. The 11 pairs of samples in this second comparison were alfalfa-sweet clover (Nos. 35, 52), aster (62, 63), blend (122, 123), chinquapin (168, 169), white clover (236, 240), coralvine (306, 307), cotton (308, 314), gallberry (329, 332), privet (404, 405), raspberry (412, 413), and vetch (470, 475). The results are shown in table 4. Statistical tests were not used in compiling this table.

Color, granulating tendency, and acidity were most constant. Dextrose showed the most variation, differing in 10 of the 11 pairs; it was higher in 4 and lower in 6. Since granulating tendency varied little, the dextrose changes were relatively small. Higher values were generally found for the 1957 samples for nitrogen, ash, hydrogen ion concentration (lower pH), higher sugars, and moisture content; lower values were found for dextrose, levulose, and color.

TABLE 4—*Comparison of 1957 samples with 1956 samples of the same floral type of honey, each from the same producer and location*

[+ means 1957 was higher than 1956 sample; − means 1957 sample was lower]

Samples compared	Color	Granulation	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen
Alfalfa-sweet clover	−		+	+		−	−	+	+		−		−		−		−
Aster			+	−		−					−	+	+	+	+		+
Blend	−		−	−	+	+	−		+						+	+	
Chinquapin		+	+		+	+			−	−	−	+	+	+	+		+
Clover, white	−	−	+		−	−		+			−					−	
Coralvine			+			−											+
Cotton					−		−									+	+
Gallberry	+		+	−	−	+		−	−	−	−	+	+	+	+	+	
Privet	−					+	+	+		−	−	−	−	−		−	
Raspberry				−	−	−	−	−	+	+	+	+	−	+	−	+	+
Vetch		−	−		−	−	+	+	+							+	
Total	5	3	8	5	7	10	6	6	6	4	7	5	6	5	6	7	6

EFFECT OF AREA OF PRODUCTION ON COMPOSITION

The effect of area of production on honey composition is difficult to assess. Only where the floral type has outstanding analytical characteristics can a comparison of samples from different areas provide meaningful information. Even then one cannot decide if differences are due to plant source and climate or simply to the availability of different minor sources.

A few groups of samples were compared from this viewpoint. It is well known that alfalfa honey from the Imperial Valley is darker than alfalfa honey from the Intermountain area and has a more pronounced flavor. Table 5 shows how these two honey types differ in average composition. The Valley values are averages of samples 6, 7, 8, and 10; the Intermountain values are averages of samples 9, 11, 13, 14, 15, 16, 17, and 19.

In addition to the differences in flavor and color, the Valley honey appears to be lower in levulose, higher in dextrose, higher in ash, and considerably greater in free and lactone acidity, though the lactone/acid ratio and pH are not different. It also granulates more readily. However, if the samples are paired and analyzed statistically, most of these differences are not significant, variation among samples of either type being as great as that shown in table 5. The difference in granulating tendency is the only significant factor.

Cotton honey is characteristically rapid-granulating. Examination of averages of samples of cotton honey from three areas provides some information on the effect of location on the composition of a honey type. Table 6 shows averages calculated for two samples from Texas

TABLE 5.—*Average composition of alfalfa honey from different areas*

Characteristics compared	Intermountian area	Imperial Valley area
Color	Light half of Extra White.	Dark half of Extra Light Amber.
Granulating tendency	¼–½″ layer	Complete
Age at analysis, months	8	16
Composition:		
Moisture, percent	16. 4	15. 8
Levulose, do	39. 55	37. 88
Dextrose, do	33. 28	34. 11
Sucrose, do	2. 42	2. 88
Maltose, do	5. 85	5. 85
Higher sugars, do	. 80	. 83
Unanalyzed, do	1. 7	2. 6
pH	3. 83	3. 84
Free acid, meq./kg	15. 18	22. 55
Lactone, do	6. 42	9. 98
Total acidity, do	21. 60	32. 53
Lactone/free acid	. 423	. 442
Ash, percent	. 059	. 158
Nitrogen, do	. 026	. 032

TABLE 6.—*Average composition of cotton honey from different areas*

Characteristics compared	Texas	Arizona	California
Color	Dark half of White.	Dark half of White.	Light half of White.
Granulating tendency	Complete soft.	Complete soft.	Complete soft.
Age at analysis, months	9	7	15
Composition:			
Moisture, percent	15. 6	16. 3	16. 1
Levulose, do	39. 42	39. 08	39. 77
Dextrose, do	37. 21	37. 35	36. 18
Sucrose, do	. 80	1. 17	1. 52
Maltose, do	5. 02	4. 55	4. 85
Higher sugars, do	. 42	. 57	. 46
Undetermined, do	1. 5	1. 2	. 9
pH	4. 42	4. 39	4. 12
Free acidity, meq./kg	26. 23	23. 07	25. 29
Lactone, do	5. 08	3. 85	7. 09
Total acidity, do	31. 31	26. 92	32. 38
Lactone/free acid	. 194	. 166	. 280
Ash, percent	. 339	. 406	. 258
Nitrogen, do	. 047	. 025	. 047

(Nos. 309, 318), four from Arizona (Nos. 308, 310, 313, 314), and three from California (Nos. 311, 312, 316).

These values are remarkably similar. No striking differences in composition are apparent. The California samples are slightly higher in sucrose, definitely of lower pH (higher hydrogen ion concentration), somewhat higher in lactone/free acid ratio, and somewhat lower in ash. The Arizona samples appear lower in nitrogen content, being but half that of the other two. None of these differences is statistically significant. More samples would be needed for differences of this magnitude to be statistically valid.

Another comparison of this type is between three samples of California orange honey (Nos. 377–379) and three samples of Florida orange (orange-grapefruit) honey (Nos. 382, 389, 391). Table 7 shows the data. The values are similar; only those for nitrogen, lactone content, and the lactone/free acid ratio are significantly ($P=0.05$) different. The Florida samples are unusually low in nitrogen, and the California samples unusually high in lactone content.

Pairs of samples of the same floral type from different areas show the variation ordinarily encountered. Examples are samples 76 and 77, basswood-clover from Wisconsin and Minnesota; 168 and 169, chinquapin from Florida and California; 354 and 355, horsemint from areas 50 miles apart in Texas; 415 and 416, rosinweed from Iowa and Montana. Rather wide ranges in composition among samples listed as the same floral source occur in the various groups of legume honeys. In the group of 1957 alfalfa-sweet clover honeys, one of the more homogeneous groups, one sample (No. 51) is not from the Intermountain area, being from Iowa. It shows the highest moisture, lowest levulose, lowest sucrose, lowest maltose, lowest higher sugars, lowest pH value, highest free acidity, highest lactone, total acidity, and lactone/free acid ratio. It is a distinctly different sample, even though labeled as extra-white alfalfa-sweet clover.

TABLE 7.—*Average composition of orange honey from two areas*

Characteristic measured	California	Florida
Color	Light half of White.	Dark half of White.
Granulating tendency	½″ layer	¼ of depth
Composition:		
Moisture, percent	16. 7	16. 6
Levulose, do	39. 26	38. 70
Dextrose, do	31. 83	31. 82
Sucrose, do	1. 87	2. 00
Maltose, do	6. 50	7. 70
Higher sugars, do	1. 33	1. 51
Undetermined, do	2. 5	1. 3
pH	3. 67	3. 89
Free acidity, meq./kg	24. 23	21. 27
Lactone, do	13. 12	7. 28
Total acidity, do	37. 35	28. 55
Lactone/free acid	. 540	. 352
Ash, percent	. 082	. 067
Nitrogen, do	. 030	. 009

Both the analytical values and the descriptions of some samples in a group appear to differ markedly from others in the group. For example, of the 1956 alfalfa honeys, sample 2 is high in sucrose, lowest in moisture, and markedly low in acidity, compared with the others. Sample 23 is apparently not alfalfa, being much higher in levulose and lower in dextrose than all the others.

Samples 412 and 413 are listed as raspberry, 1956 and 1957, but the 1957 sample, with low levulose, high higher sugars, and very low lactone/free acid ratio seems to contain honeydew.

RELATION OF GRANULATING TENDENCY TO COMPOSITION OF HONEY

Table 8 gives the average composition for all honey samples (excluding honeydew) in each of the 10 classes of granulating tendency. The data show several general trends. The most striking are the increase in dextrose content as granulating tendency increases, and the constancy of the levulose values.

In order to decide what composition factors affect granulation, an analysis of variance for regression was made of granulating tendency on each of the other 16 factors in table 8. The following listing shows the results in decreasing order of significance.

Factor	F	Direction of change as granulation increases
Dextrose	61. 4	Increases.
Maltose	26. 7	Decreases.
Moisture	22. 4	Do.
Higher sugars	20. 5	Do.
Undetermined	18. 1	Do.
Sucrose	11. 86	Increases.

TABLE 8.—*Average composition of honey samples classified by granulating tendency*

Extent of granulation	Granulation code	Color[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*
Completely liquid		7	17.5	13	37.48	27.70	0.94	9.38	2.25	4.6	4.04	25.71	6.58	32.29	0.272	0.269	0.050
Few scattered crystals	1	5	17.3	13	38.13	30.44	1.26	7.90	1.72	3.1	3.91	21.55	6.76	28.19	.322	.156	.044
1/16- to 1/8-in. layer	2	4	17.6	11	38.27	31.53	1.34	6.83	1.38	2.9	3.84	21.21	7.53	28.74	.357	.142	.037
Few clumps of crystals	3	4	17.4	12	38.50	32.45	1.42	6.71	1.09	2.4	3.83	20.03	6.13	26.36	.301	.117	.039
1/4- to 1/2-in. layer	4	5	17.8	10	38.39	32.49	1.34	6.40	1.16	2.8	3.84	21.09	8.16	29.24	.399	.133	.038
1/4 of depth granulated	5	5	16.9	11	38.83	33.67	1.40	5.91	.99	2.3	3.87	22.84	8.26	31.13	.365	.147	.039
1/2 of depth granulated	6	4	16.9	11	38.86	33.38	1.38	6.29	1.03	2.1	3.90	17.41	6.12	23.51	.354	.128	.031
3/4 of depth granulated	7	4	16.7	12	38.54	34.39	1.73	5.84	1.02	1.9	3.93	20.60	6.92	27.53	.353	.170	.033
Complete soft granulation	8	4	16.1	11	38.62	34.85	2.41	5.43	.78	1.8	3.97	17.55	5.56	23.11	.323	.158	.028
Complete hard granulation	9	5	15.7	13	38.55	35.22	1.65	5.70	.96	2.2	3.93	21.75	7.65	29.40	.364	.162	.044

[1] See p. 6 for explanation of color code.

All values are significant at the 1-percent probability level or less ($F=11.26$). The F value for color was 6.7, significant at the 5-percent level. No other factor varies with granulating tendency in a significant manner.

Thus, we see that dextrose content is the most important consideration in stability of honey in storage. This is expected since the material granulating is dextrose. By examining the other significant factors, we find that as dextrose is low, maltose, higher sugars, and undetermined material are all higher. Since levulose is not varying and all samples approximate the same total sugar content, these other types of sugars must make up the balance.

In the past, several indices have been proposed to express the granulating tendency of honey. The one most used has been the levulose/dextrose (L/D) ratio. High values have been associated with liquid or slow-granulating honey.

The L/D values in the literature may be compared with one another. But in the past reducing disaccharides were included with dextrose; therefore, the values in the literature cannot be compared directly with those reported here, or by Austin (*3*), who also used the selective adsorption method for sugar analysis.

Jackson and Silsbee (*16*), on the basis of studies of the solubility relationships of pure solutions of dextrose, levulose, and sucrose, proposed two indices of granulating tendency, the "supersaturation coefficient" and "granulation tendency." Austin has discussed these values; it is sufficient to note that tupelo honey, which is nongranulating, has a supersaturation coefficient of 1.66 calculated by Jackson from Browne's data (*9*). Even if data presented here are used, including correct dextrose values, tupelo honey is calculated to be highly supersaturated. Part of the difficulty is in the original solubility data of Jackson and Silsbee, on which their calculations are based. They did not extend their data through the composition region of honey, as pointed out by Lothrop.[5] When calculated using Lothrop's solubility data, tupelo honey shows a supersaturation coefficient of 1 or less. This coefficient is not convenient to calculate; the "granulation tendency" of Jackson and Silsbee is (dextrose—water)÷levulose, and is simpler. They did not find this index to be particularly sensitive when applied to Browne's data.

Austin has proposed a new index of crystallization for honey, the dextrose/water (D/W) ratio, noting that "it falls more logically in line with observed honey behavior than most crystallization indexes" (*3*). He also suggested that when honeys are to be compared on the basis of their D/W ratio, their composition should be calculated to equivalent moisture contents. Since on the basis of our results moisture content is a significant factor in granulating tendency, we have calculated this index on both bases.

We have calculated several of these indices for each of the average honey compositions in table 8, and carried out an analysis of variance for regression of granulating tendency on L/D ratio, Jackson and

[5] Lothrop, R. E. SATURATION RELATIONS IN AQUEOUS SOLUTIONS OF SOME SUGAR MIXTURES WITH SPECIAL REFERENCE TO HIGH CONCENTRATIONS. Thesis, George Washington Univ., 1943.

Silsbee's $\frac{D-W}{L}$, and Austin's D/W ratio. As shown below, the index proposed by Austin, not adjusted to a common H_2O content, shows the most highly significant relationship with granulating tendency.

Index	F	r^2
D/W	152	95. 0
$\frac{D-W}{L}$	131	94. 2
D/W, common water content	91	91. 9
Dextrose	61	88. 5
L/D	50	86. 3

All these F values exceed the F value for the 1-percent probability level (F=11.26). The D/W ratio, on the natural basis, appears to be the preferable index. These values for the 10 levels of granulating tendency in table 8 are as follows:

Code	Granulation	D/W ratio
0	Liquid	1. 58
1	Few scattered crystals	1. 76
2	1/16- to 1/8-inch layer crystals	1. 79
3	Few clumps crystals	1. 86
4	1/4- to 1/2-inch layer crystals	1. 83
5	1/4 of depth granulated	1. 99
6	1/2 of depth granulated	1. 98
7	3/4 of depth granulated	2. 06
8	Complete, soft granulation	2. 16
9	Complete, hard granulation	2. 24

The purpose of a granulation index is to relate composition of a honey to granulating tendency, in order ultimately to predict such behavior. The calculations just described are based on the average compositions shown in table 9, and not on actual honey samples. To determine whether individual variation is so large that these indices have no practical use in prediction, an analysis of variance for regression of granulating tendency on D/W, $\frac{D-W}{L}$ and on L/D was carried out for all 490 honey samples. The first two indices gave similar results, though their order was different. Both showed considerably more significant relationship than did the L/D ratio. Since the D/W ratio is simpler to calculate and does not require that levulose be determined, it is preferred for use.

It thus appears that the granulating tendency of a honey can be estimated on the basis of the D/W ratio. Values of 1.7 and lower generally are associated with nongranulating honeys, whereas values of 2.1 and higher predict rapid granulation to a solid. Table 27

shows exceptions to this rule, however. The calculation of dextrose content to a common solids basis before comparison of samples, proposed by Austin, does not appear necessary; in fact, it reduces the spread of values and as seen from the listings above, reduces the significance of the relationship.

Relation of Color and Composition of Honey

The color of honey, which ranges from nearly colorless to deep red-amber, is frequently used to form quick (sometimes erroneous) opinions of its other characteristics. Many believe that strength of flavor increases as color deepens. Most of the reports on the composition of honey have noted that certain analytical characteristics appear to vary with color. Browne (*9*) did not measure color. Eckert and Allinger (*12*) reported that ash content of California honey increased directly with color, and that acid had "a tendency" to increase similarly. Schuette and his coworkers (*34, 36–38*) found that the content of ash, potassium, sodium, magnesium, iron, copper, manganese, chlorine, and sulfur was higher in dark honeys than in lighter honeys. The calcium, phosphorus, and silica contents did not vary significantly. The Wisconsin workers (*33, 35*) also found that both invertase and diastase activities were higher in dark than in light honeys.

Anderson [6] in an unpublished analysis of 62 South African honey samples, reported that ash and nitrogen content increased with color.

Table 9 shows the average composition of all honey samples falling into each of the 13 color groups used in this work. Free and total acidity, nitrogen, and ash all increase regularly with increasing honey color. An analysis of variance for regression shows that the following factors change as we progress from light honeys to dark honeys. They are listed in decreasing order of significance.

Decreasing:	F	Increasing:	F
Sucrose	24. 1	Total acid	601
Lactone/free acid	23. 7	Free acid	279
Dextrose	23. 6	Nitrogen	97. 7
Hydrogen ion concentration	23. 3	Ash	43. 0
Levulose	15. 9	Undetermined	26. 2
Granulation	9. 2	Maltose	17. 8
		Higher sugars	6. 4

Moisture content, age at analysis, and lactone content do not differ significantly. The critical F value for the 1-percent probability level is 9.65. This is exceeded by all factors listed except granulation and higher sugars; these exceed the 5-percent probability level value of 4.84.

Summarizing.—In comparing the average light honeys with the average dark honeys, the former are significantly higher in simple sugars (dextrose and levulose), sucrose, and tendency to granulate, and show a greater lactone/free acid ratio and hydrogen ion concentration. The darker honeys in general appear to be higher in acidity, nitrogen, ash, and more complex sugars.

[6] See footnote 2, p. 3.

TABLE 9.—*Average composition of honey samples classified by color*

Color	Color code	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq/kg.*	*Meq/kg.*	*Meq/kg.*		*Percent*	*Percent*
Light half of water white	0	3	16.7	8	38.51	32.59	2.74	6.48	1.16	1.8	3.87	11.83	4.50	16.25	0.363	0.053	0.023
Dark half of water white	1	4	16.7	12	38.94	31.79	1.83	7.09	1.40	2.1	3.82	13.65	5.34	18.99	.385	.058	.025
Light half of extra white	2	3	17.1	11	38.56	32.38	1.31	6.76	1.44	2.4	3.83	15.36	5.96	21.44	.388	.065	.027
Dark half of extra white	3	3	17.1	11	38.33	32.60	1.63	6.54	1.30	2.3	3.79	17.19	6.96	24.15	.388	.084	.030
Light half of white	4	3	17.3	12	38.62	32.28	1.38	6.64	1.24	2.5	3.82	20.16	7.67	27.67	.376	.124	.037
Dark half of white	5	3	17.6	12	38.32	32.19	1.16	6.78	1.18	2.8	3.87	21.47	7.40	28.89	.339	.128	.039
Light half of extra light amber	6	3	17.0	14	38.48	31.32	1.19	7.28	1.41	3.3	3.94	23.63	7.82	31.44	.326	.178	.045
Dark half of extra light amber	7	3	17.6	13	38.83	30.85	1.06	7.11	1.21	3.3	3.95	25.37	8.68	34.05	.343	.192	.052
Light half of light amber	8	2	17.2	12	37.89	29.76	.99	8.37	1.75	4.0	4.18	26.98	6.82	33.80	.249	.305	.055
Dark half of light amber	9	2	17.5	13	36.92	29.96	1.01	8.33	1.89	4.3	4.00	31.01	9.45	40.46	.304	.261	.050
Light half of amber	10	1	16.5	14	34.19	26.47	.87	10.45	3.80	7.6	4.44	37.00	4.25	41.25	.121	.503	.073
Dark half of amber	11	0	17.4	12	34.96	26.39	.88	10.04	2.64	6.7	4.40	39.24	6.76	46.00	.174	.608	.058
Dark amber	12	3	18.9	14	36.34	29.60	.93	8.05	1.63	4.5	4.02	35.77	8.37	44.14	.245	.202	.063

[1] See p. 6 for explanation of granulation code.

HONEYS AVERAGED BY STATE OF ORIGIN

Table 28 (appendix) shows average composition of honey by States and regional areas of the United States. The number of samples in each average is also shown. Honeys of the East and South were darker than the national average; those of the North Central and Intermountain areas were lighter. The North Central honeys were somewhat higher in moisture content, while the Intermountain and Western honeys were heavier bodied; this was also noted by Browne (*9*).

With respect to granulating tendency, the honeys of the South Atlantic States had the least, and the North Atlantic honeys were next. The predominately alfalfa-clover type from the Intermountain area gave this group the greatest tendency to granulate.

HONEYS AVERAGED BY PLANT FAMILY

The average composition of honey samples from various plant sources is given in appendix table 27. Table 29 lists average values of all samples of honey and honeydew from each of 33 plant families. These averages include only honeys from single plant sources, not blends. The number of samples included in each average is also given. Even if the families with only one or two samples analyzed are eliminated, pronounced differences among the averages for the families may be noted in all constituents.

EFFECT OF STORAGE ON HONEY COMPOSITION

Honey is considered to be a relatively stable foodstuff, with only minor changes in flavor and color taking place during several years of storage. It is well known that properly ripened honey is not susceptible to spoilage by micro-organisms, with the exception of osmophyllic yeasts, and then only at moisture contents above 17 percent (*21*, *39*). Granulation of honey increases the possibility of spoilage, since it results in an increase in the moisture content of the liquid portion. A comprehensive study of the effect of storage at elevated temperature and of heat processing on the color of honey has been described by Milum (*26*).

Both physical and chemical actions are involved in the transformation of nectar to honey, with the activity of enzymes being most prominent. Since these enzymes remain in the honey, their action may continue at a declining rate. The decrease in the sucrose content of honey after extraction has long been ascribed (*9*, *17*) to a continuing action of the invertase added by the bee. However, the sucrose content of a honey does not reach zero even after several years of storage, although it may still contain active invertase.

It was recently shown (*53*) that honey contains a transglucosylase which produces several oligosaccharides, including maltose and isomaltose, from sucrose. Austin pointed out (*3*) that because of this enzymic activity the "maltose" (actually reducing disaccharide) content of a honey depends to some degree on methods of apiary management, storage temperature, and density of honey. He did not

predict the effect of storage in general on the maltose content of honey.

de Boer (*6*) examined a number of honey samples that had been stored for up to 22 years; nearly all were white clover and all were stored in the unheated state. He pointed out that the same changes in composition that occur on heating of honey also occur in storage. He concluded that polarization is unchanged and the change in sucrose content negligible, implying no changes in the sugars. He stated that the amounts of glucose and fructose and their ratio remained unchanged; and, contrary to previous reports (*2*), no relative increase was noted in fructose content. Diastase decreased with age—3 Gothe "steps" in 10 years. The acidity was unchanged, but the Fiehe test for hydroxymethylfurfural (HMF) became positive and after 10 years HMF could be determined gravimetrically.

Armbruster (quoted by de Boer (*6*)) reported that aging for as short a period as 2½ months sometimes causes a noticeable decrease of diastatic activity, while other types of honey show no loss after as long as 5 months. After 2½ years, a considerable decrease was found in one type of honey.

We have reexamined the effects of storage on the composition of honey. We have studied the effect of storage at room temperature for up to 3 years on unheated and mildly heated honey, determining changes in dextrose, levulose, maltose (reducing disaccharides), sucrose, higher sugars, diastase, free acidity, lactone, and total acidity. Contrary to previous beliefs, significant changes were found for nearly all these constituents.

For this work, unheated samples were used. On receipt they were divided into three portions: one was stored at −20° C. (−4° F.) within 1 day of receipt, a second heated in a closed jar in a water bath at 55° C. (131° F.) for 30 minutes and cooled (essential pasteurization without enzyme inactivation), and the remainder left unheated. The latter two portions were stored in the dark at room temperature (23°–28° C., 73°–82° F.). Samples from frozen storage were allowed to reach room temperature overnight before analysis. Analyses of corresponding samples of a set were carried out on the same day; sets were selected at random.

Carbohydrates

Table 10 shows the values obtained for each type of storage for five honey samples, each set calculated to the moisture content shown for the cold-storage sample.

The data in table 10 were subjected to the analysis of variance. Each set of 15 values for each sugar was examined, and the variability due to sample and storage was calculated and tested statistically. All differences due to storage were significant at the 1-percent probability level, except for the unanalyzed portion, where the change is significant at the 5-percent probability level.

The mean square resulting from storage conditions was further subdivided; that of frozen storage was compared with that of the two

TABLE 10.—*Effect of storage on honey sugars* [1]

Sample No. and kind of storage [2]	H_2O [3]	Levulose	Dextrose	Maltose	Sucrose	Higher sugars	Unanalyzed	Age [4]
91:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Months*
F	18. 6	35. 85	33. 87	4. 92	0. 58	1. 28	4. 90	20
H	(17. 5)	35. 07	29. 82	8. 94	. 93	1. 46	5. 18	20
R	(16. 6)	34. 85	29. 44	9. 22	. 89	1. 45	5. 55	20
258:								
F	20. 8	35. 95	32. 31	5. 43	. 28	1. 71	3. 62	22
H	(19. 0)	33. 95	27. 88	9. 59	. 85	1. 67	5. 26	22
R	(19. 3)	33. 84	27. 81	10. 18	. 92	2. 03	4. 42	22
94:								
F	17. 4	38. 22	31. 29	7. 54	. 73	1. 23	3. 59	22
H	(16. 2)	36. 39	28. 54	11. 02	. 87	2. 36	4. 42	22
R	(16. 6)	36. 23	28. 55	10. 51	. 90	1. 46	4. 95	22
96:								
F	17. 7	36. 36	29. 85	7. 64	. 78	1. 77	5. 79	23
H	(16. 0)	34. 19	25. 39	13. 13	. 85	1. 91	6. 93	23
R	(14. 2)	34. 49	25. 24	13. 05	. 99	2. 05	6. 48	23
98:								
F	18. 5	37. 98	31. 02	6. 83	. 44	1. 84	3. 39	23
H	(17. 0)	36. 10	28. 02	10. 95	1. 00	1. 82	3. 61	23
R	(16. 8)	35. 73	26. 71	11. 47	1. 16	1. 93	4. 50	23
Average:								
F	18. 8	36. 89	31. 67	6. 47	0. 56	1. 57	4. 26	-------
H	-------	35. 14	27. 93	10. 73	. 90	1. 64	5. 08	-------
R	-------	35. 03	27. 55	10. 89	. 97	1. 78	5. 18	-------
Change in—								
Heated honey	-------	−1. 75	−3. 74	+4. 26	+. 34	+. 07	−. 82	-------
Unheated honey	-------	−1. 86	−4. 12	+4. 42	+. 41	+. 21	−. 92	-------
Unheated, percent	-------	5. 5	13. 0	68	73	13. 4	22. 2	-------

[1] Each set of values calculated to the moisture content of corresponding cold-storage sample.

[2] Storage conditions are identified as follows: F=unheated, cold storage; H=heated, room-temperature storage; R=unheated, room-temperature storage.

[3] Moisture values in parentheses are actual values found for the samples.

[4] Months sample was in storage after receipt at the laboratory.

room-temperature storage conditions. The two room-temperature storage sets (heated and unheated) were also compared with each other. A sample calculation is shown in table 11, and table 12 summarizes the mean squares and the F values obtained therefrom, for each sugar.

The table shows that the differences between the frozen samples and those stored at room temperature are significant for all sugars at the 1-percent probability level. None of the differences between the average values in table 10 for the unheated and heated samples, both stored at room temperature, are significant, except the values for higher sugars, which are significant at the 5-percent probability level.

TABLE 11.—*Effect of storage on dextrose content—analysis of variance*

Source of variability	S.S	D.F.	M.S.	F[1]
Total	72. 00	14		
Storage [1]	51. 79	2	25. 89	99. 6**
F vs. R & H	51. 43	1	51. 43	198**
R vs. H	. 36	1	. 36	1. 4
Samples	28. 14	4	7. 03	27. 0**
Error	2. 07	8	. 26	

[1] Storage conditions are identified as follows : F-unheated, cold storage; H-heated, room-temperature storage; R-unheated, room-temperature storage.
**Exceeds 1-percent probability level.

TABLE 12.—*Significances of changes in honey composition due to storage*

Source of variability	D.F.	Levulose		Dextrose		Maltose	
		M.S.	F	M.S.	F	M.S.	F
Samples	4	3. 18	31. 8**	7. 03	27. 0**	5. 71	22. 0**
Storage [1]	2	5. 46	54. 6**	25. 9	99. 6**	31. 3	120**
F vs. R & H	1	10. 90	109**	51. 4	198**	62. 6	241**
R vs. H	1	. 03	0	. 36	1. 4	. 06	. 2
Error	8	. 10		. 26		. 26	

Source of variability	D.F.	Sucrose		Higher sugars		Unanalyzed	
		M.S.	F	M.S.	F	M.S.	F
Samples	4	0. 018	0. 86	0. 217	36. 2**	3. 03	17. 8**
Storage [1]	2	. 240	11. 4**	. 061	10. 2**	1. 33	7. 8*
F vs. R & H	1	. 466	22. 2**	. 073	12. 2**	2. 63	15. 5**
R vs. H	1	. 013	. 62	. 049	8. 2*	. 02	. 1
Error	8	. 021		. 006		. 17	

[1] Storage conditions are identified as follows: F-unheated, frozen storage; H-heated, room-temperature storage; R-unheated, room-temperature storage.
*Exceeds 5-percent probability level.
**Exceeds 1-percent probability level.

These analyses show that when unheated honey is stored for 2 years at temperatures ranging between 23° and 28° C., the following changes take place in the carbohydrate composition:

1. A decrease of free dextrose (averaging 13 percent) and a decrease of free levulose (averaging 5.5 percent); an average of 18.5 percent of the free monosaccharide content of the honey is thus lost.
2. A marked increase of "maltose" or reducing disaccharide sugars, averaging 68 percent of the amount initially present.
3. A *relatively* large increase in sucrose content.

4. A small (13 percent) increase in the higher sugar content of the honey.

5. An increase, averaging 22 percent, in the amount of unanalyzed material (100—sugars+water).

The heat treatment given these samples (55° C., 130° F.) for 30 minutes) had no effect on these changes, except possibly to reduce the extent of increase of the higher sugar values. The changes in the stored samples are in the direction of increased complexity of sugars. This might be expected from the conditions within the sample. A high sugar concentration and a considerable acidity over a period of time would promote combination of monosaccharides (reversion, (*30, pp. 434, 515, 605*).). The presence of an active transglucosylase enzyme (*53*) in the honey may also result in accumulation of oligosaccharide material; the heat treatment used was not sufficient to inactivate enzymes. Possible explanations for the changes observed are as follows:

LEVULOSE.—This sugar is subject to degradation to hydroxymethylfurfural by long standing in acid solution. Conversion to nonreducing fructose anhydrides is also possible. Levulose-containing oligosaccharides may result from enzyme transfer of dextrose to a levulose acceptor.

DEXTROSE.—Twice as much dextrose disappeared as did levulose. This may reflect the specificity of the enzyme transferring dextrose from oligosaccharides (honey invertase, a glucoinvertase).

"MALTOSE".—This actually represents reducing disaccharide material, including maltose, isomaltose, maltulose, turanose, and nigerose (*51*). All these sugars are hydrolyzed by honey α-glucosidase.[7] The increase in this category of sugars accounts for most of the decrease in monosaccharides.

SUCROSE.—Postharvest ripening has long been known to take place in unheated honey (*9, 17*). Sucrose reaches a low value within a few months after honey is removed from the hive, but never disappears completely, despite (or probably because of) the presence of an active invertase. The data here show a later change in the amount of sucrose, where it increases toward 1 percent. Mold enzymes have been shown to resynthesize sucrose by transfructosylation during their hydrolytic action on sucrose (*13*).

HIGHER SUGARS.—The increase in this fraction is further evidence of reversion and transglucosylation.

UNANALYZED.—From the point of view of the carbohydrates, the unanalyzed category can contain difructose anhydrides, nonreducing disaccharides (except sucrose), and kojibiose, a very weakly reducing disaccharide (2-O-α-D-glucosyl-D-glucose) recently discovered in honey by Watanabe and Aso (*47*). This sugar is not determined in the analytical procedure used, since it has only about 6 percent of the reducing power of glucose against copper reagents. The increase in unanalyzed material may represent an increase in the amount of kojibiose (and possibly trehalose) in honey. Both of these compounds have been isolated from hydrol, where it is believed that they arose by reversion from dextrose (*31, 42*).

[7] WHITE, J. W. JR. Unpublished data.

EFFECT OF LONG-TERM STORAGE.—An analysis of a 35-year-old sample of honey is compared with a corresponding contemporary sample in table 13. The 1923 sample [8] is an alsike clover–white clover honey produced at Delphos, Ohio. It had been stored in a dark cupboard and never been opened; it was liquid except for a few coarse crystals at the bottom. The 1957 sample is an alsike clover–white clover honey (sample 175), produced at Columbia City, Ind. To facilitate comparison, data were calculated to the same moisture content. The differences shown in the table are all similar in trend to those in table 10, except that the 1957 sucrose value is higher, though the value for the aged sample (equilibrium?) is close to the average of the 2-year-old samples. In general the changes in monosaccharide and "maltose" shown after 35 years of storage are similar to, but larger than, for the 2-year-old samples in table 10.

Analysis of honey samples after extended storage have been reported by de Boer (*6*) and Auerbach and Bodländer (*2*). The analytical methods de Boer used would not detect the differences in carbohydrate composition shown here. He did not confirm the earlier conclusion of Auerbach and Bodländer that the ratio of levulose to dextrose increased after storage of honey. Auerbach and Bodländer reported the analysis of 13 samples of 14-year-old honey. Their levulose/dextrose ratio ranged from 1.19 to 1.81, and averaged 1.40; 10 samples of fresh honey ranged from 1.06 to 1.19 and averaged 1.11. These values have only relative meaning, since the analytical methods used gave no differentiation between monosaccharide and disaccharide.

The results in tables 10 and 13 substantiate the views of Auerbach and Bodlander that the amount of free dextrose decreases on storage and that the ratio of levulose to dextrose increases. They ascribed this to possible enzymic condensation of dextrose, which we also believe is a contributing factor.

TABLE 13.—*Effect of age on a clover honey*

Items compared	1957 crop	1923 crop	Difference	
			Actual	Percentage of 1957
	Percent	*Percent*	*Percent*	*Percent*
Moisture	18. 2	[1] (18. 2)		
Levulose	38. 25	35. 05	−3. 20	−8. 3
Dextrose	33. 58	23. 12	−10. 29	−30. 6
Maltose	5. 50	16. 41	+10. 91	+198
Sucrose	1. 68	1. 04	−. 64	−38. 2
Higher sugars	. 82	2. 06	+1. 24	+151
Undetermined	2. 0	4. 1	+2. 1	+105

[1] Moisture content of the 1923 sample was 17.6 percent; data are calculated to the 18.2 percent shown by the 1957 sample to facilitate comparison. Samples analyzed in late 1958.

[8] Donated by C. A. Reese, Department of Entomology, Ohio State University.

The changes described in the sugar distribution of honey have some practical implications. With the tendency toward increasing complexity, there may be a corresponding loss of nutritive value; some of the disaccharides and higher sugars may not be digestible.

The considerable decrease in dextrose content is probably responsible for the gradual liquefaction that is often noted in finely granulated honey samples as they stand in storage. If the dextrose content of a granulated honey is near the lower limit of granulation, the changes in a year or so will reduce the dextrose well below the saturation point so that the crystals will slowly dissolve. Figure 5 shows a jar of 4-year-old honey, originally completely granulated, which is slowly liquefying during storage.

This may explain the changes in texture that are known to occur in finely granulated honey (honey spread) during storage. If the storage temperature is high enough to affect the texture of such a spread adversely by its effect on the solubility of dextrose, this will be immediately apparent. The changes in sugar content described here take place very slowly, and at temperatures previously considered safe for storage of finely granulated honey spread. Over a period of, say, 6 to 12 months the D/W ratio in the spread can change sufficiently to cause serious softening and quality loss. Such spreads

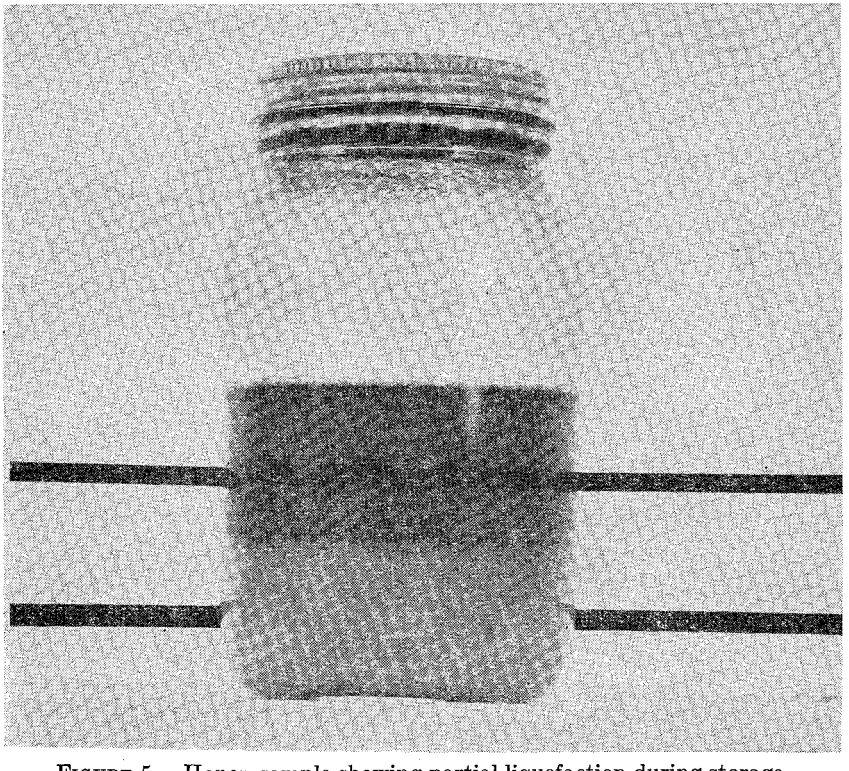

FIGURE 5.—Honey sample showing partial liquefaction during storage.

TABLE 14.—*Effect of storage on acidity of honey*[1]

Sample No.	Free acid		Lactone		Total acidity	
	F[1]	R[2]	F[1]	R[2]	F[1]	R[2]
	Meq./kg.	*Meq./kg.*	*Meq./kg.*	*Meq./kg.*	*Meq./kg.*	*Meq./kg.*
91	24. 04	27. 07	9. 87	12. 39	33. 92	39. 46
258	20. 56	24. 06	6. 45	7. 73	27. 00	31. 80
92	19. 85	21. 66	4. 90	5. 32	24. 35	26. 98
94	15. 04	15. 78	2. 55	2. 62	17. 59	18. 40
96	22. 28	23. 90	6. 17	9. 21	28. 45	33. 11
107	23. 73	24. 88	2. 20	2. 18	25. 93	27. 04
97	20. 82	20. 13	7. 00	8. 08	27. 82	28. 21
108	22. 88	24. 29	1. 90	4. 21	24. 78	28. 46
109	25. 24	26. 45	5. 83	7. 68	31. 05	34. 13
98	25. 62	26. 63	8. 33	10. 39	33. 85	37. 02

[1] F=stored at −20° C; samples 91–96 and 258, 21 months; others 24 months.
[2] R=stored at room temperature same times as above.

TABLE 15.—*Effect of storage on acidity—analysis of variance*

Source of variability	D.F.	Free acidity			
		S.S.	M.S.	F	S
Total	19	207. 6			
Materials	9	190. 6	21. 17	31. 0**	
Storage	1	10. 9	10. 93	16. 0**	
Error	9	6. 14	. 68		0. 83

Source of variability	D.F.	Lactone			
		S.S.	M.S.	F	S
Total	19	175. 0			
Materials	9	159. 2	17. 69	31. 1**	
Storage	1	10. 7	10. 68	18. 8**	
Error	9	5. 11	. 57		0. 75

Source of variability	D.F.	Total acidity			
		S.S.	M.S.	F	S
Total	19	582. 6			
Materials	9	523. 9	58. 2	35. 9**	
Storage	1	44. 1	44. 1	27. 2**	
Error	9	14. 6	1. 6		1. 27

**Exceeds 1-percent probability level.

cannot be salvaged by reprocessing, since their composition has changed. On the other hand, texture lost by short-time high-temperature storage, resulting only in solution of the dextrose, could be restored by reprocessing.

The slow decrease of D/W ratio due to loss of dextrose will not be an important factor in quality loss if the initial ratio is sufficiently high. However, a too-high ratio would yield an excessively hard product.

Acids

Table 14 shows the free acidity, lactone content, and total acidity of 10 samples stored under the conditions described above. None of the samples showed visible evidence of fermentation. Table 15 gives the analysis of variance for the free acidity, lactone, and total acidity values. The average changes in each of these categories are seen to be highly significant. Cocker (*10*) and White (*49*) proposed that an enzyme producing acidity occurs in honey. If this is the case, honey samples with high diastase number might be expected to show a correspondingly high rate of acid production. These values for 10 honey samples are given in table 16. Also in the table is an analysis of variance for regression. The F value obtained, 11.5, demonstrates a highly significant regression between the two sets of values. This is not meant to imply that amylase is responsible for acid production, but rather that the factors affecting amylase activity also influence the activity of the acid-producing enzyme.

TABLE 16.—*Regression of acid production by honey on diastase value*

Sample No.	Diastase value	Change in total acidity per year
		Meq./kg.
91	38. 0	3. 16
258	35. 3	2. 74
92	33. 3	1. 50
94	19. 1	. 46
96	27. 8	2. 66
107	18. 5	. 59
97	8. 0	. 18
108	20. 0	1. 84
109	10. 7	1. 59
98	21. 7	1. 58

Analysis of variance for regression

Source	S.S.	D.F.	M.S.	F
Total	927. 28	9		
Linear regression	546. 99	1	547	11. 5**
Deviations	380. 29	8	47. 5	

**Significant at 1-percent probability level.

Diastase

The amylase (diastase) content of honey has long been used by Europeans as a measure of the heat treatment to which a honey has been exposed. The voluminous literature will not be reviewed here (*4, 6, 11, 18–20, 23, 32, 35, 46*). Recently (*11, 18*), it has been proposed that diastase content alone is not a suitable criterion for the detection of overheated honey.

There appears to be relatively little information in the literature on the effect of storage of honey on its diastase content. de Boer (*5*), using the Gothe procedure, reported that diastase decreased gradually with age of honey—about 3 Gothe "steps" in 10 years. Schade, Marsh, and Eckert, (*32*) using their improved procedure, reported diastase value for eight honey samples before and after storage for 13 to 15 months at 20° C. They reported that the diastase activity had "decreased slightly but not significantly in most cases." We have subjected their data (the seven samples in their table 3) to the analysis of variance, and the changes were significant at the 1-percent probability level ($F' = 11.7$). Their data for seven samples showed an average decrease of 10.1 percent in diastase value after storage for the approximately 14 months at 20° C., or 0.72 percent per month.

TABLE 17.—*Effect of storage on diastase content of honey*

Sample No.	Storage time	Diastase value		Loss	Loss per month
		Frozen	Room temperature		
	Months			*Percent*	*Percent*
234	21	61. 2	30. 9	49. 5	2. 36
430	20	32. 6	18. 6	42. 9	2. 16
361	20	14. 6	8. 11	44. 5	2. 23
326	19	17. 6	7. 23	59. 1	3. 11
238	17	10. 6	7. 59	28. 3	1. 66
403	13	6. 74	3. 97	41. 1	3. 16
91	13	38. 0	21. 8	42. 6	3. 28
258	13	35. 3	20. 8	41. 1	3. 16
92	13	33. 3	19. 0	42. 9	3. 30
94	13	19. 1	12. 9	32. 5	2. 50
96	13	27. 8	18. 4	33. 8	2. 60
97	13	8. 00	4. 42	44. 7	3. 44
98	13	21. 7	15. 8	27. 2	2. 09
261	13	10. 3	8. 40	18. 4	1. 41
142	13	22. 4	13. 2	41. 1	3. 16
104	9	10. 8	8. 15	24. 5	2. 72
121	8	22. 6	15. 9	29. 6	3. 70
179	8	16. 7	11. 4	31. 7	3. 96
333	8	15. 2	9. 38	38. 1	4. 76
214	4	15. 2	12. 8	15. 8	3. 95
Average	13. 2	22. 0	13. 4	38. 9	2. 95

We have determined diastase value for aliquots of 20 samples of honey after dark storage for 4 to 21 months at −20° C. and also at laboratory room temperature (table 17). Samples were from the 1956 and 1957 crops and were frozen on receipt at the laboratory at varying times (½ to 14 months) after their extraction. The data are based on the reasonable assumption that no change takes place in samples stored at −20° C. This table shows an average loss in diastase value of 2.95 percent per month, for honey stored unheated at temperatures ranging from about 23° to 28° C. This is equivalent to a half-life of 17 months.

This loss may be compared to the 0.72 percent per month shown by the data of Schade et al. for a temperature probably 5° to 6° C. lower. This at once emphasizes the importance of low-temperature storage for honey in which diastase content must be maintained. Our data show a considerable variation in the rate of loss of diastase among the honey samples. Kiermeier and Koberlein (*18*) reported that the heat sensitivity of honey diastase is related to the pH of the sample; Schade, Marsh, and Eckert (*32*) agree.

We made an effort to relate several compositional factors to the rate of loss of diastase in storage, but no relationship was obtained for ash, total acidity, hydrogen ion concentration, original diastase value, and moisture content (table 18). An analysis of variance for regression on the values for diastase loss versus original diastase value, for example, gave an F value of 2.66, significant at the 10-percent probability level. However, rate of loss was correlated with storage time; the rate for samples stored for short periods was significantly greater than the overall rate for samples stored for longer periods. Analysis of variance of these data yields an F value for linear regression of 12.4, significant at the 1-percent probability level. A less significant relation was found between total age and rate of diastase loss. This does not provide information on the composition factors controlling rate of loss.

These data and also those of Schade and coworkers show that storage temperature is a most important factor affecting retention of diastase in honey. Many workers have reported studies relating diastase loss to degree of heating (*4, 11, 18–20, 23, 32, 46*) investigating the thesis that diastatic activity is an indication of heating of

TABLE 18.—*Correlation of diastase loss rate with other factors*

Factor	F value[1]
Time of storage	12. 4**
Original diastase value	[2] 2. 7
Moisture content	. 1
Total acidity	. 5
Hydrogen ion concentration	. 07
Ash	1. 9
Total age	7. 6*

[1] Calculated by analysis of variance for regression.
[2] Significant at 10-percent probability level.
*Exceeds 5-percent probability level.
**Exceeds 1- percent probability level.

honey. de Boer in his study of aging of honey did note that in general the changes that occur as honey ages are the same as those brought about by heating; he had particular reference to increase in hydroxymethylfurfural content. We have now, for the first time, evidence that over a storage period of 12 to 18 months, without heating, a honey may lose enough diastase to fall below the minimum values required for European acceptance as table honey.

OFFICIAL DEFINITION OF HONEY

Under the original Federal Food and Drugs Act of 1906, the following definition and standard for honey was in force (*44*):

1. HONEY. The nectar and saccharine exudations of plants gathered, modified, and stored in the comb by honeybees (*Apis mellifica* and *A. dorsata*). Honey is levorotatory and contains not more than 25 percent of water, not more than 0.25 percent of ash, and not more than 8 percent of sucrose.
2. COMB HONEY. Honey contained in the cells of comb.
3. EXTRACTED HONEY. Honey which has been separated from the uncrushed comb by centrifugal force or gravity.
4. STRAINED HONEY. Honey removed from the crushed comb by straining or other means.

This statement represents the current view of the Food and Drug Administration as to what honey should be, but it now has an advisory status rather than the status of a definition and standard for a food established under Section 401 of the present Federal Food, Drug, and Cosmetic Act.[9] There is no definition and standard for honey under the present Act.

If the analytical results in table 1 are examined with these limits in mind, it appears that the moisture limit of 25 percent is too high. The 8-percent limit for sucrose is not exceeded by any of the samples; a 7-percent limit would be exceeded by only one sample. The 0.25-percent limit for ash content appears to be too low. It is exceeded by 103 (21 percent) of the 490 samples that were classified as honey by their producers. Feinberg (*15*) has also noted that the 0.25-percent limit for ash is unrealistic. It is not needed to distinguish honey from honeydew, since there are other criteria for this purpose.

SUMMARY AND CONCLUSIONS

1. The results of physical and chemical examination are given and discussed for 504 samples of honey and honeydew from 47 States. They represent 83 single floral types, 93 blends of known composition, and 4 types of honeydew, all from the 1956 and 1957 crop years. The analyses carried out and the average values for 490 honey samples are: color, dark part of "White"; granulating tendency, ⅛- to ½-inch layer; moisture, 17.2 percent; levulose, 38.19 percent; dextrose, 31.28 percent; sucrose, 1.31 percent; "maltose" (reducing disaccharides), 7.31 percent; higher sugars, 1.50 percent; pH, 3.91; free acidity, 22.03 meq./kg.; lactone, 7.11 meq./kg.; total acidity, 29.12 meq./kg.; lac-

[9] Osborn, R. A., Division of Food, Food and Drug Administration. Private communication.

tone/free acid ratio, 0.335; ash, 0.169 percent; nitrogen, 0.041 percent; and diastase, 20.8. A limited number of melezitose determinations was also made.

2. The analytical values for 74 types and blends of honey and honeydew were compared with averages.

3. All honey samples showed the same pattern of sugars present when examined by paper chromatography. Considerable variation was noted in the relative amounts of the various minor sugars.

4. Lactone material is a general constituent of honey; the ratio of lactone to free acidity (average, 0.335) is closely related to the pH of the honey. Honeydew with higher pH shows lower values (average 0.127) for the ratio.

5. The pH of honey was found to be related to its ash content rather than to the titratable acidity.

6. Where comparisons were made of the same floral types of honey as produced in the two crop years, relatively small or no differences were apparent. Dextrose content and granulating tendency showed significant differences in some cases.

7. Not enough samples were available for definitive comparison of the effect of area of production on composition. Comparisons of averages for alfalfa honey (Intermountain versus Imperial Valley), cotton honey (Arizona, California, and Texas), and orange honey (California versus Florida) were made. Differences due to location were very minor and, where tested, not statistically significant.

8. Samples were grouped into 10 classes of granulating tendency, and the relationship of the average composition of each group to its granulating tendency was examined. It was shown statistically that dextrose content is most closely related, with levulose content showing no relation to granulating tendency.

9. As an index to predict the granulating tendency of honey the dextrose/water ratio of Austin is of most practical value, being more useful than the old levulose/dextrose ratio. D/W values of 1.7 and lower are generally associated with nongranulating honey while values of 2.1 and above predict rapid granulation to a solid.

10. It is statistically confirmed that dark honeys contain higher ash (mineral) and nitrogen content than light honeys. They also have lower sucrose, lactone/free acid, dextrose, and levulose content. Dark honeys are higher in total acid, free acid, maltose, higher sugars, and pH.

11. When honey samples are averaged by state of origin, it is seen that honeys from the East and South are darker than average, and those from the Intermountain and North Central regions lighter. North Central honeys are higher in moisture, with Intermountain samples more heavy-bodied. Honey from the South Atlantic States granulates least, while the predominating alfalfa-clover types give the Intermountain honey the greatest granulating tendency.

12. Average composition of 251 "single"-source samples grouped into 33 plant families is given.

13. Although it is a relatively stable commodity, honey is subject to chemical, physical, and biological change even when stored at 73° to 82° F. During 2 years of such storage about 9 percent of the monosaccharides are converted per year into more complex disaccha-

rides and higher sugars. The free-dextrose content declines twice as rapidly as does the free levulose. All samples examined in the storage study showed such changes.

14. Significant increases were noted in acidity during storage, but some samples showed no change. Evidence for possible enzymic nature of this change is given.

15. Diastase values of unheated honey decline in room-temperature storage (23–28° C.), with diastase showing a half-life of 17 months under these conditions.

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APPENDIX

ANALYTICAL PROCEDURES

Full details of all analytical methods used and pertinent reference material are included here. Sufficient information is included to allow such analyses to be made substantially without outside reference. Many of the methods are those of the Association of Official Agricultural Chemists and appear in the ninth edition of the Book of Methods.

Moisture

Refractive index was determined on an Abbé refractometer at 20° C. (68° F.); moisture content was obtained from data in table 19.

TABLE 19.—*Refractive index and moisture content of honey*[1]

n_D^{20}	Moisture	n_D^{20}	Moisture	n_D^{20}	Moisture
	Percent		*Percent*		*Percent*
1. 5041	13. 0	1. 4955	16. 4	1. 4871	19. 8
35	. 2	50	. 6	66	20. 0
30	. 4	45	. 8	62	. 2
25	. 6	40	17. 0	58	. 4
20	. 8	35	. 2	53	. 6
15	14. 0	1. 4930	. 4	49	. 8
10	. 2	25	. 6	1. 4844	21. 0
05	. 4	20	. 8	28	21. 5
1. 5000	. 6	15	18. 0	15	22. 0
1. 4995	. 8	10	. 2	02	22. 5
90	15. 0	05	. 4	1. 4789	23. 0
85	. 2	1. 4900	. 6	77	23. 5
80	. 4	1. 4895	. 8	64	24. 0
75	. 6	90	19. 0	52	24. 5
70	. 8	85	. 2	39	25. 0
65	16. 0	80	. 4	26	25. 5
60	. 2	76	. 6	1. 4714	26. 0

[1] Moisture values from 13.0 to 21 percent are from AOAC(*1*). Extrapolation and dilution of known samples were used by authors to extend range to 26 percent.

Color

Color was estimated with the USDA honey color classifier. The instrument is commercially available and is shown in figure 6.

The color comparators containing the permanent glass color standards are all-metal boxes having dimensions approximately 8 by 2 by 3 inches, divided by thin partitions into five square compartments,

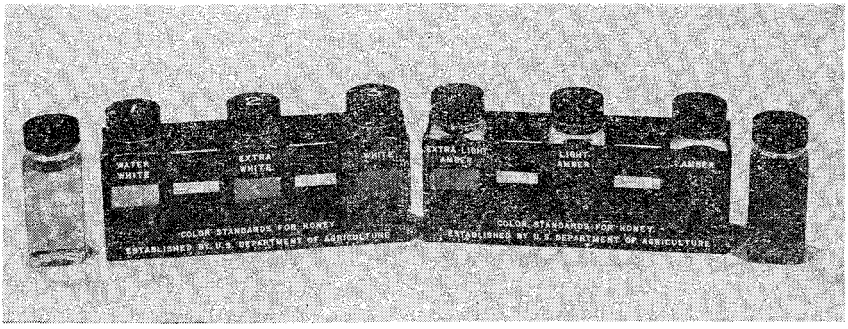

FIGURE 6.—U.S. Department of Agriculture honey color classifier.

each of which has two windows approximately 1.2 inches square. The three lighter glass standards (Water White, Extra White, and White) are mounted in one of the comparator boxes on a shelf against the front windows in compartments 1, 3, and 5. The three darker standards (Extra Light Amber, Light Amber, and Amber) are mounted in a similar manner in a second comparator box. Three 2-ounce square sample bottles of 1¼ inches (31.5 mm. internal thickness) filled with distilled water (referred to as "blanks") are placed in the compartments behind the glass standards in the comparator being used for grading. A similar bottle containing honey to be classified is placed in the appropriate comparator in either compartment 2 or 4 so that it will be between adjacent standards. To assist in the classification of honeys which are appreciably turbid, three square bottles are provided containing suspensions of diatomaceous earth in distilled water containing 0.5% carboxymethylcellulose and 0.1% sorbic acid. These are referred to as "Cloudy 1," "Cloudy 2," and "Cloudy 3," and are used interchangeably with any one of the clear blanks to reduce the brightness of a glass standard to a level near that of the honey to be classified.

Use the following procedure in classifying extracted honey with these comparators:

(1) Place the clear blanks or the cloudy suspensions in back of the glass standards in compartments 1, 3, and 5 of one or both of the comparators.
(2) Pour the honey to be classified, which must be free of granulation, into a clean dry bottle. Then place the bottle in compartment 2 or 4 of either comparator box.
(3) Hold the comparator at a convenient distance from the eye and view it by diffused light (e.g., by north sky, overcast sky, or diffused artificial light source provided by a tungsten lamp or a white or daylight fluorescent lamp). Then determine the color classification of the honey by comparing the sample with the standards. Switching the sample from compartment 2 to 4, or vice versa, interchanging the clear blanks and the appropriate cloudy suspension, and in some cases shifting to the second comparator or using both comparators, may be necessary.

The standard glasses represent the upper grade limits, or the "darkest" color permitted in the color class named above each glass. If a sample is equal to or lighter than a glass (White, for example), but not lighter than the next lighter glass (Extra White, for example), it is placed in the former class; in this example, White. Honey darker than the Amber glass is classified Dark Amber.

Most honeys are appreciably cloudy because of the presence of air bubbles and fine suspended matter. The brightness of such a sample is lowered, and its color classification may be difficult to determine, particularly if its hue is near that of one of the color standards. Its color classification will be more easily determined if the clear blank is replaced by one of the cloudy suspensions.

Granulation

The procedure is fully described earlier in this bulletin. The polariscope referred to was constructed for detecting incipient granulation in honey. A drawing of the device is shown in figure 7.

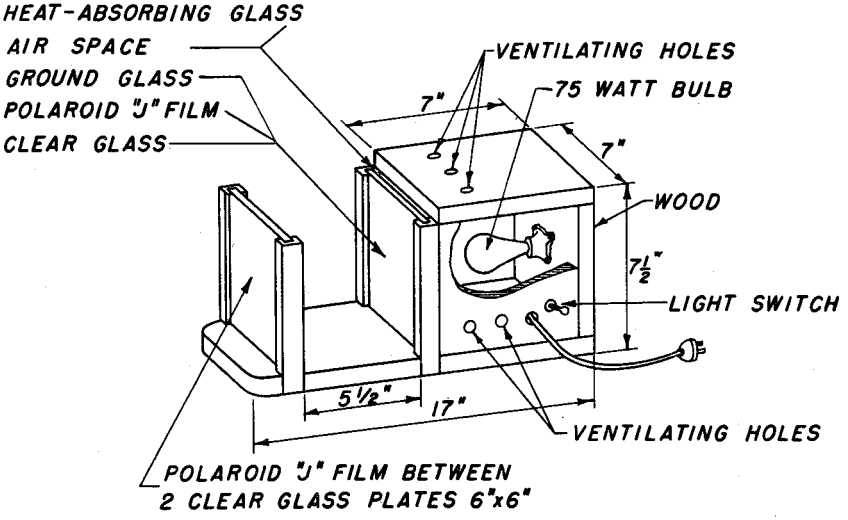

FIGURE 7.—Polariscope for observing crystallization in honey.

Carbohydrate Analysis

By adsorption of honey sample on charcoal, followed by elution into monosaccharide, disaccharide, and higher sugar fractions, interference of disaccharides in dextrose and levulose determinations is eliminated. Elution is by progressively higher EtOH concentrations, followed by determination of individual monosaccharides, sucrose, reducing disaccharides collectively as maltose, and trisaccharides and higher sugars collectively after hydrolysis.

617147°—62——4

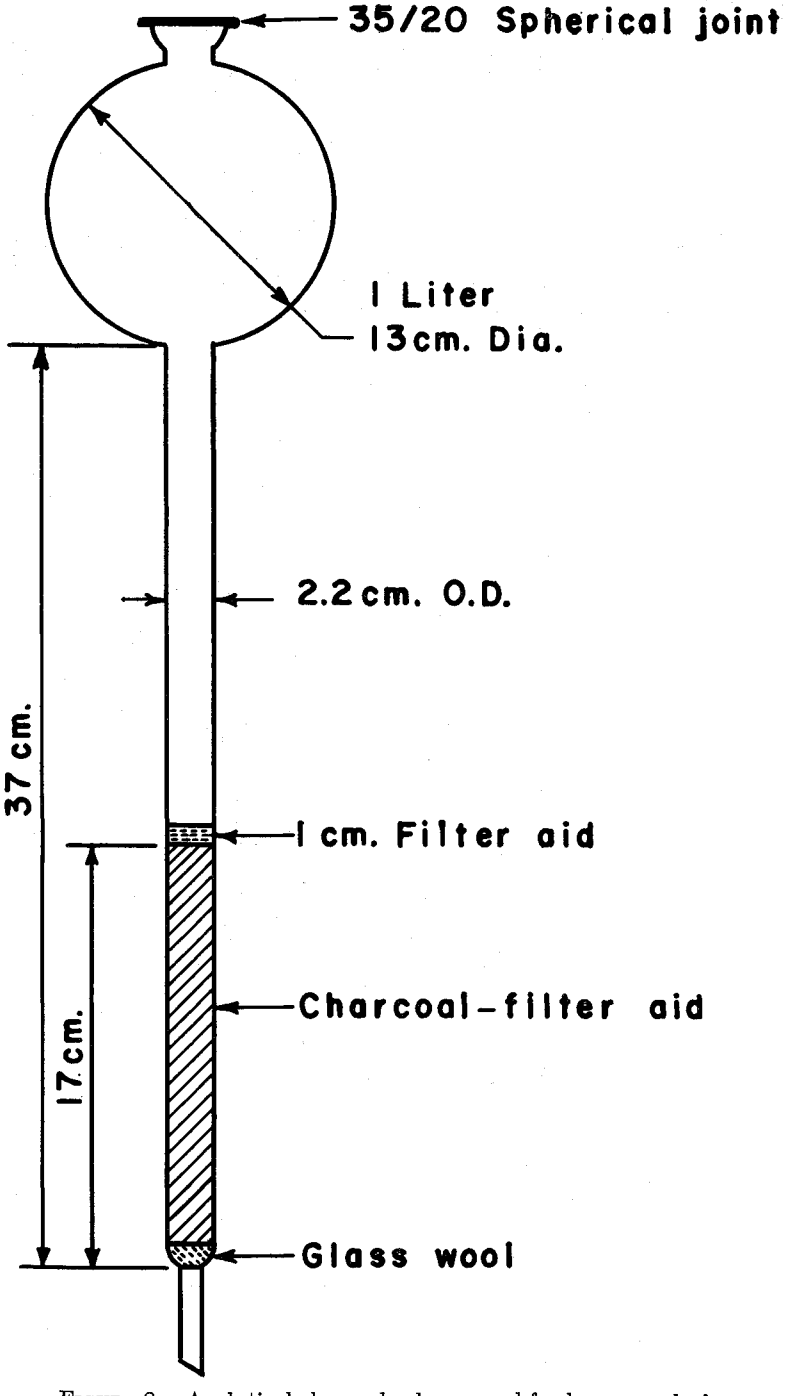

FIGURE 8.—Analytical charcoal column used for honey analysis.

PREPARATION AND STANDARDIZATION OF ADSORPTION COLUMN.—Column, shown in figure 8, is 22 mm. outside diameter by 370 mm. long, with 1 liter spherical section and 35/20 spherical ground joint at top. Adsorbent is 1+1 mixture of Darco G–60 charcoal and rapid filter-aid (Celite 545 or Dicalite 4200).[10]

Insert glass wool plug, wet from below, and add enough dry adsorbent to the dry tube (23–26 cm.) to compress to 17 cm. when vacuum is applied with *gentle* tapping of column. Remove excess charcoal from walls of column, and add filter-aid layer at top with *gentle* packing (1–1.5 cm.). Wash column with 500 ml. H_2O and 250 ml. 50 percent EtOH, and let stand overnight with 50 percent EtOH on it. Flow rate should be 5.5–8.0 ml./min. with H_2O at 9 lb./sq. in. air pressure. Slower flow rates delay analyses excessively.

The following alternative wet packing procedure has been found to increase column flow rate: Prepare a column with glass wool plug and 10 mm. of dry filter aid at bottom. Then, with outlet open, add a suspension of 18 gm. of adsorbent mixture in 200 ml. of water. After 5 min., apply 4 lb./sq. in. air pressure until the charcoal surface is stabilized. After application of 9 lb./sq. in. pressure, use suction to remove any excessive charcoal mixture beyond 17 cm. depth and place layer of filter aid on the charcoal surface. Then continue washing as above.

Alcohol content of eluting solutions must be adjusted to retentive power of charcoal used. Wash column EtOH-free with 250 ml. H_2O, quantitatively add 10 ml. solution of 1.000 g. anhydrous dextrose to top, and draw it into column with suction; do not let dry. Add 300 ml. H_2O to top, break suction, apply pressure (10 lb./sq. in. max.), and collect eluate in five 50 ml. portions in tared beakers. Include 10 ml. from sample introduction in first 50 ml. fraction. Evaporate fractions on steam bath, dry in vacuum oven at 89°–100° C., and weigh.

Decant remaining H_2O from top of column, pass 50 ml. 5 percent EtOH and then 250 ml. H_2O through column, and repeat chromatography, using 1.000 g. anhydrous dextrose in 10 ml. 1 percent EtOH, washing with 250 ml. 1 percent EtOH as above. Repeat chromatography with 2 percent EtOH if necessary to select as solvent A that which removes dextrose in 150 ml.

Wash column with 250 ml. H_2O and then 20 ml. 5 percent EtOH. To top, add 10 ml. 5 percent EtOH solution containing 100 mg. maltose and 100 mg. sucrose. Elute as above with 250 ml. 5 percent EtOH, weighing evaporated 50 ml. portions of filtrate. Repeat, if necessary, with 7, 8, and 9 percent EtOH to find solvent B that will elute at least 98 percent disaccharides in 200 ml. Solvent A previously selected must not elute disaccharides. Combinations found satisfactory with various charcoals are 1, 7; 2, 8; 2, 9 percent. At conclusion, pass 100 ml. 50 percent EtOH through column, and store under layer of this solvent.

PREPARATION OF FRACTIONS.—Wash column with 250 ml. H_2O and

[10] Darco G–60 is a product of Darco Corporation, New York, N.Y.; Celite 545, Johns Manville, New York, N.Y.; and Dicalite 4200, Dicalite Div., Great Lakes Carbon Corp., New York, N.Y. Mention of trade names does not imply endorsement by the Department of Agriculture over similar products not mentioned.

decant any supernatant. Pass 20 ml. solvent A through column, and discard. Dissolve 1 g. sample in 10 ml. solvent A in 50 ml. beaker. Transfer sample (using long-stem funnel) onto column, and force into column. Use 15 ml. solvent A to rinse beaker and funnel, and add to column. Collect all eluate, beginning with sample introduction in 250 ml. volumetric flask. Add 250 ml. solvent A, and collect exactly 250 ml. total (fraction A-monosaccharides). Decant excess solvent from top, add 265–270 ml. solvent B, and collect 250 ml. in volumetric flask (fraction B-disaccharides). Decant excess, add 110 ml. 50 percent EtOH (solvent C), and collect 100 ml. in volumetric flask (fraction C-higher sugars). Mix each fraction thoroughly. Column may be stored indefinitely, outlet closed, under 50 percent EtOH. Discard packing after 8 uses.

LEVULOSE DETERMINATION, REAGENTS.—(a) *Iodine solution.*–0.05 N. Dissolve 13.5 g. pure I in solution of 24 g. KI in 200 ml. H_2O, and dilute to 2 liters. Do not standardize.

(b) *Sodium hydroxide solution.*–0.1N. Dissolve 20 g. NaOH and dilute to 5 liters.

(c) *Sodium hydroxide solution.*–1N. Dissolve 41 g. NaOH in H_2O and dilute to 1 liter.

(d) *Sulfuric acid solution.*–1N. Add 56 ml. H_2SO_4 to H_2O and dilute to 2 liters.

(e) *Sulfuric acid solution.*–2N. Add 56 ml. H_2SO_4 to H_2O and dilute to 1 liter.

(f) *Sodium sulfite solution.*–1%. Dissolve 1 g. Na_2SO_3 in 100 ml. H_2O. Make fresh daily.

(g) *Starch solution.*–1%, freshly prepared.

(h) *Bromcresol green solution.* Dissolve 150 mg. bromcresol green in 100 ml. H_2O.

(i) *Shaffer-Somogyi reagent.* Dissolve 25 g. each anhydrous Na_2CO_3 and Rochelle salt in about 500 ml. H_2O in 2-liter beaker. Add 75 ml. of solution of 100 g. $CuSO_45H_2O$ per liter, through funnel with tip under surface, with stirring. Add 20 g. dry $NaHCO_3$, dissolve, and add 5 g. KI. Transfer solution to 1-liter volumetric flask, add 250 ml. 0.100N KIO_3 (3.567 g. dissolved and diluted to 1 liter), dilute to volume, and filter through fritted glass. Age overnight before use.

(j) *Iodide-oxalate solution.* Dissolve 2.5 g. KI and 2.5 g. K oxalate in 100 ml. H_2O. Make fresh weekly.

(k) *Sodium thiosulfate standard solution.*–0.005N. Prepare from standardized stock 0.1000N solution. Make fresh daily.

LEVULOSE DETERMINATION, PROCEDURE.—Pipet 20 ml. fraction A into 200 ml. volumetric flask. Add 40 ml. 0.05N I solution by pipet, then with vigorous mixing add 25 ml. 0.1N NaOH over 30 seconds period, and immediately place flask in 18 ± 0.1°C. water bath. Exactly 10 minutes after alkali addition, add 5 ml. 1N H_2SO_4 and remove from bath. Exactly neutralize I with Na_2SO_3 solution, using 2 drops starch solution near end point. Back-titrate with dilute I if necessary. Add 5 drops bromcresol green and exactly neutralize solution with 1N NaOH; then make just acid to indicator. Dilute to volume and

determine reducing value of 5 ml. aliquots by Shaffer-Somogyi method: Place 5 ml. in 25 by 200 mm. test tubes, add 5 ml. Shaffer-Somogyi reagent, and mix by swirling. Place in boiling H_2O bath and cap with funnel or bulb. After 15 minutes, remove to running H_2O cooling bath with care, and cool 4 minutes. Carefully remove caps, and add, down side, 2 ml. iodide-oxalate solution and then 3 ml. 2N H_2SO_4. (Do not agitate solution while alkaline.) Mix thoroughly, seeing that all Cu_2O is dissolved. Return to cold H_2O and let stand 5 minutes, mixing twice in this period. Titrate in tube with 0.005N $Na_2S_2O_3$ and starch indicator. (Magnetic stirrer is most suitable for purpose.) Make duplicate blanks and determinations. Deduct titration from that of blank and calculate levulose:

$$\text{Percent levulose} = \frac{500\ [(\text{titer} \times 0.1150) + 0.0915] \times 100}{\text{mg. sample}}$$

Levulose correction for dextrose determination = l.c. = [(titer × 0.1150) + 0.0915] × 40. Bracketed quantity is mg. levulose in 5 ml. aliquot, valid between 0.5 and 1.75 mg. levulose.

DEXTROSE DETERMINATION, REAGENTS.—*Sodium thiosulfate solution.*–0.05N. Prepare from standardized stock 0.1000N solution.

DEXTROSE DETERMINATION, PROCEDURE.—Pipet 20 ml. fraction A into duplicate 250 ml. Erlenmeyers. Evaporate to dryness on steam bath in air current. Add 20 ml. H_2O, pipet 20 ml. 0.05N I, and as in levulose determination, add 25 ml. 0.1N NaOH slowly, and immediately place in $18 \pm 0.1°$ H_2O bath. Exactly 10 minutes from end of alkali addition, add 5 ml. 2N H_2SO_4, remove from bath, and titrate with 0.05N $Na_2S_2O_3$, using starch solution. Make duplicate blanks, using H_2O. Subtract titration value from that of blank, and calculate dextrose:

$$\text{Percent dextrose} = \frac{56.275\ [\text{titer} - (0.01215 \times \text{l.c.})] \times 100}{\text{mg. sample}},$$

where l.c. = levulose correction from levulose determination. Equation is valid over range 10–50 mg. dextrose in 20 ml. In presence of dextrose, 1 mg. levulose requires 0.01215 ml. 0.05N $Na_2S_2O_3$, in range 15–60 mg. levulose.

REDUCING DISACCHARIDES AS MALTOSE, DETERMINATION.—Pipet duplicate 5 ml. aliquots of fraction B into 25 × 200 mm. test tubes, and add 5 ml. Shaffer-Somogyi reagent. Determine reducing value as in levulose determination, except boil tubes 30 minutes. Value for 15 minute-water blank may be used here. Calculate % reducing disaccharides as maltose:

$$\text{Percent "maltose"} = \frac{50\ [(\text{titer} \times 0.2264) + 0.075] \times 100}{\text{mg. sample}}$$

Maltose correction for sucrose determination = maltose titer × 0.92. Reducing value of maltose at 15 minutes is 92 percent of final

value. Bracketed quantity is mg. maltose in 5 ml. aliquot, valid between 0.15 to 3.80 mg. maltose.

SUCROSE DETERMINATION, REAGENTS.—(a) *Hydrochloric acid solution.*—6N. Add 250 ml. HCl to H_2O and dilute to 500 ml.

(b) *Sodium hydroxide solution.*—5N. Dissolve 103 g. NaOH in H_2O and dilute, after cooling, to 500 ml.

SUCROSE DETERMINATION, PROCEDURE.—Pipet 25 ml. fraction B into 50 ml. volumetric flask. Add 5 ml. 6N HCl and 5 ml. H_2O. Mix, let stand in 60° H_2O bath 17 minutes, cool, and neutralize to bromcresol green with 5N NaOH (polyethylene squeeze bottle is excellent for holding and delivering alkali). Adjust to acid color of indicator, using 2N H_2SO_4 to correct overrun. Dilute to volume and determine reducing value of 5 ml. aliquots by Shaffer-Somogyi determination as for levulose. Subtract titration from blank, and calculate sucrose by reference to curve constructed from following table:

Sucrose in 5 ml. aliquot oxidized, mg.	*0.005 N $Na_2S_2O_3$ required, ml.*
0. 255	1. 75
. 502	3. 95
1. 004	8. 72
1. 260	11. 28

From curve obtain S_1 = sucrose equivalent to maltose correction (see above for maltose) and S_2 = sucrose equivalent of sucrose titer.

$$\text{Percent sucrose} = \frac{50\ (2S_2 - S_1) \times 100}{\text{mg. sample}}$$

MELEZITOSE DETERMINATION, REAGENTS.—(a) *Yeast invertase.*—1 percent. Dissolve 1 g. melibiase-free yeast invertase preparation in water and dilute to 100 ml.

(b) *Buffer.*—M/10 acetate, pH 4.5. Dissolve 6 g. glacial acetic acid in 500 ml. water, titrate with N NaOH to pH 4.5, dilute to 1 liter.

MELEZITOSE DETERMINATION, PROCEDURE.—To 25 ml. of fraction B in a 50 ml. volumetric flask add 0.1 ml. enzyme solution and 1.0 ml. buffer. Mix, let stand 1 hour at room temperature, make to volume and determine reducing value of 5 ml. aliquot by Shaffer-Somogyi determination as for levulose. Subtract titration value from blank (with enzyme, buffer) and obtain value for true sucrose from table given under "sucrose." Calculate as for sucrose.

The difference between this value and that obtained as described under "sucrose" is considered due to melezitose. Multiply the difference, expressed as percent of honey sample, by 1.47 to obtain estimation of melezitose content of honey sample.

NOTE.—The amount of enzyme solution used will depend on the strength of the invertase solution used.

HIGHER SUGARS, OR "DEXTRIN", PROCEDURE.—Pipet 25 ml. aliquots of fraction C into 50 ml. volumetric flasks. Add 5 ml. 6N HCl and 5 ml. H_2O, and heat in boiling H_2O bath 45 minutes. Cool, neutralize as for sucrose, dilute to volume, and determine reducing value by Shaffer-Somogyi determination as for levulose. Subtract titration

value from blank and obtain dextrose equivalent from curve constructed from data below:

Dextrose, mg.	*Titer, ml.*
0. 05	0. 20
. 10	. 60
. 25	1. 85
. 50	4. 00
1. 00	8. 50
2. 00	17. 60

$$\text{Percent higher sugars} = \frac{40 \text{ (dextrose equiv.)} \times 100}{\text{mg. sample}}$$

NOTES.—For most accurate work, Shaffer-Somogyi values must check within 0.04 ml. Calibration of entire procedures, including column, using known synthetic mixtures of dextrose, levulose, sucrose, maltose, and raffinose (corrected for moisture) is recommended for critical work. Efficiency of column separation may be checked by paper chromatography of fractions A, B, and C.

Free, Total and Lactone Acidity

The following titration is carried out with a pH meter (recently calibrated at pH 4 and 8) and 10-ml. microburets with extended tips delivering 0.05N HCl and 0.05N alkali into the beaker used to contain the sample:

To a 10-g. sample of honey contained in a 250-ml. beaker, add 75 ml. CO_2-free distilled water. Dissolve honey and stir the solution with a magnetic stirrer. Place the electrodes of a pH meter in the solution and record the initial pH. Then titrate the solution with 0.05N NaOH. Add the NaOH at a rate so that individual drops just tend to merge into a steady stream (5.0 ml./min.). Stop adding NaOH when the pH reaches 8.5. Immediately add 10 ml. 0.05N NaOH by means of a 10-ml. pipet and without delay titrate back to pH 8.3 by adding 0.05N HCl from a 10-ml. buret.

The amount of NaOH added from the buret, minus the "blank" correction, is considered the measure of the free acid present, and the amount of HCl used subtracted from 10 ml. is a measure of the lactone content. The sum of free acid and lactone is the total acidity. All values are calculated to milliequivalents per kilogram. The titration rate given is as rapid as found consistent with acceptable reproducibility. Titration to pH 8.5 is equivalent to maintenance of phenolphthalein pink for 10 seconds, since the pH falls to 8.3 in that time.

Ash

Weigh 5–10 g. honey into a flamed and weighed platinum dish. Place under a 375-watt infrared lamp with variable voltage input and slowly increase until sample is black and dry and there is no longer

any danger of loss by foaming. Place in a muffle furnace at 600° C. overnight. Cool and weigh.

$$\frac{\text{wt. ash}}{\text{wt. sample}} \times 100 = \text{percent ash}$$

Nitrogen

REAGENTS.—(a) *Methyl red-methylene blue indicator.*—Mix 2 parts 0.2 percent alcoholic methyl red solution with 1 part 0.2 percent alcoholic methylene blue solution.

(b) *Sodium hydroxide-sodium thiosulfate.*—Add 25 ml. of 25 percent $Na_2S_2O_3 \cdot 5H_2O$ to 100 ml. of 50 percent NaOH.

(c) *Boric acid.*—Saturated solution.

(d) *Hydrochloric acid.*—0.01 N, diluted from standard 0.1 N.

APPARATUS.—(a) *Digestion rack.*—Use rack with electric heaters which will supply sufficient heat to a 30 ml. flask to cause 15 ml. water at 25° C. to come to a rolling boil in not less than 2 or more than 3 minutes.

(b) *Distillation apparatus.*—Use one-piece distillation apparatus (*40*).

(c) *Digestion flasks.*—Use 30 ml. regular Kjeldahl flasks (*40*).

PROCEDURE.—Transfer 300 mg. honey (sample which will require 3–10 ml. 0.01N HCl) to 30 ml. Kjeldahl flask. Add 1.9 $\pm$0.1 g. K_2SO_4, 40 $\pm$ 10 mg. HgO and 3.0 $\pm$ 0.1 ml. H_2SO_4. Add boiling chips which pass No. 10 sieve and digest for 1 hour after acid comes to a true boil. Cool, add minimum quantity H_2O to dissolve solids, cool, place thin film of petroleum jelly on rim of flask. Transfer digest and boiling chips to distillation apparatus and check completeness of transfer by adding drop of indicator to final rinses. Place 125 ml. Phillips beaker or Erlenmeyer flask containing 2.5 ml. H_3BO_3, 1–2 drops indicator under condenser with tip extending below surface. Add 8–10 ml. NaOH-$Na_2S_2O_3$ to still, collect about 15 ml. distillate, and dilute to approximately 25 ml. Titrate to gray end point or first appearance of violet. Make blank determination and calculate.

$$\text{Percent N} = \frac{\text{(ml. HCl-blank)} \times \text{N} \times 14.008 \times 100}{\text{wt. sample in mg.}}$$

Diastase

Buffered soluble starch-honey solution is incubated and time required to reach specified end point is determined by photoelectric photometer. Results are expressed as ml. 1 percent starch hydrolyzed by enzyme in 1 g. honey in 1 hour.

REAGENTS—(a) *Iodine stock solution.*—Dissolve 8.80 g. resublimed I_2 in 30–40 ml. H_2O containing 22.0 g. KI, and dilute to 1 liter with H_2O.

(b) *Iodine solution.*—0.0007 N. Dissolve 20 g. KI and 5.00 ml. I solution, (a), in H_2O and dilute to 500 ml. Make fresh every second day.

(c) *Acetate buffer.*—pH 5.3 (1.59 M). Dissolve 87 g. $NaOAc \cdot 3H_2O$ in 400 ml. H_2O, add about 10.5 ml. HOAc in H_2O, and dilute to 500 ml. Adjust pH to 5.30 with NaOAc or HOAc, if necessary.

(d) *Sodium chloride solution.*—0.5 M. Dissolve 14.5 g. NaCl in H_2O and dilute to 500 ml.

(e) *Starch solution.*—Weigh 2.000 g. soluble starch (Pfanstiehl, reagent grade, Improved Lintner Method or equivalent) and mix with 90 ml. H_2O in 250-ml. Erlenmeyer flask. Rapidly bring to boil, swirling solution as much as possible. Boil gently 3 minutes, cover, and let cool to room temperature. Transfer to 100 ml. volumetric flask and dilute to volume. Observe procedure closely to limit variation in blank starch-I absorbance values.

APPARATUS—(a) *Reaction vessel.*—Attach side-arm, 18 × 60 mm., to 18 × 175 mm. test tube. Lower side of side-arm is attached 100 mm. from bottom of tube, making 45° angle with lower portion of tube.

(b) *Photoelectric colorimeter.*—Equipped with 660 mμ red filter, or 600 mμ interference filter.

STANDARDIZATION.—Pipet 5 ml. starch solution into 10 ml. H_2O and mix well. Pipet 1 ml. of this solution into several 50 ml. graduated cylinders containing 10 ml. of the dilute I solution. Mix well, and determine H_2O dilution necessary to produce absorbance value of 0.760 ± 0.02 in photometer-test tube (or cell) combination to be used. This is standard dilution for starch preparation used. Repeat when changing starch source.

PROCEDURE.—Weigh 5 g. sample into 20 ml. beaker, dissolve in 10–15 ml. H_2O and 2.5 ml. buffer solution, and transfer to 25 ml. volumetric flask containing 1.5 ml. NaCl solution. Dilute to volume. (Solution must be buffered before adding to NaCl solution.)

Pipet 5 ml. starch solution into side arm of reaction tube and 10 ml. sample solution into bottom of tube, with care not to mix. Place tube in H_2O bath 15 minutes at $40 \pm 0.2°$ C.; then mix contents by tilting tube back and forth several times. Start stopwatch. At 5 minutes, remove 1 ml. aliquot with pipet and add rapidly to 10.00 ml. dilute I solution in 50 ml. graduated cylinder. Mix, dilute to previously determined volume, and determine absorbance in photoelectric photometer. Note time from mixing of starch and honey to addition of aliquot to I as reaction time. (Place 1 ml. pipet in reaction tube for reuse when later aliquots are taken.) Continue taking 1 ml. aliquots at intervals until absorbance value of <0.235 is obtained.

The 5 minute value gives an approximation of end point as follows:

Absorbance	*End Point (min.)*
0. 7	>25
. 65	20–25
. 6	15–18
. 55	11–13
. 5	9–10
. 45	7–8

Plot absorbance versus time on rectilinear paper; draw straight line through starting absorbance and as many points as possible. From graph, determine time diluted reaction-I mixture reaches absorbance of 0.235. Divide 300 by this time to obtain diastase number.

ACCURACY OF SUGAR ANALYSES BY THE SELECTIVE ADSORPTION METHOD

In developing the method (*54*), known sugar mixtures were subjected to the procedure and recoveries calculated. Additions of known sugars to honey solutions were satisfactorily accounted for.

During the work described in this bulletin, opportunities were taken to obtain measures of the accuracy of the method. Aliquots of the three analytical fractions for each of 17 consecutive samples were evaporated, and the dry weight so obtained was compared with that calculated from the sugar analyses. The results demonstrate the general accuracy of the method and also give some information on the materials not analyzed by the procedure.

As an additional check on the accuracy of the method as applied to honey, monosaccharide fractions from the routine analyses of five honey samples were analyzed for dextrose and levulose polarimetrically as well as by the chemical procedure. While it has been shown (*57*) that polarimetric determination of levulose in honey is not accurate, the use of charcoal column pretreatment removes interfering sugars and other materials and provides a solution containing only dextrose and levulose which can be analyzed polarimetrically.

In the analytical procedure, the carbohydrates of a honey sample (0.8–1.0 g.) are obtained as follows:

Fraction A—250 ml.—dextrose, levulose
Fraction B—250 ml.—sucrose, reducing disaccharides
Fraction C—100 ml.—higher sugars

The dextrose and levulose are determined individually. Reducing disaccharides are determined in fraction B without preliminary hydrolysis and calculated as maltose; sucrose is determined by increase in reducing power after a mild acid hydrolysis. In fraction C, reducing sugars after hydrolysis are determined by copper reduction and reported as dextrose.

Fifty-ml. aliquots of each of these three fractions from 17 consecutive honey samples were evaporated to dryness in a current of air in a steam bath and the weights of the residues determined. All solutions and residues were colorless.

Table 20 shows the weights so obtained for 4 typical samples of the 17 together with the weight calculated to be present from the chemical analyses. An analysis of variance on the individual weights of the three fractions from the 17 samples (the 4 in table 20 plus 13 not shown) as found by weighing and as calculated from the analytical values gave the results shown in table 21. The difference in the results given for fraction A by the two methods is not significant; the amount of unanalyzed material in fraction B is highly significant, and that for fraction C is also highly significant.

Table 22 shows (for the same samples as in table 20) the amount of material found in the fractions by evaporation and that calculated from the analyses, both calculated for the entire sample. The last line (not analyzed) is the material not accounted for by each procedure. About 2.3 percent of honey material (17-sample average) in the three analytical fractions escapes analysis by the selective adsorption procedure. Table 23 gives the distribution of this material among

TABLE 20.—*Weight of material in 50 ml. aliquots of analytical fractions for 4 samples*

Fraction	Sample A		Sample B		Sample C		Sample D	
	Found	Calculated	Found	Calculated	Found	Calculated	Found	Calculated
	Mg.	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
Monosaccharide	140. 3	138. 9	136. 8	137. 6	135. 0	134. 7	132. 1	132. 2
Disaccharide	18. 9	14. 2	23. 4	19. 6	20. 8	17. 3	17. 6	15. 9
Higher sugars	7. 0	5. 6	10. 0	8. 2	9. 7	6. 9	10. 5	8. 0

TABLE 21.—*Analysis of variance for 17 samples*[1]

Source of variation	D.F.	Monosaccharides			Disaccharides			Higher sugars		
		S.S.	M.S.	F	S.S.	M.S.	F	S.S.	M.S.	F
Total	33	1212. 28			236. 4			349. 9		
Materials	16	896. 8	56. 0	2. 89	163. 1	10. 2	11. 2**	328. 1	20. 5	25. 7**
Methods	1	2. 18	2. 18	. 11	58. 8	58. 8	64. 9**	54. 1	54. 1	67. 7**
Error	16	313. 3	19. 6		14. 5	. 91		12. 8	. 80	

[1] 4 samples in table 20 and 13 additional.
**Significant at 1-percent probability level.

TABLE 22.—*Material in analytical fractions, determined by 2 methods, whole-sample basis*

Fraction	Sample A		Sample B		Sample C		Sample D		Average 17 samples	
	By weight	By analyses	By weight	By analyses	By weight	By analyses	By weight	By analyses	By weight	By analyses
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Monosaccharide	71. 37	70. 67	69. 68	70. 12	67. 82	67. 70	69. 97	70. 03	71. 23	71. 06
Disaccharide	9. 61	7. 22	11. 92	9. 99	10. 45	8. 60	9. 32	8. 40	9. 12	7. 73
Higher sugars	1. 62	1. 15	2. 16	1. 68	1. 95	1. 38	2. 22	1. 70	2. 18	1. 22
Total sugars	82. 60	79. 04	83. 76	81. 79	80. 22	77. 68	81. 51	80. 13	82. 53	80. 01
H_2O [1]	15. 7	15. 7	15. 8	15. 8	18. 2	18. 2	18. 0	18. 0	17. 3	17. 3
Total	98. 3	94. 7	99. 6	97. 6	98. 4	95. 9	99. 5	98. 1	99. 8	97. 3
Not analyzed [2]	1. 7	5. 3	. 4	2. 4	1. 6	4. 1	. 5	1. 9	. 2	2. 7

[1] Moisture content of honey sample.
[2] 100—total.

TABLE 23.—*Distribution of unanalyzed material, whole-sample basis* [1]

Fraction	Sample				Average, 17 samples
	A	B	C	D	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
Monosaccharide	0. 70	−0. 44	0. 12	−0. 06	0. 40
Disaccharide	2. 39	1. 93	1. 85	. 98	1. 40
Higher sugars	. 47	. 48	. 57	. 52	. 52
Total	3. 56	1. 97	2. 54	1. 44	2. 32

[1] Values show amount of unanalyzed material in each fraction, as percent of the entire sample.

the three fractions. The largest part of the material is in fraction B, the disaccharides.

For the polarimetric determination of the sugars of fraction A, 100 ml. aliquots of fraction A from five successive honey analyses were evaporated as before. They were made to 10.00 ml. with water and a little ammonia and their rotation was determined. The specific rotation was calculated using the evaporated weights; and from the known values for pure levulose and dextrose, the composition of the solution was calculated. An example follows:

Sample E (table 24). Original weight ..... 0.9958 g.
Residue from 100 ml. fraction A ..... 0.2806 g.
Angular rotation (2 dm.) ..... −1.55°

$$[\alpha]_D^{20} = -27.62°$$

$[\alpha]_D^{20}$ levulose $= -92.5°$; dextrose, $= 52.5$ percent

$$\frac{-92.5-(-27.62)}{-92.5-(52.5)} = \frac{-64.88}{-145.0} = 44.74 \text{ percent dextrose}$$

$0.2806 \times 0.4474 = 0.1255$ g. dextrose
$0.2806 \times (1-0.4474) = 0.1550$ g. levulose

$$\frac{0.1255 \times 2.5 \times 100}{0.9958} = 31.51 \text{ percent dextrose}$$

$$\frac{0.1550 \times 2.5 \times 100}{0.9958} = 38.91 \text{ percent levulose}$$

Found by selective adsorption method,
30.79 percent dextrose,
39.15 percent levulose.

Table 24 shows the values obtained for the five samples. It also shows an analysis of variance of these data. The variance is almost entirely due to materials (different honey samples); that due to the methods is not significant at the 5-percent level for either dextrose or levulose. ($F = 6.4$ and 0.33; critical values at the 5-percent level = 6.39 for materials and 7.71 for methods.)

The agreement between the values obtained by weighing and by

TABLE 24.—*Determination of dextrose and levulose in monosaccharide fractions by 2 methods*

Sample	Dextrose		Levulose	
	Chemical	Polarimetric	Chemical	Polarimetric
	Percent	*Percent*	*Percent*	*Percent*
E	30. 79	31. 51	39. 15	38. 91
F	33. 57	34. 57	37. 55	36. 55
G	33. 15	33. 87	38. 82	38. 40
H	29. 47	30. 22	38. 69	39. 77
I	33. 52	33. 21	38. 65	38. 24
Average	32. 10	32. 68	38. 57	38. 38

Analysis of variance

Source of variance	D.F.	Dextrose			Levulose		
		S.S.	M.S.	F	S.S.	M.S.	F
Total	9	27. 43			7. 15		
Materials	4	26. 08	6. 52	48. 5**	5. 87	1. 47	4. 90
Methods	1	. 83	. 83	6. 4	. 10	. 10	. 33
Error	4	. 52	. 13		1. 19	. 30	

**Significant at 1-percent probability level. $F_{0.05}$=6.39 for materials; 7.71 for methods.

calculation from the dextrose and levulose values in the monosaccharide fraction is satisfactory. This fraction is the most important in honey, making up about 85 percent of the sugars. The 0.40 percent discrepancy found for the 17-sample average (table 23) may be compared with the standard deviation obtained when four honey samples were analyzed by three analysts in one laboratory (0.38 percent for dextrose, 0.42 percent for levulose) (*50*).

The method of analysis of fraction B is a compromise, since it has been found to contain maltose, isomaltose, turanose, maltulose, sucrose (*51*), and also kojibiose (*47*). Some evidence of trehalose (*51*) and leucrose (*47*) has been obtained. The relative reducing power of these sugars varies considerably; kojibiose is reported to have only about 6 percent of the reducing power of glucose toward the Shaffer-Hartman copper reagent (*31*). Trehalose, being nonreducing, would not be determined by the procedure used, but would appear in fraction B if present. It is therefore likely that the unanalyzed material in the disaccharide fraction is at least in part kojibiose. Table 23 shows that it varies from sample to sample. The unanalyzed material in fraction C averages 0.52 percent. Inspection of the 17 samples shows that it does not vary as widely as does that in fraction B. It may be

a systematic error in the determination, due to incomplete hydrolysis of higher sugars or destruction of fructose in the acid hydrolysis.

The satisfactory agreement found for dextrose and levulose values in the monosaccharide fraction by the two methods, plus the agreements between weighed and calculated residues, is evidence for the essential accuracy of the analytical procedure. An earlier study of five methods of honey analysis—made before the selective adsorption method was developed (*57*)— showed that variance due to methods was highly significant and greater than that due to differences among honey samples of different floral types. Here, table 24 shows that variance due to samples is about 10 times that due to methods in the analysis of monosaccharide fractions by two procedures (chemical and physical). Variance due to methods is not significant at the 5-percent level for either dextrose or levulose.

In conclusion, comparison of dry weights of fractions from the selective adsorption analysis of honey with values calculated from the analysis shows that about 2.3 percent of the material passing through the charcoal column is not analyzed. Most of this material is in the disaccharide fraction and probably represents kojibiose, possibly also trehalose. Polarimetric analyses of the monosaccharide fraction from the honey analyses gives results for dextrose and levulose not differing significantly from those obtained by chemical methods.

Floral Source Index—Common Names, Synonyms, and Botanical Names

Most useful sources for the information in this list were Pellett (*29*), and Lovell (*24*). Oertel (*27*) was also consulted. As pointed out by these authors, identical plants may have different common (beekeeper's) names at different localities, and also the same name may refer to entirely different plants in different areas.

	Sample No.
Acacia spp., see Catsclaw.	
Acer negundo, see Honeydew, boxelder.	
Actinomeris alternifolia, see Wing-stem.	
Alfalfa (*Medicago sativa*)	1–58, 102, 120, 130, 134, 135, 173, 198–208, 277–284, 290, 318, 319.
Alfalfa honeydew, see Honeydew, alfalfa.	
Alfalfa, wild, see Wild alfalfa.	
Ampelopsis spp., see Peppervine.	
Anaphalis margaritacea, see Pearly everlasting.	
Antigonon leptotus, see Coralvine.	
Arctostaphylos spp., see Manzanita.	
Arrow-weed (*Pluchea sericea*)	186.
Aster (*Aster* spp.)	59–66, 126, 285, 294, 339, 340, 348, 350.
Astragalus haydenianus, see Vetch, milk.	
Athel tree (*Tamarix aphylla*)	67, 68.
Avocado (*Persea americana*)	430.
Bachelor button (*Centauria cyanus*)	485.
Bamboo, Japanese (*Polygonum sachalinense*)	69.
Barbarea vulgaris, see Winter cress.	
Basswood (*Tilia americana*)	70–78, 120, 209, 210, 277, 286–290, 303, 455.
Bean, lima (*Phaseolus limensis*)	79–81.
Bean, pea (*Phaseolus vulgaris*)	82.
Bearberry, see Manzanita.	

SAMPLE LOCATION INDEX, BY STATES

State	Sample No.
Alabama	334.
Alaska	122, 123.
Arizona	12, 27, 31, 67, 308, 310, 313, 314, 364, 369, 370, 422.
Arkansas	115, 143, 181, 403, 431, 471, 489.
California	3–8, 10, 21, 23, 68, 79, 116, 130, 144, 149, 158–162, 168, 169, 186, 311, 312, 316, 318, 319, 324, 325, 366, 368, 377–379, 393, 406, 417–421, 423, 440–444, 469, 470, 473, 475, 492–495, 497, 499, 500, 502.
Colorado	14, 30, 35, 52, 53, 55, 58, 172, 285, 487.
Connecticut	253, 339, 433, 496.
Delaware	110.
Florida	69, 125, 151, 164, 167, 177, 235, 266, 322, 330, 380–392, 394–398, 436, 447, 462–467, 498.
Georgia	84, 176, 178, 329, 331, 332, 371.
Hawaii	None.
Idaho	19, 33, 36, 135.
Illinois	126, 191, 215, 216, 222, 225, 227, 268, 348.
Indiana	66, 83, 175, 229, 267, 350, 360, 454.
Iowa	20, 51, 73, 194, 205, 209, 210, 226, 228, 265, 270, 286, 296, 301, 323, 372, 415.
Kansas	1, 221.
Kentucky	59, 62, 63, 238, 255.
Louisiana	101, 137, 230, 249, 315, 437, 479, 488.
Maine	124.
Maryland	71, 85–88, 155, 157, 190, 196, 291, 351, 352, 361, 374, 451, 452.
Massachusetts	60, 147, 257, 320, 321, 346, 400.
Michigan	29, 82, 242, 248, 250, 273, 407.
Minnesota	26, 76, 77, 78, 81, 104, 117, 118, 120, 121, 153, 156, 170, 208, 211, 212, 223, 254, 264, 271, 277, 283, 287, 290, 347, 349.
Mississippi	141, 179, 180, 244, 247, 333, 448.
Missouri	24, 89, 127, 150, 231–233.
Montana	15, 16, 25, 34, 37, 38, 45, 46, 49, 50, 54, 57, 198–200, 202, 206, 207, 218–220, 282, 357, 358, 416.
Nebraska	18, 28, 217, 276, 278, 279, 284.
Nevada	2, 365.
New Hampshire	100, 338.
New Jersey	99, 134, 148, 237, 298, 429, 430, 461.
New Mexico	None.
New York	113, 114, 174, 213, 243, 269, 295, 304, 340, 342, 343, 399, 408, 410, 411, 438, 446.
North Carolina	90, 344, 345, 359, 409, 414, 424, 425, 460, 468, 505.
North Dakota	None.
Ohio	70, 116, 154, 171, 274, 362, 491.
Oklahoma	22, 32, 102, 129, 189, 197, 214, 315, 477, 486.
Oregon	138, 165, 173, 326–328, 353, 375, 376, 445, 472, 474, 476, 480, 482–485, 501.
Pennsylvania	61, 74, 103, 105, 128, 132, 136, 139, 142, 146, 152, 195, 256, 259–263, 302, 336, 337, 356, 412, 413, 455, 456, 459.
Rhode Island	91–98, 106–109, 133, 140, 258.
South Carolina	335.
South Dakota	17, 47, 193, 201.
Tennessee	145, 166, 182, 234, 245, 272, 373, 427, 453, 457, 481, 490.
Texas	119, 163, 183–185, 293, 297, 300, 306, 307, 309, 317, 354, 355, 367, 404, 405, 478.
Utah	11.
Vermont	252, 449, 503.
Virginia	111, 112, 192, 299, 363, 426, 428, 434, 435, 458, 504.
Washington	187, 188, 241, 280, 401, 402, 432, 450.

State	Sample No.
West Virginia	292, 439.
Wisconsin	64, 65, 72, 75, 131, 236, 239, 240, 246, 251, 275, 281, 288, 289, 294, 303.
Wyoming	9, 13, 39–44, 48, 56, 203, 204, 224.

SOURCE, DESCRIPTION, AND INDIVIDUAL ANALYSES OF HONEY AND HONEYDEW SAMPLES, AND AVERAGES BY STATE OF ORIGIN AND BY PLANT FAMILY

Full information on each honey sample is given in table 26. This includes crop year (1956 or 1957), date of removal from the bees, floral source or sources, comments offered by the producer or the authors, type and extent of heating the honey, a brief note on the physical condition of the sample when received at the laboratory, the producer's name and address, and the specific area of production of the honey sample. The State, when not given in the last column, is the same as the address of the producer. The location of each sample is shown on the map (fig. 1).

The samples are listed in alphabetical order by the common name of the principal floral source. In order to collect the highly important legume types together, the names are inverted. A few sources, named "clover" but not true clovers, are found elsewhere in the table, e.g. Mexican clover, deer clover. The unmodified designation "clover" is used for all samples so named by the producers. In addition, if the producer listed a number of clovers for a single sample, it has been designated "clover."

In general, if the producer indicated more than two floral sources, the sample is listed as a blend, further described according to time of harvesting. For some samples, the producer may have listed a third or fourth source but as present only in minor amounts. This is usually shown under "Comments."

We have included a considerable number of blends in this work. In many areas bee pasture of single plants is not extensive enough to permit harvesting single-types or even mixtures of a few floral types. Much honey is produced and sold in such areas, and it is hoped that by including information on time of collection and harvest, and specific location of production where possible, these blends will be sufficiently well characterized so that the data in this publication will be useful for these types of honey also. All blends are listed as natural; this implies that they were blended by the bees or at extraction, and not by mixing of known floral types by the beekeeper. They are characterized in time of production and harvesting as spring, summer, fall, or season (all three) blends. Such blends do not vary widely over the long run in one locality.

The time of removal from the bees is listed in table 26 as given by the producer. Samples occasionally were not received at the laboratory until several months later. Where a sample is described as unheated, a producer has so stated. If no information was given by the producer, this column was left blank. It had been emphasized in soliciting the sample that unheated samples were preferred.

The results of the analytical examination of the honey samples are detailed in table 27. This table is interleaved with table 26 so that full information is available on any sample without turning pages.

Where the number of samples of similar type justifies it, average values are inserted into table 27 following the group. For some important floral types, averages are given for each crop year, 1956 and 1957 followed by averages for both years. For example, in table 27, samples 1 to 10 (single space) are 1956 alfalfa, followed by their average. Next are given samples 11 to 23, 1957 alfalfa, followed by their average. The average for all alfalfa samples is given in the next line. Sample 24 is one-of-a-kind, with no average given. Sample 25 and 26 are both alfalfa-clover blends, and their average follows No. 26.

Samples 1 to 491 were classified by their producers as honey and the remainder, 492 to 505, as honeydew. Some floral-type honey samples were stated by the producers to contain some honeydew, and are so described in table 26. Many other samples probably contained some honeydew, judging by the flavor. After sample 505 are several lines of averages; their identities are given at that place.

The average values in table 27 are all simple numerical averages, except for the pH values. Here the numbers were necessarily converted to hydrogen ion concentration, averaged, and the result converted back to the logarithmic pH form.

In order to display all of the analytical information in one table, it was necessary to code two of the values, color and granulating tendency.

For color, the numbers refer to the U.S. Color Standards for extracted honey, with two numbers representing light and dark parts of each color class, as already described. The code is given on page 6.

Averaging these code numbers probably does not accurately represent the color of a mixture of the sample of various color classes, but it is indicative and we believe gives a useful idea of the "average" color of a group of samples.

The code values for granulation represent an increasing scale of granulation after storage under fixed conditions (see p. 6). It does not repeat the information given under "Condition" in table 26, but is considered supplemental to it. In most cases the degree of granulation given in table 26 under "Condition" is indicative of the behavior of the unheated, frequently unstrained, honey with whatever natural seeding it has been subjected to in extraction and handling by the beekeeper. In table 27 the data under "Granulation" gives some information on the tendency of the honey to granulate in undisturbed storage, after heating to eliminate seed crystals. The heating treatment used was actually milder than most commercial processing. Here again it might be debatable whether the average code number accurately depicts the granulating tendency of a mixture of samples, but since the numbers represent an increasing degree of granulation, and since granulating tendency depends on honey composition, we feel that this value is useful.

The values listed in table 27 under "Age" give the number of months between the removal of the honey from the hive and the carbohydrate analysis. We have found that the carbohydrate composition of honey changes with time (*58*). Data supporting this view were presented earlier in this bulletin. If for any reason it should be desirable to estimate the composition of honey as harvested or after certain

periods of storage, these "Age" values may be useful. This information is missing from previous compilations on honey composition. For example, the data published by Browne (*9*) resulted from analyses of honey samples gathered for an exposition in 1903; there is no indication of their age when analyzed.

The values for the sugars (and all other values in the table) are based on the honey sample at the moisture content shown in the table. As previously noted, under certain circumstances (sucrose and higher sugars each over 1 percent), melezitose was usually determined. All results are given under the column headed "melezitose" in table 27. Where the value .00 is recorded, no melezitose was found. A blank in this column shows that melezitose was not determined; it may have been present in small quantity. Averages in this column would be misleading whether calculated on the total number of samples or on the number of melezitose analyses and hence are not shown in the table.

The column in table 27 labeled "Undetermined" is intended to represent nonsugar material in the sample, since it is the difference between the total solids (100—moisture) and the sum of the five (in some cases, six) sugar determinations. Actually this value includes some sugar material not analyzed in the method. This is discussed in the sections on storage of honey and accuracy of carbohydrate analyses.

The pH values in the table are those of diluted honey solutions (13.25 percent) in carbon dioxide-free distilled water prior to the determination of acidity.

The next three columns are expressions of the acidity of the samples. All three are expressed as milliequivalents per kilogram of honey. This value is numerically equivalent to the reporting of milliliters of tenth normal alkali per hundred grams of honey. Acidity has been commonly expressed in past honey analyses as "percentage of formic acid". It has long been known that formic acid is of only minor importance in honey. A recent study of the acidity of honey (*41*) has shown that gluconic acid is the principal acid of honey, with citric acid next in importance. Many other acids have also been identified (*41*). The custom of expressing acidity of honey as formic acid is of no value, and since so many acids are present, it is more logical to give the values in milliequivalents per kilograms. These can be converted to "percentage of formic acid" if desired for comparative purposes by multiplying by 0.0046 or to "percentage of gluconic acid" by multiplying by 0.0196.

The first column, "Free acidity", corresponds to the acidity values previously reported for honey (*9*, *12*, *25*). The column labeled "lactone" is a new acidity measure for honey (*56*). It is probably largely gluconolactone (*41*). It does not include all of the gluconic acid in honey, since the lactone form of the acid is in equilibrium with the free acid form. The amount of lactone can be expressed as "percentage of gluconolactone" by multiplying by 0.0178. The column headed "Total acidity" is the sum of free and lactone acidity. The lactone content might be considered as a sort of "acidity reserve" since a partially neutralized honey will become more acid on standing due to hydrolysis of the lactone. The values in the column headed "lactone/free acid" are the ratio of lactone to free acidity.

Diastase values were determined on 292 honey samples. Of these, 272 had been stored at −20° C. immediately after receipt at the laboratory. Since deterioration in frozen storage is negligible, these values represent the diastase content of the samples as received from the producer. Nine of these samples are described in table 26 but not listed in table 27, since no other analyses were done on them. These values are as follows: No. 41, 10.3; No. 112, 33.3; No. 113, 14.3; No. 115, 46.2; No. 265, 14.6; No. 270, 15.8; No. 273, 41.4; No. 411, 10.9; No. 458, 26.7. The remaining 20 samples were analyzed for diastase after varying periods of room-temperature storage. These are listed in table 25, together with the age of the samples and the number of months elapsed before receipt of the sample. These values are, in general, low and show the effect of storage for 1 to 2 years at room temperature.

For 20 of the samples for which diastase was determined on the frozen portions, the portion stored at room temperature was also analyzed for diastase, thus providing information on the effect of room-temperature storage on diastase content of honey. This work is reported in detail earlier in this bulletin.

TABLE 25.—*Diastase content of samples stored at room temperature*

Sample No.	Age—		Diastase value
	At receipt	At analysis	
	Months	*Months*	
84	5	27	9.4
86	11	27	14.5
93	0	1	12.8
102	8	12	13.5
118	3	10	11.5
119	5	13	13.0
165	[1] 23	23	20.7
180	19	26	8.5
227	5	13	12.2
292	6	12	8.2
305	8	13	12.0
310	0	10	8.3
327	25	25	13.2
328	4	11	6.6
334	12	12	10.8
407	1	22	7.1
419	4	13	8.6
429	1	10	31.6
474	4	12	11.2
484	6	13	4.0

[1] Stored at 55°–60° F. by producer.

Diastase values in the tables are expressed in the same units used in the older Gothe method. The diastase value is the number of centigrams of starch (ml. of 1-percent starch) converted to the prescribed end point per hour per gram of honey under the test conditions.

TABLE 26.—*Source and description of honey samples*

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
1	1956	Early September.	Alfalfa	(KSC Apiary)	None		R. L. Parker, Manhattan, Kans.	Manhattan.
2	1956	Aug. 15	do			Beginning to granulate.	Paul McCart, Fernley, Nev.	Lovelock Valley, Pershing County.
3	1956	July 15	do	Strained	110°	Granulated	William Ross, Valyermo, Calif.	Kern County.
4	1956	Aug. 1	do	Unstrained	130°	Liquid	Jess Gentry, Oakdale, Calif.	Stanislaus County.
5	1956		do		None	Beginning to granulate.	R. W. Taylor, Alhambra, Calif.	Lancaster.
6	1956	July	do		140°	Granulated	Hood Littlefield, Pasadena, Calif.	Tehachapi.
7	1956	July	do	From isolated area	None	do	Delvin Ashurst, Westmorland, Calif.	Imperial Valley.
8	1956	July	do		do	do	O. P. Mandrapa, Calexico, Calif.	Do.
9	1956	August	do		100°	Partly granulated	Edward Varney, Sheridan, Wyo.	Sheridan County.
10	1956		do			Granulated	Laura Shephard, Calexico, Calif.	Imperial County.
11	1957	Aug. 30	do		120° for 2 hrs.	Liquid	William P. Nye, Logan, Utah	Cache Valley, Cache County.
12	1957		do		None	Slight granulation	C. M. Bledsoe, Phoenix, Ariz.	Maricopa County.
13	1957	July	do	Pure	do	Liquid	Harley K. Kittle, Riverton, Wyo.	Fremont County.
14	1957		do	Not processed	do	do	T. A. James, Rocky Ford, Colo.	Rocky Ford.
15	1957	Sept. 15	do		do	Crystals	Joe Barrow, Ekalaka, Mont.	Carter County.
16	1957		do			Partly granulated	C. J. Clark, Sun River, Mont.	Sun River.
17	1957		do	Unstrained (very turbid).	None	Liquid	Robert C. Fox & Son, Fruitdale, S. Dak.	Butte County.
18	1957	Aug. 22	do	Unstrained	do	Crystals	Charley W. Moosman, Valentine, Nebr.	Cherry County.
19	1957	Aug. 25	do	Also 2% clover		Granulated	Belliston Bros., Burley, Idaho	Cassia County.
20	1957	Aug. 11	do	Unstrained	130° for 15 min.	Liquid	Charles B. Crispin, Grimes, Iowa	Prairie region, Dallas County.
21	1957	July	do	Strained	130°	Partly granulated	John Allred, Madera, Calif.	San Joaquin Valley.
22	1957	July	do		None	Liquid	Glenn Gibson, Minco, Okla.	Harmon County.
23	1957		do			Soft granulation	Phillips & Blaylock, Chowchilla, Calif.	Fresno County.
24	1956	Late August	Alfalfa-blue vine		160°	Liquid	Carl Kalthoff, Lexington, Mo.	Lafayette and Saline Counties.
25	1957		Alfalfa-mixed clover.	White, alsike and sweet clovers.		Partly granulated	J. D. Harrah, Charlo, Mont.	Charlo.
26	1957	Mid-August	Alfalfa-clover		None	Many crystals	Mrs. Phil Chaffin, St. Cloud, Minn.	Haven Township, Sherburne County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
1	4	4	15.6	10	39.23	35.01	2.45	6.13	1.28	-------	0.4	3.80	21.83	12.06	33.89	0.552	0.069	0.039	19.1
2	3	8	14.1	7	37.50	32.56	7.57	6.15	1.00	-------	1.2	4.21	7.33	1.98	9.31	.270	.050	.021	14.2
3	4	4	17.0	13	38.82	33.15	.83	5.39	.91	-------	3.9	3.85	16.60	8.04	24.64	.483	.050	.027	-------
4	1	9	16.2	13	38.99	33.65	2.50	5.97	.69	-------	2.0	3.70	18.77	10.81	29.58	.578	.055	.028	16.9
5	3	9	15.1	14	40.87	33.48	2.05	6.87	1.09	-------	.5	3.80	17.20	7.27	24.47	.422	.062	.028	18.2
6	5	9	16.4	14	36.44	34.42	.98	5.18	.97	-------	5.6	3.80	18.04	8.20	26.24	.453	.050	.032	-------
7	5	8	15.7	14	37.47	33.00	5.73	5.37	.98	-------	1.7	3.93	14.77	6.45	21.22	.438	.090	.012	-------
8	9	9	16.0	14	38.76	35.11	2.33	5.41	.62	-------	1.8	3.88	26.48	10.87	37.35	.412	.318	.031	-------
9	6	5	17.4	15	38.68	34.17	1.90	6.03	.64	-------	1.2	3.78	16.71	8.26	24.97	.494	.049	.037	-------
10	9	8	15.2	28	38.87	33.92	2.47	7.42	.76	-------	1.4	3.75	30.93	14.42	45.35	.466	.174	.055	-------
Ave., 1–10	5	7	15.9	14	38.56	33.85	2.88	5.99	.89	-------	2.0	3.83	18.87	8.84	27.70	.457	.097	.031	17.1
11	4	2	14.2	6	41.54	32.02	1.16	7.14	1.29	-------	2.6	4.00	18.89	5.45	24.34	.289	.123	.015	22.2
12	8	5	16.3	6	39.84	34.04	2.42	5.44	.53	.49	.9	3.70	29.83	12.03	41.86	.403	.160	.045	-------
13	0	2	16.8	8	38.77	32.62	4.22	5.60	.82	-------	1.2	3.68	13.61	4.20	17.81	.309	.035	.020	-------
14	4	8	17.5	7	39.96	33.48	2.97	4.72	.65	-------	.7	3.60	22.23	10.70	32.92	.481	.071	.034	21.9
15	2	4	17.0	7	39.46	33.17	2.86	4.76	.74	.00	2.0	3.91	12.38	5.16	17.54	.417	.047	.028	19.0
16	1	5	17.0	8	39.39	34.03	1.98	5.54	.68	-------	1.4	3.80	15.46	7.93	23.40	.513	.051	.028	-------
17	0	6	15.4	8	39.21	33.31	2.65	6.68	.90	-------	1.8	4.05	9.22	3.24	12.46	.351	.038	.018	13.2
18	1	7	16.9	8	38.69	34.49	3.15	5.14	.68	-------	.9	3.97	11.83	4.82	16.65	.407	.048	.024	13.3
19	3	4	15.7	9	39.41	33.46	1.65	6.32	.72	-------	2.6	3.99	12.94	6.42	19.36	.496	.056	.029	-------
20	3	4	18.3	9	37.76	34.53	1.41	5.49	1.99	-------	.5	3.80	20.31	7.01	27.32	.345	.138	.040	21.4
21	8	5	16.5	14	39.04	34.89	1.01	6.29	.84	-------	1.4	3.90	32.28	11.15	43.43	.345	.200	.071	-------
22	2	4	14.4	15	38.37	33.12	4.80	6.83	.84	-------	1.6	3.68	15.84	7.65	23.46	.483	.078	.030	12.9
23	8	0	18.3	15	42.50	26.64	1.68	8.31	.83	-------	1.8	3.63	29.83	13.80	43.62	.463	.134	.057	-------
Ave., 11–23	3	4	16.5	9	39.53	33.06	2.46	6.02	.89	-------	1.5	3.80	18.82	7.66	26.47	.408	.091	.034	17.7
Ave., 1–23	4	6	16.2	11	39.11	33.40	2.64	6.01	.89	-------	1.7	3.81	18.84	8.17	27.01	.429	.093	.033	17.5
24	6	1	14.9	14	35.62	28.45	6.01	6.43	4.69	1.16	2.8	3.88	20.19	10.16	30.35	.501	.077	.026	3.1
25	1	6	15.2	7	40.77	33.92	3.07	5.26	.79	.47	.5	3.87	12.94	7.11	20.05	.550	.047	.028	-------
26	5	0	20.2	9	37.79	30.47	.66	6.64	1.19	-------	3.0	3.89	18.79	5.33	24.12	.284	.086	.045	-------
Ave., 25–26	3	3	17.7	8	39.28	32.20	1.87	5.95	.99	-------	1.8	3.88	15.87	6.22	22.09	.417	.067	.037	-------

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
27	1957		Alfalfa-cotton		None	Beginning to granulate.	C. M. Bledsoe, Phoenix, Ariz	Maricopa County.
28	1956		Alfalfa-goldenrod	From commercial packed cans, unstrained; only a little goldenrod.	155°	do	E. H. Adee, Sutherland, Nebr	Sutherland.
29	1957	Sept. 16	do	M.S.U. apiary		Partly granulated	E. C. Martin, Lansing, Mich	Ingham County.
30	1957		Alfalfa-honeydew			Granulated	Gene Sanders, Grand Junction, Colo.	Grand Junction.
31	1957		Alfalfa-mesquite		None	Beginning to granulate.	C. M. Bledsoe, Phoenix, Ariz	Maricopa County.
32	1956	July	Alfalfa-sunflower	Slight touch of sunflower (commercial sample very clear).		Liquid	R. L. Blackwell, Oklahoma City, Okla.	Oklahoma City.
33	1956	Aug. 1	Alfalfa-sweet clover.		None	Beginning to granulate.	R. D. Bradshaw & Sons, Wendell, Idaho.	Rupert.
34	1956	Aug. 10	do		do	do	Lawrence Buhmann, Zurich, Mont.	Zurich.
35	1956		do		115°	Partly coarse granulated.	J. W. Holzberlein, Meeker, Colo	White River Valley, near Meeker.
36	1956		Alfalfa-white sweet clover.	95% alfalfa		Granulated	L. R. Budge, Malad City, Idaho	Curlew Valley.
37	1956	October	Alfalfa-sweet clover.		90°	Solid granulation	Cloverdale Apiaries, Manhattan, Mont.	Townsend.
38	1956	September	do	Collected August–September.	140°	Liquid	Al Chenovick, Helena, Mont	Helena.
39	1956	do	do		140° for 1 hr	do	R. A. Bryant, Worland, Wyo	Washakie, Hot Springs and Big Horn Counties.
40	1956	do	do		110° for 1 hr	Solid granulation	Hanson Honey Co., Greybull, Wyo.	Park and Big Horn Counties.
41	1956	do	do		150°	Liquid	Rauchfuss Apiaries, Powell, Wyo	Park County.
42	1956	August	do		None	Granulated	Sterling Johnson, Lovell, Wyo	Big Horn County.
43	1956	do	do	90% alfalfa	do	Solid granulation	Clifford Reed, Ranchester, Wyo	Sheridan County.
44	1956	September	do		90° for 1 hr	do	J. M. Osborn, Buffalo, Wyo	Johnson County.
45	1956	Aug. 1	do		125°	Soft granulation	Howard Foster, Colusa, Calif	Winnet, Mont.
46	1956	Aug. 10	do		140°	Few crystals	Alex Martin, Hardin, Mont	Hardin.
47	1957	Sept. 1	do	60% alfalfa, 30% white sweet clover, 10% yellow sweet clover.	None	Liquid	J. T. McIntire, Fruitdale, S. Dak	Butte County.
48	1957		do	Some yellow sweet clover.	do	Beginning to granulate.	W. R. Thompson, Lander, Wyo	Lander.
49	1957	Sept. 1	do		130°	Crystals	H. W. Pierce, Fairfield, Mont	Teton County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
27	7	5	16.3	7	37.93	35.36	2.27	5.08	0.46	0.43	02.2	04.02	30.75	10.46	41.22	0.340	0.355	0.042	----
28	5	4	16.9	11	37.38	32.77	1.19	6.67	.89	----	4.2	3.82	18.96	8.55	27.51	.452	.066	.037	17.1
29	5	4	18.4	6	39.66	31.85	.92	5.77	.99	----	2.4	3.89	23.49	9.51	33.00	.405	.113	.041	26.9
Ave., 28-29	5	4	17.7	9	38.52	32.31	1.06	6.22	.94	----	3.3	3.85	21.23	9.03	30.26	.429	.090	.039	22.0
30	8	2	15.9	3	37.23	30.02	1.16	7.66	2.66	----	5.4	4.90	34.84	1.20	36.04	.034	.487	.072	----
31	7	4	17.3	7	40.14	32.60	1.69	5.26	.45	.72	1.8	3.88	16.59	9.86	26.45	.594	.143	.034	----
32	4	4	17.4	7	39.39	32.21	1.10	6.45	.72	----	2.8	3.73	20.55	9.32	29.72	.453	.088	.042	17.3
33	1	7	16.2	11	39.82	35.14	.91	5.96	.87	----	1.1	3.79	12.48	5.84	18.32	.468	.048	.021	10.9
34	3	6	16.2	11	36.26	35.45	.90	6.60	1.03	----	3.6	3.90	12.96	4.58	17.53	.354	.049	.025	12.6
35	2	4	15.8	3	40.61	34.62	1.53	5.35	.80	----	1.3	3.81	16.87	7.37	24.24	.436	.063	.047	21.4
36	2	9	14.8	12	40.51	35.53	.50	5.92	.73	----	2.1	4.00	10.40	4.42	14.82	.423	.057	.022	----
37	1	7	17.8	13	38.72	33.41	2.59	5.50	.65	----	1.3	3.78	13.90	6.17	20.07	.444	.067	.030	----
38	1	9	----	10	----	----	----	----	----	----	----	4.12	6.75	2.51	9.25	.372	----	----	3.0
39	4	5	16.0	13	37.81	33.34	4.33	5.85	.79	----	1.9	3.90	13.07	4.87	17.94	.373	.064	.028	2.1
40	1	6	15.1	13	39.14	32.81	2.51	6.84	1.19	----	2.4	3.92	9.16	3.86	13.01	.422	.035	.020	----
42	1	8	15.8	15	38.41	34.13	2.75	5.86	.89	----	2.2	3.90	10.36	4.37	14.73	.422	.033	.020	----
43	2	8	15.1	15	39.80	35.18	1.06	5.96	.73	----	2.2	3.93	9.59	3.65	13.24	.380	.029	.020	----
44	1	5	16.6	14	39.68	35.29	1.77	5.29	.71	----	.7	3.82	11.69	5.34	17.03	.457	.034	.019	----
45	1	9	15.9	15	38.40	32.77	6.54	5.33	.74	.00	.3	4.09	6.50	2.18	8.68	.336	.018	.015	----
46	4	8	----	12	----	----	----	----	----	----	----	3.80	14.66	8.25	22.91	.562	----	----	----
Ave., 33-46	2	7	15.9	12	39.01	34.33	2.31	5.86	.83	----	1.7	3.89	11.41	4.88	16.29	.419	.045	.024	10.0
47	1	3	16.5	5	38.72	33.35	1.75	5.75	.68	.00	3.3	3.80	11.81	2.55	14.36	.216	.026	.019	----
48	1	1	15.7	6	41.00	33.00	1.52	7.02	.82	----	.9	3.80	13.43	2.23	15.66	.166	.049	.019	----
49	1	1	15.8	6	39.55	33.68	4.18	5.44	.77	.00	.6	4.10	9.65	3.11	12.76	.322	.031	.02	10.70

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producers heating, °F.	Condition on receipt	Name and address of producer	Area produced
50	1957	August	Alfalfa-clover		None	Crystals	Joe Barrow, Ekalaka, Mont.	Ekalaka.
51	1957	Sept. 12	Alfalfa-sweet clover.	White and yellow sweet clover.	do	Granulated	Robert VandeHoef, Boyden, Iowa	Sioux County.
52	1957	Aug. 25	do	Water white	120°	Liquid	Jack Holzberlein, Meeker, Colo.	Rio Blanco and Moffat Counties.
53	1957	Aug. 25	do	Extra white	120°	do	do	Do.
54	1957		do		85°	Partly granulated	Walter G. Sagunsky, Sheridan, Mont.	Sheridan.
55	1957		do			Liquid	Gene Sanders, Grand Junction, Colo.	Grand Junction.
56	1957	Aug. 1	do	Some yellow sweet clover.	Mild	Crystals	Charlie G. Miller, Riverton, Wyo.	Fremont County.
57	1957	Aug. 15	do	Produced 7/10–8/15, from irrigated valley.	None	Solid granulation	Lester W. Hall, Livingston, Mont.	Park County.
58	1956	Aug. 15	Alfalfa-yellow sweet clover.	Also rabbit-brush and other weeds.	110°	Complete fine granulation.	S. J. Watkins, Grand Junction, Colo.	Grand Valley.
59	1956		Aster			Granulated	E. M. Miller, Eastwood, Ky.	Eastwood.
60	1956		do			Layer of crystals	Justin Caswell, Middleboro, Mass.	Middleboro.
61	1957	Oct. 10	do			Solid granulation	Andrew McShaw, Transfer, Pa.	Lawrence County.
62	1956		do		155°	Granulated	Robert Vance, Pleasureville, Ky.	Pleasureville.
63	1957		do		None	Solid granulation	do	Do.
64	1957		Aster-natural fall blend.			do	Burt L. Snyder, New Auburn, Wis.	New Auburn.
65	1957	Oct. 1	Aster-goldenrod	Unstrained	do	Soft granulation	Vernon G. Howard, Milwaukee, Wis.	Milwaukee.
66	1957		do			Crystals	Allen D. Brooks, Charlestown, Ind.	Charlestown.
67	1957	Aug. 25	Athel tree		None	Soft granulation	Clarence L. Benson, Phoenix, Ariz.	Salt River Valley, Maricopa County.
68	1957	Sept. 27	do	100% pure	do	Solid granulation	Charles D. Morse, Lakeside, Calif.	Borego Valley, San Diego County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
50	1	1	15.6	8	40.46	32.90	1.96	6.28	0.96	0.00	1.8	4.13	10.77	3.18	13.95	0.295	0.042	.026	17.0
51	2	1	19.8	10	37.52	33.54	.91	5.40	.66		2.2	3.58	20.67	8.05	28.71	.390	.059	.033	
52	1	4	16.1	11	40.09	32.48	.97	6.87	1.02	.62	1.9	3.70	15.72	5.73	21.43	.365	.065	.035	20.0
53	2	1	15.6	11	40.38	29.40	.96	8.92	1.67		3.1	3.92	13.80	3.40	17.21	.246	.077	.036	22.4
54	1	9	15.0	12	40.11	33.95	1.55	7.07	1.32		1.0	3.80	12.34	4.00	16.34	.324	.052	.028	
55	5	4	16.3	13	38.44	33.80	1.36	6.62	.81		2.7	4.10	16.89	5.01	21.90	.297	.122	.045	16.4
56	1	2	17.0	13	38.35	32.64	1.92	7.39	1.06		1.6	3.80	10.26	3.60	13.86	.351	.037	.016	
57	1	7	16.4	16	40.62	32.17	1.61	7.27	1.07		.9	4.02	8.85	.95	9.80	.107	.039	.017	
Ave., 47–57	2	3	16.3	10	39.57	32.81	1.70	6.73	.99		1.8	3.85	13.11	3.80	16.91	.280	.054	.027	17.3
Ave., 33–57	2	5	16.1	11	39.29	33.57	2.00	6.30	.91		1.8	3.87	12.19	4.39	16.57	.355	.050	.026	13.6
58	7	9	14.9	7	40.82	34.76	1.16	5.33	1.08		2.0	4.11	29.45	10.21	39.66	.354	.235	.075	26.5
59	6	1	16.2	12	39.00	31.55	.61	8.53	1.32		2.8	4.75	15.82	2.25	18.07	.142	.196	.031	
60	8	8	17.0	12	37.80	35.53	.75	4.92	1.26		2.7	4.48	19.68	3.46	23.14	.176	.240	.036	
61	6	1	18.6	9	37.73	30.43	.70	8.08	.59		3.9	4.87	19.94	.15	20.09	.008	.373	.043	
62	7	1	17.1	35	36.81	29.94	.97	10.50	1.01		3.7	4.82	18.85	1.20	20.05	.064	.344	.046	
63	6	1	18.0	14	36.42	29.19	1.01	10.22	1.01		4.2	4.60	26.82	3.77	30.59	.141	.358	.058	
Ave., 59–63	7	2	17.4	16	37.55	31.33	.81	8.45	1.04		3.5	4.68	20.22	2.17	22.39	.106	.302	.043	
64	4	1	18.2	14	37.36	29.42	.84	8.80	1.53		3.9	4.38	17.21	3.45	20.66	.201	.174	.046	
65	7	4	18.0	11	38.89	31.63	.55	7.31	.75		2.9	3.70	26.93	8.75	35.68	.325	.108	.084	
66	7	2	18.6	14	38.47	31.62	1.09	6.99	.79		2.4	4.10	31.27	8.19	39.46	.262	.265	.064	
Ave., 65–66	7	3	18.3	13	38.68	31.63	.82	7.15	.77		2.7	3.86	29.10	8.47	37.57	.294	.187	.074	
67	8	7	16.3	13	38.66	36.19	1.81	4.81	.41		1.8	4.10	31.25	2.88	34.13	.092	.370	.056	
68	7	9	14.3	12	40.84	39.11	.78	3.66	.13		1.2	4.09	29.05	8.84	37.89	.304	.240	.069	
Ave., 67–68	8	8	15.3	13	39.75	37.65	1.30	4.24	.27		1.5	4.09	30.15	5.86	36.01	.198	.305	.063	

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
69	1956	Dec. 1	Bamboo, Japanese.	(U. F. Apiary)	None	Liquid	Frank Robinson, Gainesville, Fla.	Gainesville.
70	1956	July	Basswood		135°	do	H. R. Swisher, Springfield, Ohio	Clark County.
71	1956	do	do		"Very low"	do	J. H. Lindner, Cumberland, Md.	Maryland and West Virginia.
72	1957	do	do	Nearly pure limestone hill area.	None	Solid granulation	H. A. Schaefer, Osseo, Wis.	Southern Trempealeau County.
73	1957	Aug. 11	Basswood-catnip.	From a wooded area.	130° for 15 min.	Liquid	Charles B. Crispin, Grimes, Iowa.	Kingman, Polk County.
74	1956	October	Basswood-clover	Strained	120°	do	Paul G. Cummins, Conshohocken, Pa.	Pine Forge.
75	1956	do	do		None	Granulated	H. A. Schaefer, Osseo, Wis.	Osseo.
76	1956	do	do		do	do	do	Winona County, Minn.
77	1957	Aug. 15	do	Strained	100°	Soild granulation	Harry Stewart, Winnebago, Minn.	Fairbault, Blue Earth & Martin Counties.
78	1957		Basswood-sweet clover.			Granulated	Elmer E. Viklo, Lonsdale, Minn.	Lonsdale.
79	1956	August	Bean, Lima	Strained 80 mesh	130°	Liquid	Charles Johnson, Empire Calif.	Stanislaus County.
80	1957		do	Strained	To melt	do	Paul Jaun, Dos Palos, Calif.	Merced County.
81	1957	Sept. 5	Bean, Lima-heartsease.	Produced 8/15–9/5; strained.	100°	Soft granulation	Harry Stewart, Winnebago, Minn.	Fairbault, Blue Earth & Martin Counties.
82	1956	Aug. 28	Bean, pea-sweet clover.	Beans, 80%; sweet clover, 10%; wildflowers, mostly goldenrod, 10%.	None	Beginning to granulate.	George J. Lengst, Tuscola, Mich.	Tuscola.
83	1957		Bergamot	From unfinished combs; nearly pure.	do	Crystals	Thomas A. Ott, Columbia City, Ind.	Noble County.
84	1956	May	Blackberry	(Gallberry flavor)	do	Liquid	J. H. Girardeau, Jr., Tifton, Ga.	Tift County.
85	1956	June 2	do		do	Partly granulated	Arthur G. Strang, Silver Spring, Md.	Gaithersburg.
86	1956	May	do			Liquid	Leonard M. Llewellyn, Laurel, Md.	Prince Georges County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
69	6	1	19.1	8	35.58	29.27	0.65	9.80	1.95	--------	3.7	4.08	20.42	4.67	25.09	0.229	0.142	0.054	20.8
70	5	5	17.4	15	38.60	32.83	1.73	5.44	1.04	--------	3.0	3.92	20.62	8.19	29.81	.396	.110	.023	--------
71	5	1	17.0	15	36.99	30.12	.63	8.02	1.87	--------	5.4	4.28	17.84	7.89	25.74	.441	.068	.024	--------
72	1	2	17.9	16	38.04	31.83	1.25	7.12	1.40	.00	2.5	4.01	11.89	3.66	15.55	.308	.074	.020	--------
Ave., 70–72	4	3	17.4	15	37.88	31.59	1.20	6.86	1.44	--------	3.6	4.05	16.78	6.58	23.70	.382	.084	.022	--------
73	4	2	19.1	9	39.25	33.50	.92	5.15	.66	--------	1.4	3.63	27.05	8.49	35.54	.314	.119	.041	30.9
74	7	0	17.4	10	35.83	29.36	.93	6.80	2.62	--------	7.1	3.93	27.28	8.63	35.91	.316	.169	.053	30.9
75	3	4	18.2	12	37.42	32.91	.34	5.83	1.51	--------	3.8	4.02	18.68	8.12	26.80	.434	.144	.024	20.7
76	2	4	19.0	12	37.02	32.83	.38	5.91	1.21	--------	3.7	3.80	21.06	8.84	29.90	.418	.096	.026	--------
77	4	1	19.3	13	37.57	31.41	.47	6.49	1.18	--------	3.6	3.90	18.27	6.55	24.82	.359	.134	.037	--------
Ave., 74–77	4	2	18.5	12	36.96	31.63	.53	6.26	1.63	--------	4.6	3.91	21.32	8.04	29.36	.382	.136	.035	25.8
78	2	1	20.2	11	37.28	32.14	.56	6.25	.83	--------	2.7	3.80	16.74	7.14	23.88	.427	.091	.027	--------
79	1	7	15.0	13	38.87	33.18	4.43	5.35	.95	--------	2.2	3.69	17.58	10.23	27.81	.586	.037	.024	16.0
80	4	4	15.5	14	39.29	33.02	1.90	6.53	.89	--------	2.9	3.81	18.22	6.60	24.82	.362	.105	.040	--------
Ave., 79–80	3	6	15.3	14	39.08	33.10	3.17	5.94	.92	--------	2.6	3.75	17.90	8.42	26.32	.474	.071	.032	--------
81	4	3	19.7	12	38.22	31.14	.85	6.27	.90	--------	2.9	3.70	22.53	6.25	28.78	.277	.085	.057	--------
82	6	4	18.3	11	36.67	33.54	.70	5.12	2.01	--------	3.7	4.03	34.09	11.68	45.77	.344	.211	.058	25.9
83	7	1	17.0	13	39.96	30.99	.77	6.30	1.53	--------	3.4	3.75	27.86	12.55	40.41	.451	.139	.065	--------
84	4	0	16.6	10	41.28	27.84	1.19	8.47	1.57	--------	3.1	4.10	13.43	3.96	17.35	.294	.166	.033	--------
85	10	0	16 1	15	36.07	25.64	1.84	11.43	3.19	.00	5.7	5.00	31.68	1.27	32.95	.040	.468	.069	14.0
86	10	0	16.4	18	35.57	24.33	.78	14.09	2.75	--------	6.1	5.25	37.00	.07	37.07	.002	.562	.062	--------
Ave., 84–86	8	0	16.4	14	37.64	25.94	1.27	11.33	2.50	--------	5.0	4.50	27.37	1.76	29.11	.112	.399	.055	--------

See footnote at end of table.

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TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
87	1956	June	Blackberry-tulip tree.		160°	Liquid	Brother Patrick, Ammendale, Md.	Ammendale.
88	1956		do		Yes	do	Harold L. Kelly, Silver Spring, Md.	Montgomery County.
89	1956	July	Natural Spring blend.	Wild flowers, no clover.	None	do	Otto Aiple, St. Louis, Mo	Crawford County.
90	1956		do	In comb	do	do	Stephen Jurash, Elizabeth City, N.C.	Pasquotank County.
91	1957	July 9	do		do	do	Everett E. Fields, Bristol, R.I.	Bristol.
92	1957	July 20	do		do	do	Alice Quinn, Providence, R.I.	Providence.
93	1957	July 13	do		do	do	Percy W. McIntosh, Lakewood, R.I.	Lakewood.
94	1957	July 13	do		do	do	do	Gaspee Area.
95	1957	June 28	do		do	Crystals	Mrs. Rana B. Walker, Edgewood, R.I.	Edgewood.
96	1957	June 30	do		do	Liquid	Robert Murray, Warwick, R.I.	Warwick.
97	1957	July 8	do	Fruit blossoms	None	do	H. J. Andrews, Bristol, R.I.	Bristol.
98	1957	July 12	do		do	do	Walter Starzak, N. Smithfield, R.I.	North Smithfield.
99	1957	June 21	do	Cherry, pear, peach, dandelion, alfalfa & rose.		do	Porter H. Evans, Morristown, N.J.	Mendham Township, Morris County.
100	1956	Aug. 15	Natural summer blend.		None	do	J. R. Hepler, Durham, N.H.	Strafford County.
101	1956		do		150°	do	E. C. Bessonet, Donaldsonville, La.	Donaldsonville.
102	1956		do	Hairy vetch, wild flowers, alfalfa & sweet clover (A&M apiary).		do	G. A. Bieberdorf, Stillwater, Okla.	Stillwater.
103	1956	August	do	Unstrained	None	Solid granulation	F. W. Schwoebel, Philadelphia, Pa.	Morris Arboretum, Montgomery County.
104	1956	Sept. 14	do		Below 100°	Liquid	James J. Sullivan, Minneapolis, Minn.	Le Center.
105	1957		do	Unstrained	None	do	Albert Bochmann, Downington, Pa.	Downingtown.
106	1957	July 7	do		do	do	Kenneth Bowen, Bristol, R.I.	Bristol.
107	1957		do		140°		Carl J. Manfred, Jr., Westerly, R.I.	Westerly.
108	1957	July 12	do		120°	Liquid	Gaston Levitre, Woonsocket, R.I.	Woonsocket.
109	1957	July 10	do		130°	do	Steve Abrants, Woonsocket, R.I.	Do.
110	1957	Aug. 10	do		None	do	H. E. Werner, Swanwyck, Del.	New Castle County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
87	10	1	17.1	17	35.46	27.09	0.92	7.96	4.40	--------	7.1	4.65	34.61	2.80	37.41	0.081	0.187	0.074	--------
88	9	1	17.3	16	35.95	27.49	.58	10.91	2.72	--------	5.0	4.80	28.58	2.55	31.13	.089	.400	.053	--------
Ave., 87–88	10	1	17.2	17	35.71	27.29	.75	9.44	3.56	--------	6.1	4.72	31.60	2.68	34.27	.085	.294	.064	--------
89	8	1	19.6	12	37.88	28.73	.69	7.39	1.13	--------	4.6	3.98	40.50	11.76	52.26	.290	.301	.072	42.3
90	6	1	16.2	16	41.77	31.07	2.20	6.68	1.01	--------	1.1	4.03	18.71	7.31	26.02	.391	.115	.029	10.3
91	6	2	16.6	21	35.71	30.17	.91	9.45	1.49	--------	5.1	4.11	27.07	12.39	39.46	.458	.398	.048	38.0
92	6	1	--------	26	--------	--------	--------	--------	--------	--------	--------	4.15	21.66	5.32	26.98	.246	--------	--------	38.7
93	6	6	16.8	6	39.30	32.39	.37	6.15	1.49	--------	3.5	4.48	18.04	4.66	22.70	.258	.286	.019	--------
94	6	0	16.6	22	36.58	28.83	.91	10.61	1.48	--------	5.0	4.51	15.78	2.62	18.40	.166	.300	.053	19.1
95	6	4	--------	1	--------	--------	--------	--------	--------	--------	--------	4.08	22.56	8.75	31.31	.387	--------	--------	--------
96	8	2	14.2	23	35.96	26.31	1.03	13.61	2.14	--------	6.7	4.30	23.90	9.21	33.11	.385	.363	.069	27.8
97	4	4	--------	2	--------	--------	--------	--------	--------	--------	--------	3.67	20.13	8.08	28.21	.401	--------	--------	9.0
98	7	1	16.8	22	36.48	27.27	1.18	11.71	1.97	--------	4.6	4.09	26.63	10.39	37.02	.390	.377	.068	21.7
99	8	0	16.4	16	33.79	27.23	1.12	11.97	3.43	.58	5.5	4.34	29.66	4.32	33.99	.146	.340	.059	27.3
Ave., 89–99	6	2	16.7	14	37.18	29.00	1.05	9.70	1.77	--------	4.5	4.09	23.79	7.65	31.44	.321	.310	.052	26.0
100	8	0	15.5	10	38.83	31.14	.91	7.45	3.55	--------	2.4	4.10	25.96	8.59	34.55	.330	.195	.049	20.0
101	9	2	18.4	9	38.95	32.69	1.07	7.02	.95	--------	.9	3.89	25.08	9.18	34.26	.366	.132	.046	15.4
102	9	4	16.8	16	39.72	31.72	.80	7.19	.86	.00	2.9	3.85	33.27	11.05	44.31	.333	.145	.059	--------
103	6	1	17.2	16	36.85	28.98	.50	9.00	1.59	--------	5.9	4.59	25.71	1.97	27.68	.077	.361	.043	20.0
104	5	1	17.2	28	38.75	31.66	.98	8.95	1.32	--------	1.1	4.02	13.68	4.43	18.11	.324	.107	.032	10.8
105	5	0	17.4	5	38.22	29.92	.47	8.53	1.55	--------	3.9	4.12	17.93	4.15	22.08	.232	.154	.013	--------
106	8	5	14.7	6	37.66	33.73	.82	5.79	.99	--------	6.3	4.32	17.04	4.38	21.42	.256	.291	.023	--------
107	6	0	--------	26	--------	--------	--------	--------	--------	--------	--------	4.58	24.88	2.18	27.04	.088	--------	--------	21.4
108	8	0	17.4	6	34.51	28.70	.88	8.42	2.44	.00	7.7	4.42	20.88	4.45	25.33	.213	.319	.045	20.0
109	7	1	--------	26	--------	--------	--------	--------	--------	--------	--------	4.02	26.45	7.68	34.13	.290	--------	--------	12.5
110	9	0	17.0	5	37.06	29.63	.87	8.68	1.30	--------	5.5	4.28	26.44	6.25	32.69	.236	.275	.041	--------

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
111	1957		Natural summer blend-honeydew.	Tulip tree, sumac, honeydew.	None	Liquid	Bruce Anderson, Chatham, Va.	Chatham.
112	1957		Natural summer blend.	Tulip tree, W. clover, sumac, honeydew.	do	do	do	Chatham.
113	1957	Aug. 1	do	Mountain flowers	130° for 20 min., 22" vacuum.	do	W. E. Lyman, Greenwich, N.Y.	Hamilton County.
114	1957	Aug. 1	do	Mountain flowers	None	do	do	Hamilton County.
115	1957	Summer	do	Wild flowers		do	J. O. Sherfy, Gravette, Ark.	Benton County.
116	1957	Aug. 15	do		Slightly		D. G. Greenler, Toledo, Ohio	Sandusky and Wood Counties.
117	1957	September	do	Sweet and other clovers; mixed flowers Unstrained.	None	Solid granulation	W. S. Sundberg, Fergus Falls, Minn.	Ottertail County.
118	1957	do	do	Sweet and white clover; mixed flowers.	do	do	do	Do.
119	1957	July	do	Cotton, clover, mesquite; typical summer honey.	Mild	Liquid	O. L. Tolman, Cotulla, Tex.	Maverick County.
120	1957	Aug. 28	do	Clover, basswood alfalfa, goldenrod & boxelder honeydew no surplus after early Aug.		Soft granulation	Carroll E. Stone, Hutchinson, Minn.	McLeod County.
121	1957		do		Below 100°	Liquid	James J. Sullivan, Minneapolis, Minn.	Le Center.
122	1956	Mid-September.	do	Wild raspberry white clover, fall chickweed.		Crystals	Richard H. Washburn, Palmer, Alaska.	Palmer.
123	1957	do	do	do		do	do	Do.
124	1957		do	Clovers & July woods flowers.	160° for 20 min.	Granulated	M. J. Ambrose, Winslow, Me.	Kennebec Valley.
125	1956	Feb. 1957	Natural summer and fall blends.	Gailberry, Spanish needle & palmetto.		Liquid	Millard Coggshall, Minneola, Fla.	South Lake County.
126	1956		Fall blend	Sp. needle, heartsease, goldenrod, aster from strip coal mine.	130°	do	L. M. Leiper, Belleville, Ill.	Belleville.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
111	10	0	15.3	5	33.66	25.07	1.15	11.33	4.05	0.00	9.4	5.30	32.55	3.87	33.42	0.027	0.615	0.042	27.8
114	6	2	17.1	9	40.68	31.65	.91	7.08	1.33	-------	1.2	3.90	25.63	7.66	33.29	.299	.183	.036	13.6
116	4	1	17.9	14	38.47	32.65	2.34	5.97	1.14	.79	.7	3.70	22.73	9.90	32.63	.436	.077	.045	16.2
117	1	4	17.5	15	38.13	33.38	1.93	5.78	.97	-------	2.3	3.83	14.17	4.52	18.69	.319	.059	.025	-------
118	2	1	17.9	15	37.87	32.93	.83	6.21	1.26	.66	2.3	3.95	16.88	6.02	22.70	.368	.104	.027	-------
119	5	6	18.0	18	38.42	34.60	1.58	6.33	.69	-------	.4	3.82	25.72	11.15	36.54	.434	.104	.024	-------
120	3	2	17.8	17	38.98	32.94	1.43	6.47	1.32	.00	1.1	4.10	13.09	3.05	16.14	.233	.098	.026	-------
121	2	2	20.4	16	38.00	32.08	.96	7.39	1.10	-------	.1	3.79	16.89	4.20	21.09	.249	.075	.040	22.6
122	6	1	16.6	30	38.79	29.31	.97	9.59	2.17	-------	2.6	4.05	12.42	2.95	15.37	.238	.065	.032	-------
123	4	1	14.4	18	39.59	31.22	.75	9.86	2.67	-------	2.2	4.10	13.78	4.95	18.72	.360	.101	.033	-------
124	7	5	18.8	27	35.70	33.90	1.98	5.88	2.32	.00	1.4	4.10	24.11	4.82	28.93	.200	.180	.067	-------
Ave., 100-124	6	2	17.2	15	37.94	31.40	1.11	7.65	1.68	-------	3.0	4.03	21.60	5.65	27.23	.269	.182	.037	18.2
125	9	0	17.8	11	37.79	29.69	1.22	8.43	1.21	-------	3.9	3.89	31.63	14.28	45.91	.451	.221	.053	6.8
126	8	0	16.7	17	39.13	29.16	.76	9.54	.62	-------	4.1	4.95	19.92	.27	20.18	.014	.361	.048	19.4
Ave., 125-126	9	0	17.3	14	38.46	29.43	.99	8.99	.92	-------	4.0	4.15	25.78	7.28	33.05	.233	.291	.051	13.1

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
127	1956	Late September.	Natural season blend.	Nearly everything		Liquid	L. C. Lueddecke, St. Louis, Mo.	South St. Louis.
128	1956	October	do		150° for 20 min	do	F. R. Buchanan, Whitemarsh, Pa.	Whitemarsh.
129	1956		Natural season blend.	Unstrained		Partly granulated	H. C. Walden, Tulsa, Okla.	Tulsa County.
130	1956	Oct. 5	do	Alfalfa, yellow star thistle, tarweed, blue curl.	120°	Liquid	Jess Gentry, Oakdale, Calif.	Stanislaus County.
131	1956		do		None	Granulated	H. A. Schaefer, Osseo, Wis.	Osseo.
132	1956	Late October	do		do	do	Paul S. Zeigler, Bethel, Pa.	Bethel.
133	1956	Oct. 1956	do		120°	Liquid	Clarence Munroe, E. Providence, R.I.	East Providence.
134	1956	Nov. 1956	do	Dandelion, tulip tree, alfalfa, alsike clover, sumac.	100° for 18 hr	do	Paul L. Holcombe, Lambertville N.J.	Lambertville area.
135	1957	Sept. 15	do	Sweet clover alfalfa, wild flowers and Canada thistle.		Partly granulated	Wallace Irving, Bonners Ferry, Idaho.	Boundary County.
136	1957	November	do			Liquid	N. B. Cook, Collegeville, Pa.	Collegeville.
137	1956		Natural blend		150°	do	E. C. Bessonet, Donaldsonville, La.	Donaldsonville.
138	1956		do			do	G. V. Palmrose, Beaverton, Oreg.	Tualatin Valley.
139	1956		do		142° for 30 min	Coarse granulation	A. R. Dean, Pittsburgh, Pa.	Pittsburgh.
140	1956	Fall	do		130°	Crystals	B. M. Bosworth, Barrington, R.I.	Barrington.
141	1956		Natural blend	Swamp sources	None	Granulated	Wm. W. Wicht, Hattiesburg, Miss.	Hattiesburg.
142	1957		do			Liquid	Howard Day, Honesdale, Pa.	Honesdale.
143	1957		do		None	Crystals	Cecil E. Keiter, Monette, Ark.	Monette.
144	1957	April 15	do	Desert blend		Few crystals	E. S. Foote, Poway, Calif.	North West Anza Desert, San Diego County.
145	1957		do			Granulated	Roy D. Brown, Del Rio, Tenn.	Del Rio.
146	1957	November	do			Soft granulation	N. B. Cook, Collegeville, Pa.	Schwenksville.
147	1956		Blueberry			Granulated	Walter Witherell, Westhampton, Mass.	Westhampton.
148	1957		Blueberry–huckleberry.	Early honey		Partly granulated	Frank Fekel, Vineland, N.J.	Hammonton.
149	1956	September	Blue curls		None	Granulated	L. G. Gear, Los Banos, Calif.	Los Banos.
150	1957	do	Bluevine	From crushed virgin combs. (Has a dense turbid layer on top)	do	Soft granulation	Carl Kalthoff, Lexington, Mo.	Lafayette and Saline Counties.
151	1957	August	Boneset			Few crystals	M. V. Coggshall, Minneola, Fla.	Hendry County.
152	1956	Sept. 1	Buckwheat			Liquid	James S. Messner, Bareville, Pa.	Tioga County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisturs	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
127	10	1	15.8	10	39.79	29.91	1.05	7.51	2.30	-------	3.6	4.01	33.98	11.67	45.65	0.344	0.188	0.133	39.0
128	7	1	21.8	8	35.52	29.48	.49	7.09	1.32	-------	4.3	3.88	28.49	7.82	36.31	.275	.200	.060	22.4
129	6	2	19.0	10	37.42	30.69	1.03	6.68	1.44	-------	3.7	3.81	29.22	9.12	38.35	.312	.156	.054	15.0
130	5	9	16.2	11	38.47	34.41	1.02	6.05	1.10	-------	2.7	4.10	23.60	14.80	38.40	.627	.159	.052	27.0
131	5	5	18.3	11	39.59	33.53	.53	5.03	1.15	-------	1.9	3.85	25.88	10.56	36.44	.406	.135	.042	33.3
132	9	1	18.6	12	34.25	28.16	.88	7.84	4.08	-------	6.2	4.16	39.22	7.87	47.09	.200	.084	.027	-------
133	7	1	-------	10	-------	-------	-------	-------	-------	-------	-------	4.23	21.13	6.96	28.09	.328	-------	-------	8.3
134	10	1	17.4	14	33.25	28.50	.92	10.63	2.27	-------	7.0	4.68	36.41	3.00	39.41	.082	.447	.053	22.2
135	4	3	13.4	8	39.88	31.98	3.21	7.81	1.41	.00	2.3	3.85	13.79	2.30	16.09	.167	.054	.025	-------
136	10	0	18.5	11	32.46	29.59	1.11	8.00	3.24	.75	6.4	4.05	39.88	7.92	47.80	.199	.447	.099	24.0
Ave., 127–136	7	2	17.7	11	36.74	30.69	1.14	7.40	2.03	-------	4.2	4.01	29.16	8.20	37.36	.294	.208	.061	23.9
137	8	1	18.5	12	36.08	30.40	.84	8.42	1.32	-------	4.8	4.21	25.20	7.23	32.43	.287	.309	.049	25.2
138	9	0	15.2	12	28.98	23.58	1.36	15.55	6.36	.70	8.3	4.36	36.57	7.33	43.90	.201	.472	.065	37.5
139	8	4	-------	10	-------	-------	-------	-------	-------	-------	-------	4.08	28.80	9.14	37.94	.317	-------	-------	30.0
140	8	3	-------	9	-------	-------	-------	-------	-------	-------	-------	3.96	23.59	9.65	33.24	.408	-------	-------	-------
141	8	1	18.0	33	38.13	29.69	.67	8.86	1.34	.40	2.9	4.54	15.71	1.88	17.60	.120	.183	.045	-------
142	3	1	-------	1	-------	-------	-------	-------	-------	-------	-------	3.88	14.98	5.68	20.66	.379	-------	-------	25.5
143	4	5	19.0	7	38.38	32.55	.79	5.41	1.13	-------	2.7	4.10	27.83	6.52	34.36	.234	.230	.043	27.9
144	4	2	17.3	15	41.50	30.46	.64	6.61	.95	.81	1.7	3.60	24.62	10.15	34.77	.412	.114	.058	30.9
145	9	1	-------	19	-------	-------	-------	-------	-------	-------	-------	3.99	30.51	8.70	39.21	.285	-------	-------	-------
146	10	1	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	.490	.092	-------
Ave., 137–146	7	2	17.6	13	36.61	29.34	.86	8.97	2.22	-------	4.1	4.01	25.31	7.36	32.68	.294	.300	.059	29.5
147	8	2	17.4	16	37.20	31.08	.79	9.09	.83	-------	3.6	4.36	16.36	4.92	21.29	.301	.163	.059	-------
148	9	0	17.9	9	38.52	29.89	.75	8.23	1.07	-------	3.6	4.05	34.40	11.10	45.49	.323	.271	.024	-------
149	5	9	16.1	11	30.91	40.75	1.34	5.54	1.13	-------	4.2	3.60	28.10	13.73	41.83	.489	.097	.044	-------
150	4	0	16.1	16	35.35	28.34	2.63	7.20	5.30	.35	4.7	3.90	15.84	6.99	22.83	.441	.103	.040	-------
151	8	1	20.6	16	40.01	28.65	1.00	6.68	1.03	-------	2.0	4.00	32.45	7.20	39.66	.222	.142	.119	25.6
152	12	9	16.2	12	37.05	33.38	.57	5.69	1.18	-------	5.9	3.98	46.29	7.94	54.23	.172	.118	.124	46.2

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
153	1956		do	In comb	None	Partly granulated	L. W. Sundberg, Richville, Minn.	Richville, Ottertail County.
154	1956	September	do		135°	Liquid	H. R. Swisher, Springfield, Ohio	Clark County.
155	1956	August	do			do	Leonard M. Llewellyn, Laurel, Md.	Garrett County.
156	1957	Sept. 2	do		None	Partly granulated	Mrs. Phil Chaffin, St. Cloud, Minn.	Sherburne County.
157	1956		Buckwheat-goldenrod.		"Very low"	Few crystals	J. H. Lindner, Cumberland, Md.	Garrett County.
158	1956	July 25	Buckwheat, wild	Strained	110°	Partly granulated	William Ross, Valyermo, Calif.	Los Angeles County.
159	1956		do		None	do	R. W. Taylor, Alhambra, Calif.	Soledad Canyon.
160	1956	July	do		140°	Granulated	Hood Littlefield, Pasadena, Calif.	Inyo County.
161	1957	July 1	do			do	E. S. Foote, Poway, Calif.	San Diego County.
162	1957		Buckwheat, wild avocado.			Crystals	C. L. Morris, Vista, Calif.	Do.
163	1957	June	Cantaloupe	Unstrained	None	Liquid	J. Herman Larkin, Laredo, Texas.	Laredo.
164	1957		Cape vine			do	A. T. Uzzell, Moore Haven, Fla.	Moore Haven.
165	1956		Carrot, wild-clover.	Core sample 60 # cans, 56–60° storage.	None	Granulated	H. J. Moulton, Portland, Oreg.	North Willamette Valley.
166	1956		Cherry, wild-privet.			Liquid	L. H. Little, Shelbyville, Tenn.	Shelbyville.
167	1956		Chinquapin	In comb	None	do	Wilbur Murray, Lake City, Fla.	Lake City.
168	1956	September	do	do	do	do	C. G. Wenner, Glenn, Calif.	Mt. Lassen, 5,500–7,000 ft.
169	1957	do	do	Elevation 6,000 ft	120°	Solid granulation	do	Mt. Lassen area, Shasta County.
170	1956		Clover, alsike	Drained from chunk comb.	None		Robert Banker, Cannon Falls, Minn.	Cannon Falls.
171	1956	July	do		135°	Liquid	H. R. Swisher, Springfield, Ohio	Madison County.
172	1957		do	6,500 ft. elevation		Granulated	S. J. Watkins, Fruita, Colo.	Steamboat Springs.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
153	8	2	17.8	12	35.26	28.54	0.77	6.92	4.51	----	6.2	4.17	32.73	8.79	41.52	0.268	0.307	0.030	31.6
154	12	1	19.0	14	37.06	31.09	1.41	7.51	1.03	----	2.9	3.93	32.17	8.38	40.55	.260	.158	.031	----
155	10	0	15.4	15	30.81	23.94	.61	11.41	3.85	----	14.0	4.38	38.18	4.42	42.60	.158	.472	.050	----
156	7	0	22.9	8	36.30	30.33	.56	6.62	.77	----	2.5	3.70	26.00	5.41	31.41	.208	.066	.083	----
Ave., 152–156	10	2	18.3	12	35.30	29.46	.78	7.63	2.27	----	4.3	3.97	35.07	6.99	42.06	.213	.224	.064	38.9
157	12	6	18.4	13	38.22	33.91	.66	4.88	1.01	----	2.9	3.99	39.09	8.15	47.24	.208	.226	.030	----
158	6	1	15.7	13	39.15	30.79	.89	8.49	.91	----	4.1	4.08	22.77	6.80	29.57	.298	.232	.058	33.0
159	5	4	16.1	14	41.30	29.96	.87	6.69	.97	----	4.1	3.88	26.50	4.95	31.45	.186	.088	.048	25.0
160	6	5	15.7	14	39.74	32.21	.84	6.15	.72	----	4.6	4.04	23.18	4.70	27.88	.202	.082	.043	----
161	6	2	17.5	12	38.67	29.02	.57	7.52	.71	----	6.0	3.71	28.53	10.87	39.40	.381	.143	.067	----
Ave., 158–161	6	3	16.3	13	39.72	30.50	.79	7.21	.83	----	4.7	3.90	25.25	6.83	32.08	.267	.136	.054	29.0
162	8	1	17.7	16	37.72	28.11	.91	9.61	1.24	----	4.7	4.01	37.45	8.25	45.70	.220	.295	.094	----
163	7	8	15.4	11	37.00	34.51	2.85	5.41	1.10	.00	3.7	3.80	31.28	10.20	41.57	.326	.203	.021	8.1
164	5	4	22.3	6	36.05	31.61	.45	5.18	.59	----	3.5	3.93	22.28	6.61	28.89	.298	.119	.017	24.0
165	9	7	16.4	31	33.96	30.47	1.02	11.15	3.04	----	4.0	4.20	31.66	10.43	42.09	.329	.378	.060	----
166	4	2	16.6	9	37.40	32.15	1.77	6.93	1.62	----	3.5	4.02	15.24	5.90	21.14	.387	.130	.038	15.0
167	11	0	17.3	9	34.79	22.04	1.18	15.98	1.72	----	7.0	5.26	19.47	3.71	23.18	.190	.943	.017	19.0
168	10	0	14.5	12	31.67	21.78	.71	10.71	8.49	----	12.1	5.22	23.97	1.25	25.22	.052	.721	.031	31.6
169	10	4	15.6	16	34.43	27.96	.77	10.13	4.17	----	6.9	4.65	42.27	5.11	47.38	.121	.618	.107	----
Ave., 167–169	10	1	15.8	12	33.63	23.93	.89	12.27	4.79	----	5.3	4.95	28.57	3.36	31.93	.121	.761	.052	25.3
170	4	2	16.6	12	38.37	31.03	1.53	7.59	1.58	----	3.3	3.86	17.91	10.06	27.97	.562	.090	.032	17.6
171	3	1	18.2	16	39.09	33.09	1.70	5.94	.95	----	1.0	3.73	17.57	7.72	25.29	.439	.049	.017	----
172	1	1	15.6	11	40.07	28.03	.98	8.84	2.13	----	4.3	3.91	11.97	3.80	15.77	.318	.062	.027	----
Ave., 170–172	3	1	16.8	13	39.18	30.72	1.40	7.46	1.55	----	2.9	3.83	15.82	7.19	23.01	.440	.067	.025	----

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
173	1957	Sept. 1	Clover, alsike-alfalfa.	Unstrained; some ladino clover.	None	Solid granulation	Oliver Petty, Albany, Oreg	Jefferson County.
174	1957		Clover, alsike-sweet clover.	From river valley	do	Liquid	W. H. Freeman, Ft. Covington, N.Y.	Near St. Lawrence River.
175	1957		Clover, alsike-white clover.		do	Crystals	Thomas A. Ott, Columbia City, Ind.	Noble County.
176	1956	May	Clover, crimson	Reseeding		⅛" crystals	J. H. Girardeau, Jr., Tifton, Ga	Dougherty County.
177	1956		do		None	Liquid	Allen Bostick, Quincy, Fla	Quincy.
178	1957	May	do			do	J. H. Girardeau, Jr., Tifton, Ga	Albany, Dougherty County.
179	1957		do	In comb	None	Liquid	Wm. W. Wicht, Hattiesburg, Miss.	Hattiesburg.
180	1956		Clover, crimson-gallberry.	Also some vetch	do	Crystals	do	Do.
181	1957	Summer	Clover, crimson-hop clover.			Liquid	J. O. Sherfy, Gravette, Ark	Benton County.
182	1957		Clover, crimson-tulip tree.			do	John Bean, Leoma, Tenn	Leoma.
183	1957	June 12	Clover, hubam	Unstained early crop rainy season.	None	do	Roy S. Weaver, Jr., Navasota, Texas.	College Station, Brazos County.
184	1957	July 1	do	Unstrained midseason dry season.	do	do	do	McGregor, McLennan County.
185	1957	July 31	do	Strained	do	Crystals	Emilian Mensick, LaGrange, Texas.	Fayette County.
186	1956	June 15	Clover, hubam-natural spring blend.	Salt cedar, arrow weed	120°	Granulated	Melvin Beatty, Westmorland, Calif.	North end, Imperial Valley.
187	1957		Clover, red-birds foot trefoil.	WSC Apiary, Montgomery clover.		Soft granulation	Carl Johansen, Pullman, Wash	Pullman.
188	1957	July 15	Clover, strawberry-white clover.	About 90% strawberry clover.		Solid granulation	Charles G. Becker, Outlook, Wash.	Yakima Valley.
189	1956		Clover, sweet	Unstrained		Liquid	Lynn H. Beard, Tulsa, Okla	Tulsa County
190	1956	July	Clover, sweet	In comb	None	do	Leonard M. Llewellyn, Laurel, Md.	McCook, Allegany County.
191	1956		do	From strip coal mine	130°	do	L. M. Leiper, Belleville, Ill	Belleville.
192	1956	July	do		None	do	Arthur G. Strang, Silver Spring, Md.	Fauquier County, Va.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
173	5	9	15.6	17	38.71	33.88	1.69	7.05	0.85	--------	2.2	3.75	29.39	11.30	40.69	0.385	0.087	0.076	--------
174	1	2	15.6	6	37.16	30.14	4.37	7.35	1.99	.00	3.4	3.88	10.13	4.34	14.47	.428	.034	.021	18.2
175	4	4	18.2	13	38.25	33.58	1.68	5.50	.82	--------	2.0	3.40	28.26	14.36	42.62	.508	.081	.047	--------
176	4	4	19.1	14	39.02	32.81	.73	6.26	1.14	--------	.9	3.83	20.64	7.49	28.13	.364	.080	.036	18.2
177	3	1	17.4	13	36.72	29.31	.85	10.27	1.43	--------	4.0	3.80	13.73	6.93	20.66	.506	.056	.030	24.0
178	1	0	15.8	10	39.66	30.46	.77	9.22	1.68	--------	2.4	3.73	15.40	5.35	20.75	.347	.040	.027	31.9
179	1	1	17.2	22	37.45	30.90	1.29	8.61	2.26	--------	2.3	3.63	12.81	4.38	17.19	.342	.050	.021	16.7
Ave., 176–179	2	2	17.4	15	38.21	30.87	.91	8.59	1.63	--------	2.4	3.74	15.65	6.04	21.68	.390	.057	.029	22.7
180	3	3	18.4	31	37.39	31.51	.86	8.77	1.66	.72	.7	3.71	12.17	3.02	15.19	.248	.035	.037	--------
181	4	0	19.9	10	36.94	32.90	1.96	4.94	1.25	.00	2.1	3.42	30.67	15.37	46.04	.501	.079	.050	19.4
182	8	0	18.0	15	35.30	22.89	1.04	14.94	3.01	.00	4.8	4.71	20.51	2.82	23.36	.138	.449	.031	17.6
183	1	2	19.8	6	38.96	32.65	.62	5.18	.58	--------	2.2	3.78	19.15	8.46	27.61	.442	.096	.004	--------
184	1	3	17.7	5	39.65	33.99	.86	5.99	.74	--------	1.1	3.91	13.65	5.06	18.71	.369	.059	.011	--------
185	4	5	17.0	13	37.45	33.63	1.09	7.51	.91	--------	2.4	3.80	24.06	13.30	37.36	.553	.120	.037	--------
Ave., 183–185	2	3	18.2	8	38.69	33.42	.86	6.23	.74	--------	1.9	3.83	18.95	8.94	27.89	.455	.092	.017	--------
186	7	9	15.2	14	39.26	34.40	2.01	6.11	.70	--------	2.3	3.97	21.64	8.37	30.01	.385	.126	.058	--------
187	1	2	16.8	14	38.81	30.83	.68	8.84	1.08	--------	3.0	3.99	11.79	2.56	14.35	.217	.063	.030	--------
188	6	5	17.6	18	39.88	33.86	1.59	5.60	.91	--------	.6	3.65	31.98	14.80	46.77	.463	.087	.051	--------
189	5	1	17.8	9	38.63	30.12	1.01	8.17	1.94	--------	2.3	3.88	22.71	6.85	29.56	.301	.073	.052	18.8
190	4	0	17.3	16	36.59	26.36	.73	12.90	1.63	.00	4.5	4.39	13.36	6.77	20.13	.507	.190	.029	11.0
191	4	2	17.4	22	38.30	33.86	1.95	5.83	.73	.57	1.4	3.87	17.89	7.14	25.03	.399	.063	.035	7.0
192	5	0	18.4	27	36.84	26.88	.71	11.86	1.57	--------	3.7	3.69	17.42	4.32	21.74	.248	.071	.029	23.6
Ave., 189–192	5	1	17.7	18	37.59	29.30	1.10	9.69	1.47	--------	3.0	3.82	17.84	6.27	24.11	.364	.099	.036	15.1

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
193	1957	August	Clover, sweet			Liquid	Clarence Beck, Sioux Falls, S.D.	Sioux Falls.
194	1957	July	do	Black loam soil	None	Granulated	Walter L. Guntren, Storm Lake, Iowa.	Buena Vista County.
195	1957	August	do			Liquid	Andrew McShaw, Transfer, Pa.	Lawrence County.
196	1957	July 4	do		None	do	Arthur G. Strang, Silver Spring, Md.	Gaithersburg.
197	1957	Spring	do	Unstrained	do	Crystals	L. E. Hazen, Stillwater, Okla.	Stillwater.
198	1956	July 30	Clover, sweet-alfalfa.		120°	Granulated	Roscoe Geise, Augusta, Mont.	Sun River.
199	1956	Aug. 10	do		120°	do	do	Do.
200	1956	Aug. 15	do	First cutting alfalfa; mostly yellow sweet clover.	None	do	Lester Hall, Livingston, Mont.	Paradise Valley.
201	1956	Late August	do		150°	Liquid	P. J. Pooley, Mitchell, S.D.	Mitchell.
202	1956	Aug. 1	do		140°	do	Earl Barnes, Dillon, Mont.	Dillon.
203	1957	Sept. 10	do		None	do	E. O. Rauchfuss, Powell, Wyo.	Park County.
204	1957	July	do			Crystals	John M. Osborn, Buffalo, Wyo.	Johnson County.
205	1957		Clover, white sweet-alfalfa.			Partly granulated	Carold W. Mains, Red Oak, Iowa.	Red Oak.
206	1957	Sept. 14	Clover, sweet-alfalfa.	Unstrained	None	do	J. F. Meade, Pablo, Mont.	Lake County.
207	1957	Aug. 26	do		do	Solid granulation	Harry J. Rodenberg, Wolf Point, Mont.	Wolf Point.
208	1957	October	do		140°	Liquid	I. C. Andersen, Lake Benton, Minn.	Lincoln County.
209	1957	August	Clover, sweet-basswood.	Sandy and clay soil	None	Granulated	Walter L. Guntren, Storm Lake, Iowa.	Buena Vista County.
210	1957	Aug. 11	do	From river basin	130° for 15 min.		Charles B. Crispin, Grimes, Iowa.	Garlock, Polk County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
193	0	6	17.8	5	38.16	33.14	1.63	5.64	0.83	--------	2.8	4.01	12.07	3.92	15.99	0.324	0.044	0.024	22.6
194	1	2	18.7	9	39.26	33.61	.64	5.29	.87	--------	1.6	3.90	13.33	5.99	19.32	.449	.051	.026	--------
195	6	2	18.7	9	38.68	33.93	1.83	4.46	.58	--------	1.6	3.42	42.97	15.25	58.22	.355	.141	.072	18.9
196	6	0	16.0	15	38.84	30.00	.82	8.63	1.84	--------	3.9	3.85	19.41	5.78	25.19	.298	.097	.042	24.6
197	6	1	17.2	22	36.24	30.82	3.41	6.97	2.60	1.21	1.6	3.58	16.83	6.76	23.59	.402	.022	.033	--------
Ave., 193–197	4	2	17.7	12	38.24	32.80	1.67	6.20	1.34	--------	2.3	3.69	20.92	3.77	28.46	.366	.071	.039	20.0
Ave., 189–197	4	2	17.7	15	37.95	30.97	1.41	7.75	1.40	--------	2.6	3.77	19.55	6.98	26.53	.365	.084	.038	18.1
198	0	7	16.8	7	39.61	34.36	3.72	4.83	.88	--------	.0	4.02	7.60	3.38	10.98	.446	.033	.014	8.2
199	0	8	16.7	6	40.11	35.10	2.38	4.23	.85	--------	.7	4.00	7.73	3.33	11.06	.429	.045	.019	7.8
200	2	9	16.2	7	39.03	35.32	1.56	5.35	1.03	--------	1.5	3.99	9.21	3.43	12.64	.372	.009	.026	10.2
201	4	6	16.8	12	38.80	34.46	2.90	5.80	.84	--------	.4	3.74	12.62	5.76	18.27	.455	.017	.025	6.8
202	1	9	--------	12	--------	--------	--------	--------	--------	--------	--------	3.82	11.49	5.13	16.62	.447	--------	--------	9.7
Ave., 198–202	2	8	16.6	9	39.39	34.81	2.64	5.05	.90	--------	.6	3.90	9.71	4.21	13.92	.430	.026	.021	8.5
203	0	2	17.6	6	38.91	33.94	2.43	5.40	.84	--------	.9	3.60	15.63	6.26	21.89	.401	.043	.023	--------
204	0	1	14.9	8	39.08	32.11	3.30	7.49	1.07	.00	2.0	4.10	9.77	1.30	10.07	.133	.026	.016	9.9
205	4	4	18.3	8	39.74	33.02	1.33	5.71	.78	--------	1.1	3.65	20.83	8.41	29.24	.404	.066	.034	--------
206	3	5	15.0	6	41.23	33.25	1.28	6.68	.99	.00	1.5	3.93	17.57	8.28	25.86	.471	.084	.045	--------
207	2	3	16.2	13	38.89	34.05	1.27	6.01	.79	--------	2.8	3.80	17.56	6.19	27.75	.353	.081	.039	--------
208	3	3	18.0	16	38.19	33.89	2.56	5.77	.84	--------	.8	3.68	17.22	6.15	23.37	.357	.049	.034	--------
Ave., 203–208	2	3	16.7	10	39.34	33.38	2.03	6.18	.89	--------	1.5	3.74	16.44	6.10	23.02	.354	.058	.032	--------
Ave., 198–208	2	5	16.7	9	39.36	33.95	2.27	5.73	.89	--------	1.2	3.82	13.39	5.24	18.89	.388	.045	.028	8.8
209	2	1	18.2	8	39.03	32.55	.57	6.31	1.00	--------	2.3	4.09	15.24	6.33	21.57	.415	.121	.030	--------
210	4	2	18.8	9	38.83	33.23	.88	5.81	1.40	--------	1.0	4.01	20.11	5.68	25.78	.282	.180	.067	20.0
Ave., 209–210	3	2	18.5	9	38.93	32.89	.73	6.06	1.20	--------	1.7	4.05	17.68	6.01	23.68	.349	.151	.049	--------

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
211	1957	Sept. 3	Clover, sweet-blue vervain.	Possible honeydew unstrained.	None	Liquid	F. Q. Bunch, Welch, Minn.	Welch.
212	1957	Aug. 10	do	Processed honey for sale.	158°	do	do	Do.
213	1957		Clover, sweet-natural summer blend.		None	do	George W. Stone, Niagara Falls, N.Y.	Niagara Falls.
214	1957	August	Clover-vetch	Strained (A & M Apiary).		do	G.A. Bieberdorf, Stillwater, Okla.	Stillwater.
215	1957		Clover, white sweet.			Beginning fine granulation.	J. D. Brown, Gardner, Ill.	Gardner.
216	1957	August	Clover blend	Clover, white sweet, alsike and ladino.		Soft granulation	Lloyd A. Lindenfelser, Tremont, Ill.	Tremont.
217	1957		Clover, yellow sweet.	Trace of alfalfa		Partly granulated	Frank O. Lucore, S. Sioux City, Nebr.	South Sioux City.
218	1957	Aug. 16	do			Granulated	A. B. Carlson, Hinsdale, Mont.	Valley County.
219	1957	July 25	do		None	Very hard, granulated.	Harry J. Rodenberg, Wolf Point, Mont.	Wolf Point.
220	1957		Clover, yellow sweet-mustard.			Partly granulated	C. J. Clark, Sun River, Mont.	Cascade.
221	1956	Late July	Clover, sweet, mixed.	KSC Apiary	130°	Liquid	R. L. Parker, Manhattan, Kans.	Manhattan.
222	1956	July	Clover, yellow and white sweet.	Unstrained, stored at 60°–70°.	120°	do	Harry B. Rocke, Eureka, Ill.	Livingston County.
223	1957	Aug. 15	Clover, white and yellow sweet.			do	Thomas A. Peterson, St. Paul, Minn.	Dakota County.
224	1957		do	Direct from extractor	None	Beginning to granulate.	A. P. Sturtevant, Laramie, Wyo.	Laramie.
225	1957		do		120°	Liquid	Marvin Wahl, Chenoa, Ill.	Chenoa.
226	1957		Clover, yellow and white sweet.			do	Ralph Wilson, Belmond, Iowa	Wright County.
227	1957	July	Clover, white and yellow sweet-heartsease.		120°	do	Harry B. Rocke, Eureka, Ill.	Livingston County.
228	1957	Oct. 3	Clover, blend-heartsease.	White, white and yellow sweet and alsike clovers.	None	do	Earl C. Robinson, Oelwein, Iowa.	Fayette County.
229	1957	Aug. 1	Clover, white and yellow sweet-white clover.		10 min	Crystals	Ray Silver, Logansport, Ind.	Clay Township, Cass County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
211	2	3	17.8	5	36.95	31.08	0.92	7.55	1.27	-------	4.4	4.02	17.60	4.61	22.21	0.262	0.127	0.009	16.4
212	1	4	17.4	5	37.91	33.27	1.56	6.03	.99	.00	2.8	3.87	14.62	6.96	21.58	.476	.075	.018	-------
Ave., 211–212	2	4	17.6	5	37.43	32.18	1.24	6.79	1.13	-------	3.6	3.94	16.11	5.79	21.90	.369	.101	.014	-------
213	4	5	18.2	5	36.73	82.35	3.27	5.04	1.49	.00	3.3	3.65	21.58	9.85	31.43	.450	.060	.034	17.9
214	1	2	16.4	19	37.40	30.12	1.11	8.34	2.08	-------	4.6	3.80	22.80	10.43	33.16	.458	.119	.045	15.2
215	1	6	18.8	5	36.77	33.72	1.00	5.51	.79	.69	2.7	3.65	15.62	3.75	19.37	.240	.041	.010	20.4
216	4	1	17.9	16	39.27	31.63	1.47	5.61	.86	-------	3.3	3.59	26.91	9.96	36.87	.370	.080	.058	-------
217	3	4	16.6	9	39.65	31.76	.74	7.31	1.19	-------	2.7	4.18	13.41	4.75	18.17	.354	.083	.026	-------
218	1	4	14.6	11	39.78	33.53	3.49	6.48	.81	.00	1.3	3.92	10.21	9.70	19.91	.950	.044	.020	-------
219	0	3	16.8	14	38.22	33.14	4.56	6.11	.92	-------	.3	3.85	10.78	2.40	13.18	.223	.042	.021	-------
Ave., 217–219	1	4	16.0	11	39.22	32.81	2.93	6.63	.97	-------	1.4	3.96	11.47	5.62	17.09	.509	.056	.022	-------
220	2	5	15.3	8	40.13	32.25	.78	7.75	1.06	-------	2.7	4.02	10.14	4.00	14.14	.395	.055	.018	-------
221	4	2	18.7	11	37.39	32.14	2.09	6.00	.95	-------	2.7	3.89	19.12	7.57	26.69	.396	.071	.045	16.4
222	3	4	19.1	13	36.68	33.61	1.74	5.23	.87	-------	2.8	3.81	15.82	6.95	22.77	.438	.055	.037	20.0
223	2	2	18.9	5	36.50	32.96	.56	6.17	1.08	-------	3.8	3.86	15.40	4.09	19.60	.266	.047	.009	-------
224	1	8	15.6	6	40.19	32.78	2.89	5.39	1.02	.00	2.1	3.90	13.06	1.48	14.54	.113	.067	.025	10.6
225	3	1	18.4	7	39.00	33.95	1.06	4.87	.64	-------	2.1	3.55	22.66	7.98	30.64	.352	.051	.035	30.3
226	0	2	20.0	7	38.17	33.99	2.25	4.17	.57	-------	.8	3.81	15.69	7.83	23.52	.499	.033	.025	21.0
227	1	3	17.9	18	38.87	33.62	1.40	6.66	1.01	-------	.5	3.74	16.43	5.08	21.51	.309	.046	.036	-------
Ave., 221–227	2	3	18.4	9	38.11	33.29	1.71	5.50	.87	-------	2.1	3.7	16.88	5.85	22.75	.339	.053	.030	19.7
228	4	1	17.8	14	39.01	29.21	.71	8.44	1.05	-------	3.8	4.00	17.40	2.77	20.17	.159	.086	.067	31.3
229	5	4	16.8	14	37.73	33.82	2.44	5.38	.92	.09	2.9	3.58	25.31	11.11	36.43	.439	.073	.047	-------

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
230	1956		Clover, white	Heartsease flavor	150°	Liquid	E. C. Bessonet, Donaldsonville, La.	Donaldsonville.
231	1956	Early August	do	Nearly pure	Lightly heated	do	L. C. Lueddecke, St. Louis, Mo.	South St. Louis.
232	1956	Sept. 15	do		None	do	William A. Warren, St. Louis, Mo.	St. Louis.
233	1956	July	do		do	Beginning to granulate.	Otto Aiple, St. Louis, Mo.	Do.
234	1956		do			Liquid	L. H. Little, Shelbyville, Tenn.	Chattanooga.
235	1956	June 7	do	Unstrained	None	do	George O'Neill, Haines City, Fla.	Haines City.
236	1956		do		do	Granulated	H. A. Schaeffer, Osseo, Wis.	Osseo.
237	1956	October	do	Strained	125°	Liquid	Earl W. Sutvan, Laurel Springs, N.J.	Camden County.
238	1956	Aug. 7	do		120°	do	L. H. Townsend, Lexington, Ky.	Fayette County.
239	1957	Sept. 20	do		140° (flash)	do	Elva Kirlin, Warsaw, Ill.	Iowa County, Wis.
240	1957		do		None	Crystals	H. A. Schaefer, Osseo, Wis.	Western Jackson County.
241	1957	July 15	do			Solid granulation	Charles G. Becker, Outlook, Wash.	Yakima Valley.
242	1957		Clover, white-alsike clover.			Liquid	Don Kloepfer, Grand Ledge, Mich.	Grand Ledge.
243	1956	Before September.	Clover-blue thistle.	Unstrained	90° F., 24 hrs.	Beginning to granulate.	W. C. Wahl, Clayton, N.Y.	Clayton.
244	1957		Clover, white-cotton.	Also vetch		Few crystals	Jensen's Apiaries, Macon, Miss.	Lowndes and Noxubee Counties.
245	1957		do			Liquid	W. J. Dunn, Covington, Tenn.	Covington.
246	1957		Clover, white-dandelion.		None	Crystals	H. A. Schaefer, Osseo, Wis.	Northern Trempealeau County.
247	1956	June 25	Clover, white-mixed clovers.	MSC Apiary; primarily white clover, also hop, red, crimson clover.		Liquid	C. A. Wilson, State College, Miss.	NE prairie section.
248	1957	August	do	White, alsike and sweet clovers.		Beginning fine granulation.	Tacoma Bros., Falmouth, Mich.	Missaukee County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
230	6	4	17.8	13	36.96	31.26	1.77	7.18	1.39	--------	3.9	3.73	19.93	9.03	28.95	0.452	0.067	0.039	13.6
231	6	4	16.4	11	37.62	32.83	1.15	6.86	1.35	--------	3.8	3.87	26.87	12.11	38.98	.451	.087	.055	27.0
232	5	1	17.7	10	38.95	30.46	1.02	7.55	1.69	--------	2.6	3.98	15.46	6.57	22.03	.424	.092	.041	18.8
233	5	6	18.2	12	38.34	33.46	.96	5.28	.91	--------	2.8	3.86	29.20	12.50	41.70	.427	.137	.066	--------
234	4	0	21.0	3	38.11	28.13	.74	7.86	1.83	--------	2.4	3.62	31.35	19.37	50.72	.618	.140	.040	61.2
235	5	0	16.8	15	38.94	29.31	.86	9.20	1.52	--------	3.4	4.08	13.69	4.58	18.27	.335	.108	.031	12.5
236	4	4	18.4	13	38.48	32.10	.83	6.00	1.69	--------	2.5	3.90	22.52	6.67	29.19	.294	.126	.036	27.3
237	9	0	17.8	12	36.40	27.99	.85	8.73	2.75	--------	5.5	4.31	31.03	5.89	36.92	.190	.348	.068	20.7
238	5	0	16.8	15	39.93	28.15	1.35	8.21	1.72	--------	3.8	3.90	16.46	3.27	19.73	.199	.498	.045	10.6
Ave., 230–238	5	2	17.9	12	38.19	30.41	1.06	7.43	1.65	--------	3.4	3.88	22.95	8.89	31.83	.377	.178	.047	24.0
239	4	5	17.8	12	38.39	31.58	1.11	6.73	1.33	0.18	2.9	3.75	15.74	5.10	20.84	.324	.064	.028	--------
240	1	1	19.2	15	37.71	30.22	.83	7.68	1.63	--------	2.7	3.65	17.58	4.45	22.03	.253	.051	.036	24.0
241	6	5	16.5	18	40.49	33.02	.90	6.60	.89	--------	1.6	3.82	35.55	15.01	50.57	.422	.159	.067	--------
Ave., 239–241	4	4	17.8	15	38.86	31.61	.95	7.00	1.28	--------	2.4	3.75	22.96	8.19	31.15	.333	.091	.044	--------
Ave., 230–241	5	3	17.9	12	38.36	30.71	1.03	7.32	1.56	--------	3.2	3.84	22.95	8.71	31.66	.366	.156	.046	--------
242	4	2	18.1	15	38.40	32.32	1.29	5.87	1.19	.71	2.1	3.70	22.53	9.68	32.21	.430	.077	.048	25.2
243	2	1	16.2	10	38.67	31.21	1.39	8.53	2.33	--------	1.7	3.77	12.23	5.32	17.56	.435	.020	.025	11.5
244	6	4	15.8	8	36.48	31.95	.90	6.46	1.10	--------	7.3	3.75	24.81	9.11	33.92	.367	.103	.018	24.0
245	8	1	18.7	7	38.19	31.84	2.32	5.64	1.33	.00	2.0	4.10	39.82	9.71	49.53	.244	.380	.036	--------
Ave., 244–245	7	3	17.3	8	37.34	31.90	1.61	6.05	1.22	--------	4.7	3.89	32.32	9.41	41.73	.306	.242	.027	--------
246	1	3	19.6	17	37.55	30.56	.88	7.49	1.40	--------	2.5	3.80	17.90	4.33	22.24	.242	.068	.034	--------
247	8	1	18.8	13	37.10	30.86	1.04	7.38	1.29	--------	3.5	4.05	27.05	9.58	36.63	.353	.097	.052	20.7
248	3	4	17.3	6	36.97	32.93	.89	6.50	1.28	--------	4.1	3.80	17.13	5.99	23.11	.350	.065	.013	30.8
Ave., 247–248	6	3	18.1	10	37.04	31.90	.97	6.94	1.29	--------	3.8	3.91	22.09	7.79	29.87	.352	.081	.033	25.7

See footnote at end of table.

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TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
249	1957	May 10	Clover, white–spring blend.	Willow, Persian clover and blackberry.	None	Liquid	E. Oertel, Baton Rouge, La	E. Baton Rouge Parish.
250	1957		Clover, white–sweet clover.			do	Wesley W. Stephens, West Branch, Mich.	Ogemaw County.
251	1956	Early August	Clover	Traces dandelion, locust, basswood.	140° for 5 min	do	C. L. Farrar, Madison, Wis	Madison.
252	1956	September	Clover blend	Vetch, trefoil, alsike clover, alfalfa.	None	Granulated, still pourable.	Charles Mraz, Middlebury, Vt	Middlebury.
253	1956	Oct. 16	Clover	Scraped from Comb	do	Partly granulated	P. J. Hewitt, Jr., Litchfield, Conn	Litchfield.
254	1956		do	In comb	do	do	L. W. Sundberg, Richville, Minn	Richville, Ottertail County.
255	1956		do	A little alfalfa		do	E. M. Miller, Eastwood, Ky	Eastwood.
256	1956		do			Liquid	Fisher Apiaries, Granville, Pa	Granville.
257	1956		do			do	Harold E. Swasey, Leicester, Mass	Leicester.
258	1957	July 10	do		None	do	Everett E. Fields, Bristol, R.I	Bristol.
259	1957		do			do	Robert Yepson, Honesdale, Pa	Wayne County.
260	1957		do			do	Francis Motichka, Honesdale, Pa	Honesdale.
261	1957		do			do	do	Lake Ariel, Wayne County.
262	1957		do			do	Jane Clarke, Center Hall, Pa	Centre County.
263	1957		do			do	do	Lemont, Centre County.
264	1957	July 15	Clover		None	do	Rudolph and Herb Studier, Glenville, Minn.	Glenville.
265	1957		do			do	G. L. Hazeltine, Marion, Iowa	Marion.
266	1957		do		None	do	Cecil W. Hoff, Eau Gallie, Fla	Eau Gallie.
267	1957	Sept. 10	Clover blend	White and yellow sweet, alsike and white.	do	Partly granulated	Gerald L. Hodson, Converse, Ind	Miami County.
268	1957		do	Alsike, white, ladino, sweet.		Liquid	Earl R. Bronson, Salem, Ill	Salem.
269	1957	Aug. 20	Clover		None	do	W. E. Lyman, Greenwich, N.Y	St. Lawrence County.
270	1957		do			do	Lloyd Stanley, Gilbert, Iowa	Gilbert.
271	1957	Aug. 15	do	Strained	100°	Solid granulation	Harry Stewart, Winnebago, Minn	Fairbault, Blue Earth and Martin Counties.
272	1957		Clover blend	Crimson, white, and sweet clover, vetch.		Liquid	Earl Barham, Madison College, Tenn.	Davidson County.
273	1957		do			do	Don Kloepfer, Grand Ledge, Mich.	Grand Ledge.
274	1957	Sept. 15	do		140° for 25 min	do	J. E. Morgan, Van Wert, Ohio	Pleasant Township, Van Wert County.
275	1957		Clover			Crystals	N. R. Chamberlin, Poplar, Wis	Poplar.
276	1957	Aug. 15	do		None	Solid granulation	Lee Reents, Lincoln, Nebr	Lincoln.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*	
249	7	1	17.6	6	37.55	28.31	0.39	8.15	1.04	--------	7.0	4.29	27.93	5.49	33.42	0.196	0.367	0.048	29.4
250	0	1	15.1	17	39.98	34.39	3.32	5.90	1.11	--------	.2	3.72	13.90	5.68	19.59	.409	.042	.035	20.0
251	4	5	16.7	11	38.14	34.81	2.18	5.52	1.04	--------	1.7	3.74	18.74	8.20	26.94	.437	.055	.036	15.2
252	2	6	15.6	10	38.32	33.29	1.06	7.45	2.37	--------	1.9	3.95	13.78	5.52	19.30	.402	.056	.028	13.5
253	9	1	17.4	9	38.71	30.20	1.02	8.23	2.24	--------	2.2	4.02	27.18	10.51	37.69	.386	.213	.023	13.3
254	5	4	19.0	12	37.80	32.55	.58	5.42	1.71	--------	2.9	3.70	28.24	11.89	40.13	.422	.125	.073	34.5
255	6	7	18.6	14	37.64	34.21	1.32	5.44	1.01	--------	1.8	3.62	25.91	11.41	37.32	.440	.048	.037	--------
256	4	4	17.9	14	37.65	31.81	1.83	6.05	1.56	--------	3.3	3.63	26.31	10.97	37.28	.415	.105	.044	14.4
257	5	2	15.7	14	37.25	31.56	3.67	7.61	1.83	--------	2.4	3.70	16.24	6.00	22.24	.369	.060	.037	3.1
Ave., 251–257	5	4	17.3	12	37.93	32.63	1.67	6.53	1.68	--------	2.3	3.74	22.34	9.21	31.56	.410	.095	.040	15.7
258	4	1	19.3	22	34.48	28.34	.94	10.37	2.07	--------	4.5	4.10	24.06	7.73	31.80	.321	.411	.038	35.3
259	2	4	17.3	5	37.45	33.55	1.72	6.52	1.13	0.00	2.3	3.80	15.90	6.81	22.71	.428	.035	.000	30.0
260	2	2	19.3	5	36.57	29.61	.56	6.49	1.20	--------	6.3	3.79	16.32	5.56	21.88	.340	.042	.007	21.4
261	5	2	19.0	5	36.62	32.48	.97	6.55	1.03	--------	3.4	3.61	21.25	6.58	27.83	.310	.074	.003	10.3
262	4	4	16.4	5	38.13	32.47	2.01	6.66	1.25	.00	3.1	3.87	17.53	7.35	24.88	.420	.053	.006	19.7
263	3	4	17.8	6	38.06	32.61	2.33	5.48	1.09	.38	2.3	3.80	18.42	8.47	26.89	.459	.034	.022	24.0
264	3	2	20.0	7	39.42	30.65	.50	5.43	.92	--------	3.1	3.70	18.62	5.10	23.69	.274	.047	.027	--------
266	5	0	17.4	9	38.79	30.69	.78	8.02	1.47	--------	2.8	4.30	13.24	6.55	19.79	.495	.192	.023	18.5
267	5	2	18.4	7	39.15	32.64	.94	5.84	.79	--------	2.2	3.61	32.63	12.42	45.05	.381	.096	.051	--------
268	7	2	17.8	8	37.89	32.91	1.75	5.40	1.53	.00	2.7	3.89	38.34	15.53	53.87	.405	.179	.064	26.7
269	2	2	16.2	9	39.29	32.28	1.67	7.04	1.92	.00	1.6	3.71	15.15	3.75	18.90	.248	.042	.028	8.8
271	4	2	19.3	13	37.46	32.64	.86	5.72	1.00	.56	2.5	3.70	20.21	6.18	26.40	.306	.084	.040	--------
272	6	0	19.2	15	36.10	31.47	1.11	7.24	1.32	1.20	2.4	3.61	27.78	8.31	36.09	.299	.127	.051	10.5
274	4	2	17.2	15	38.89	33.47	1.39	6.46	1.08	.62	.9	3.68	23.21	10.25	33.46	.442	.079	.053	21.6
275	2	1	16.8	19	38.38	33.90	2.21	6.41	1.26	1.13	.0	3.68	17.40	7.30	24.70	.420	.068	.029	10.0
276	1	2	17.0	18	38.21	33.01	1.61	6.40	1.12	--------	2.7	3.92	13.21	8.51	21.73	.644	.041	.031	--------
Ave., 258–276	4	2	18.0	11	37.81	32.05	1.33	6.63	1.26	--------	3.8	3.77	20.83	7.90	28.73	.387	.100	.030	19.7
Ave., 251–276	4	3	17.8	11	37.84	32.22	1.44	6.60	1.39	--------	2.6	3.76	21.29	8.30	29.59	.394	.099	.033	18.4

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
277	1956	September	Clover-alfalfa	UM Apiary; some basswood.	100°	Beginning to granulate.	M. H. Haydak, St. Paul, Minn	St. Paul.
278	1956		do	Unstrained, same honey as 279.	155° for several hours.	Liquid	E. H. Adee, Sutherland, Nebr	Sutherland.
279	1956		do	Unstrained, heated in electronic oven.	136° for 2½ min.	do	do	Do.
280	1957		do			Beginning to granulate.	James E. Bunch, Sunnyside, Wash.	Sunnyside.
281	1957	Sept. 7	do			Crystals	George Biesterveld, Little Chute, Wis.	Outagamie County.
282	1957	July 20	do	Sweet and alsike clovers.	None	Granulated	John Speelman, Kalispell, Mont	Flathead Valley.
283	1957		do	Alsike, white and sweet clover.		do	Francis A. Schiltgen, St. Paul, Minn.	Washington County.
284	1957		do			Solid granulation	Lee Reents, Lincoln, Nebr	Lincoln.
285	1957		Clover-asters	Alsike, white, yellow and white sweet clovers.		Granulated	Gale H. Patterson, Norwood, Colo	Norwood.
286	1957	Aug. 1	Clover-basswood			Partly granulated	Ronald Wulff, Charles City, Iowa	Floyd County.
287	1957		do	White sweet clovers from limestone hills.	None	Solid granulation	H. A. Schaefer, Osseo, Wis	Winona County Minn.
288	1957		Clover-basswood	White and yellow sweet, white clovers from sand prairie.	None	Soft granulation	H. A. Schaefer, Osseo, Wis	Southern Trempealeau County.
289	1957		do	Also fruit blossoms		Crystals	Burt L. Snyder, New Auburn, Wis.	New Auburn.
290	1957	Late October	do	Also some alfalfa	140°	Liquid	I. C. Andersen, Lake Benton, Minn.	Lincoln County.
291	1956	August	Clover-blue thistle		None	do	Harold L. Kelly, Silver Spring, Md.	Washington County.
292	1957		do	White and sweet clovers.	Yes	do	A. D. Hiett, Martinsburg, W. Va	Martinsburg.
293	1957	Aug. 1	Clover-cotton		None	do	G. O. Stroope, Waxahachie, Texas	Ellis County.
294	1957		Clover-fall blend	White, ladino clover; goldenrod, asters and fall flowers.	110°	Solid granulation	Nathan Paddock, Bruce, Wis	Bruce.
295	1957	Late	Clover-goldenrod			Liquid	Homer M. Dunn, Lisbon, N.Y	Lisbon.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
277	4	4	18.5	6	38.90	33.80	0.63	5.85	1.00	--------	1.3	4.01	18.06	6.77	24.83	0.374	0.094	0.038	16.2
278	7	4	16.6	11	37.55	33.57	.44	6.39	.99	--------	4.5	3.82	16.13	8.18	24.31	.508	.067	.026	21.4
279	3	8	17.4	13	37.97	33.80	.84	5.87	.83	--------	3.3	3.82	15.08	7.46	22.54	.494	.104	.028	19.7
Ave., 277–279	5	5	17.5	10	38.14	33.72	.64	6.04	.94	--------	3.0	3.87	16.42	7.47	23.89	.459	.088	.031	19.1
280	1	4	15.7	7	40.81	32.74	1.03	6.97	.95	--------	1.8	3.62	17.93	9.79	27.72	.546	.049	.020	--------
281	2	1	19.4	7	38.96	32.72	.59	5.61	.87	--------	1.8	3.80	17.22	6.83	24.04	.397	.052	.030	--------
282	1	6	16.2	10	39.94	33.01	1.03	6.80	1.18	0.00	1.8	3.68	15.71	4.50	20.20	.286	.069	.033	--------
283	3	2	18.4	17	37.94	31.35	1.04	6.52	1.28	--------	3.5	3.72	17.22	6.45	23.67	.375	.050	.039	--------
284	4	1	16.9	20	39.16	33.14	1.72	5.86	1.06	--------	2.2	3.81	19.27	7.33	26.60	.380	.070	.049	--------
Ave., 280–284	2	3	17.3	12	39.36	32.59	1.08	6.35	1.07	--------	2.2	3.72	17.47	6.98	24.45	.397	.058	.034	--------
Ave., 277–284	3	4	17.4	11	38.90	33.02	.92	6.23	1.02	--------	2.5	3.77	17.08	7.16	24.24	.420	.069	.033	--------
285	8	0	16.4	7	37.18	28.80	.70	10.16	2.44	--------	4.3	4.72	32.70	2.67	35.36	.082	.562	.078	--------
286	1	1	17.9	7	39.15	31.61	.67	6.98	1.03	--------	2.7	3.91	14.28	4.13	18.41	.289	.073	.022	--------
287	2	1	19.0	14	38.13	30.27	1.13	6.91	1.39	.90	2.3	3.73	17.39	5.71	23.10	.328	.074	.033	--------
288	1	4	18.9	13	37.60	30.01	.93	7.23	1.36	--------	4.0	3.90	14.92	4.15	19.07	.278	.084	.027	--------
289	4	2	17.7	17	37.23	31.01	.88	7.56	1.83	--------	3.8	4.05	15.81	5.13	20.94	.325	.124	.031	--------
290	2	3	18.0	16	38.72	32.71	1.55	6.71	1.09	.00	1.2	3.82	13.81	2.99	16.80	.217	.074	.026	--------
Ave., 286–290	2	2	18.3	13	38.17	31.12	1.03	7.08	1.34	--------	2.8	3.87	15.24	4.42	19.66	.287	.086	.028	--------
291	6	0	17.0	15	38.14	30.15	.80	8.84	1.48	--------	3.6	3.78	27.36	8.80	36.16	.322	.141	.040	--------
292	7	0	18.4	21	37.92	31.02	.97	6.63	2.03	.61	2.4	3.79	29.22	10.53	39.75	.360	.156	.070	--------
Ave., 291–292	7	0	17.7	18	38.03	30.59	.89	7.74	1.76	--------	3.0	3.79	28.29	9.67	37.96	.341	.149	.055	--------
293	4	7	17.8	5	37.93	35.10	.71	5.41	.44	--------	3.3	4.08	27.18	6.45	33.63	.247	.185	.014	29.3
294	4	2	17.9	14	37.73	29.86	1.17	8.06	1.31	--------	4.0	4.13	18.18	5.68	23.86	.312	.136	.044	--------
295	4	1	17.1	7	39.23	32.94	1.22	6.24	1.43	--------	1.9	3.75	17.55	5.08	22.63	.290	.075	.036	20.4

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
296	1957	Aug. 30	Clover-heartsease			Beginning to granulate.	Ronald Wulff, Charles City, Iowa	Floyd County.
297	1957	July 1	Clover-marigold		None	Liquid	G. O. Stroope, Waxahachie, Texas	Ellis County.
298	1956		Clover-privet		do	do	F. R. Buchanan, Whitemarsh, Pa.	Cape May, N.J.
299	1957	Sept. 2	Clover-sourwood	White sweet and white clovers.	do	do	John Amos, Cambria, Va.	Montgomery County.
300	1956	July 7	Clover-natural spring blend.		140°	Beginning to granulate.	James Youngblood, Ennis, Texas	Ennis.
301	1957	July	Clover-natural summer blend.	Strained		Liquid	Charles G. Bennett, Muscatine, Iowa.	Muscatine.
302	1957	July	do	Wild mustard, fruit bloom, locust and berries.		do	Leonard E. Good, Spinnerstown, Pa.	Bucks County.
303	1957		do	White, alsike clover; raspberry and basswood.	110°	Solid granulation	Nathan Paddock, Bruce, Wis.	Bruce.
304	1957	July 25	Clover-birdsfoot trefoil.		None	Crystals	W. E. Lyman, Greenwich, N.Y.	Washington County.
305	1957		Clover-vetch		130°–140°	Liquid	W. E. Drane, Forest, La.	Tensas Parish.
306	1956	Oct. 15	Coralvine			do	W. Wortham Maxwell, San Antonio, Texas.	San Antonio.
307	1957	Oct. 20	Coralvine	Pure		do	do	Do.
308	1956	Oct. 12	Cotton	Short staple cotton (upland).	None	Solid granulation	C. L. Benson, Phoenix, Ariz.	Northern Pinal County.
309	1956	Nov. 7	do		do	Soft granulation	James Youngblood, Ennis, Texas	Ennis.
310	1957		do		do	Beginning to granulate.	C. M. Bledsoe, Phoenix, Ariz.	Maricopa County.
311	1957	Sept. 20	do			Crystals	Charles Frederick, Shandon, Calif.	Kings County.
312	1956		Cotton	Strained	Yes, to melt	Liquid	E. S. Bostwick, Chowchilla, Calif.	Fresno County.
313	1957	October	do	Pure		Solid granulation	Robert Reed, Safford, Ariz.	Safford.
314	1957	Sept. 5	do	Unstrained	None	do	Clarence L. Benson, Phoenix, Ariz.	Pinal County.
315	1957	September	do		do	do	Glenn Gibson, Minco, Okla.	Tillman County.
316	1957		do	Fermented		do	Roy Stanley, Terra Bella, Calif.	Tulare County.
317	1957	September	do		None	do	O. L. Tolman, Cotulla, Texas	Hale County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
296	4	1	17.4	7	41.49	31.21	0.88	6.11	1.06	--------	1.8	3.92	17.36	3.57	20.92	0.206	0.049	0.054	36.6
297	4	5	18.0	6	37.80	34.18	.87	5.74	.54	--------	2.9	3.65	26.40	11.28	37.68	.427	.085	.030	25.6
298	2	2	17.0	10	39.03	30.46	1.00	7.40	3.40	--------	1.7	3.83	15.58	6.36	21.94	.408	.090	.036	20.7
299	5	1	18.3	7	40.22	28.97	.62	6.99	1.40	--------	3.4	3.83	25.38	10.38	35.76	.409	.132	.052	34.1
300	6	7	15.6	12	39.34	34.97	1.60	6.15	.87	--------	1.5	3.98	24.22	10.50	34.72	.433	.089	.040	10.4
301	4	4	19.8	5	38.16	31.96	.49	5.66	1.19	--------	2.7	4.12	17.23	4.50	21.73	.261	.171	.020	13.0
302	7	1	17.0	8	38.37	31.76	.60	7.06	1.05	--------	4.2	4.12	23.73	7.23	30.96	.305	.184	.043	26.7
303	3	1	17.3	17	37.70	30.99	.96	8.00	1.47	--------	2.6	4.02	17.06	7.01	24.07	.411	.115	.034	--------
Ave., 301–303	5	2	18.0	10	38.08	31.57	.68	6.91	1.24	--------	3.2	4.08	19.34	6.25	25.59	.326	.157	.032	19.8
304	5	3	17.5	10	38.99	33.18	1.10	5.89	1.34	0.00	2.0	3.52	31.52	12.03	43.55	.382	.102	.074	--------
305	5	4	16.7	21	38.89	30.61	.76	8.41	1.56	.72	2.4	3.90	16.98	5.54	22.52	.326	.076	.042	--------
306	11	--------	16.3	14	34.87	28.68	.60	6.16	3.05	3.15	7.2	4.35	45.51	9.30	54.81	.204	.616	.039	--------
307	11	0	17.2	2	34.84	28.24	.62	6.05	3.01	3.06	8.5	4.30	46.91	8.50	55.41	.181	.567	.074	--------
Ave., 306–307	11	0	16.8	8	34.86	28.46	.61	6.11	3.03	--------	7.9	4.32	46.21	8.90	55.11	.193	.592	.057	--------
308	4	8	15.7	5	39.36	36.89	1.11	5.11	.64	--------	1.2	4.53	20.41	2.68	23.09	.132	.321	.021	12.2
309	7	8	15.4	3	40.14	36.66	.66	4.97	.53	--------	1.6	4.30	27.61	8.48	36.09	.307	.292	.054	21.8
310	6	9	16.2	5	39.91	36.93	2.32	4.59	.29	.00	.0	4.20	28.69	6.63	35.32	.231	.402	.018	--------
311	4	6	16.0	7	40.32	37.07	.74	4.70	.36	--------	.8	4.14	25.97	9.08	35.05	.350	.304	.044	23.6
312	4	9	15.6	24	39.67	33.99	3.02	5.56	.68	.68	.8	4.10	16.59	3.78	20.37	.228	.146	.030	--------
313	4	7	17.8	6	39.19	38.34	.55	2.74	1.00	--------	1.3	4.35	19.47	3.96	23.43	.203	.428	.026	--------
314	5	8	15.7	12	37.85	37.25	.70	5.76	.37	--------	2.4	4.61	23.70	2.13	25.83	.090	.472	.031	--------
315	4	9	16.4	13	38.31	35.04	.60	5.88	.45	--------	3.3	4.45	25.49	5.27	30.75	.207	.321	.036	--------
316	5	9	16.6	14	39.31	37.50	.81	4.29	.35	--------	1.1	4.10	33.31	8.41	41.72	.253	.325	.066	--------
317	4	7	15.8	16	38.71	37.77	.94	5.08	.32	--------	1.4	4.60	24.86	1.68	26.55	.068	.386	.041	--------
Ave., 308–317	5	8	16.1	10	39.28	36.74	1.14	4.87	.50	--------	2.3	4.29	24.61	5.21	29.82	.207	.339	.037	--------

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
318	1957		Cotton-alfalfa			Solid granulation	H. J. Weatherson, Kerman, Calif.	Fresno County.
319	1957		do			do	R. H. Lane, Porterville, Calif.	Tulare County.
320	1956		Cranberry			Few crystals	Justin Caswell, Middleboro, Mass.	Middleboro.
321	1956	October	do		None	Liquid	Karl W. P. Reece, Whitman Mass.	Whitman.
322	1957	October	Crotalaria			Few crystals	M. V. Coggshall, Minneola, Fla.	Lake County.
323	1957		Cucumber			Liquid	Ralph Wilson, Belmond, Iowa	Belmond.
324	1956	April	Eucalyptus			Granulated	Loren Vernon, Sonoma, Calif.	Sonoma County.
325	1957	April 15	do		None	Liquid	M. E. Thacker, Santa Ana, Calif.	Irvine, Orange County.
326	1956		Fireweed			do	G. V. Palmrose, Beaverton, Oregon.	Tillamook burn area.
327	1956		do	Core sample 60 # tin, 56°–60° storage.	None	Granulated	H. J. Moulton, Portland, Oreg.	Coast mountains, Oregon.
328	1957	Sept. 1	do	May have blackberry, Canada thistle and pearly everlasting.	Mild		Oliver Petty, Albany, Oreg.	Sweet Home, Linn County.
329	1956	June	Gallberry		None	Liquid	J. H. Girardeau, Jr., Tifton, Ga.	Alapaha.
330	1957	April 26	do		120°	do	H. M. Myers, Ransomville, N.Y.	Glades County, Florida.
331	1957	June	do	Tall phase		do	J. H. Girardeau, Jr., Tifton, Ga.	Tift County.
332	1957	June	do	Flatwoods phase		do	do	Alapaha, Berrien County.
333	1957		do	In comb	None	do	Wm. W. Wicht, Hattiesburg, Miss.	Hattiesburg.
334	1957	June 20	do		Flash to 130°	do	Adolphus Jones, Bay Minette, Ala.	Baldwin County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
318	4	5	15.9	16	39.43	34.84	1.20	5.96	.62	--------	2.1	3.91	26.98	8.13	35.11	0.271	0.226	0.049	--------
319	7	9	16.1	14	39.11	36.00	1.46	5.25	.65	--------	1.4	3.81	34.87	11.35	46.22	.326	.229	.058	--------
Ave., 318–319	5	7	16.0	15	39.27	35.42	1.33	5.60	.63	--------	1.8	3.86	30.92	9.74	40.67	.298	.227	.053	--------
320	8	1	17.4	16	36.29	29.42	.87	7.36	2.48	--------	6.2	4.38	18.89	6.04	24.93	.320	.296	.039	--------
321	9	0	17.0	15	34.89	26.84	1.17	8.69	3.41	0.44	8.0	4.36	28.75	6.59	35.34	.228	.364	.643	26.7
Ave., 320–321	9	1	17.2	16	35.59	28.13	1.02	8.03	2.95	--------	7.1	4.37	23.82	6.32	30.14	.274	.330	.041	--------
322	9	0	18.4	14	37.34	31.41	1.17	7.17	1.21	.62	2.7	3.78	31.23	12.70	43.93	.407	.167	.056	13.2
323	4	1	18.7	11	38.20	32.59	1.45	5.66	.96	--------	2.4	3.82	21.12	9.41	30.52	.444	.094	.045	15.8
324	6	3	17.3	18	39.28	32.93	.65	5.93	.69	--------	3.2	4.10	22.06	10.24	32.30	.464	.226	.056	31.6
325	6	2	16.6	18	39.41	31.60	2.20	7.74	.91	--------	1.5	4.18	15.85	4.77	20.62	.301	.182	.043	12.2
Ave., 324–325	6	3	17.0	18	39.35	32.27	1.43	6.84	.80	--------	2.4	4.14	18.96	7.51	26.46	.383	.204	.050	21.9
326	5	1	16.6	12	40.00	28.82	.82	8.54	2.62	--------	2.6	4.10	16.28	3.40	19.68	.209	.110	.027	17.6
327	6	9	15.7	32	40.29	32.61	1.00	6.49	1.76	--------	2.2	3.80	22.01	10.28	32.29	.467	.151	.034	--------
328	1	2	15.8	17	39.13	30.74	2.01	6.34	1.80	2.87	1.3	3.68	19.61	8.74	28.35	.446	.064	.036	--------
Ave., 326–328	4	4	16.0	20	39.81	30.72	1.28	7.12	2.06	--------	2.0	3.83	19.30	7.47	26.77	.374	.108	.032	--------
329	4	0	15.4	12	40.89	27.45	.92	10.44	1.66	--------	3.2	4.75	8.89	1.24	10.13	.140	.072	.024	12.5
330	4	7	17.4	8	39.26	31.43	.52	6.18	1.05	.00	4.2	4.21	14.79	7.18	21.97	.485	.265	.014	23.5
331	6	0	15.7	9	40.43	30.24	.35	6.87	1.15	--------	5.3	4.38	23.66	6.17	29.83	.261	.247	.025	21.4
332	5	0	19.6	8	39.73	29.48	.62	7.86	.89	--------	1.8	4.30	15.72	3.30	19.02	.210	.099	.018	18.0
333	4	2	18.4	20	39.63	32.24	1.20	6.42	1.39	.43	.3	3.81	17.77	5.71	23.48	.321	.101	.044	15.2
334	6	0	16.0	21	39.14	30.06	.70	8.49	1.19	--------	4.4	4.30	16.29	3.17	19.46	.195	.196	.044	--------
Ave., 329–334	5	2	17.1	13	39.85	30.15	.72	7.71	1.22	--------	3.2	4.20	16.19	4.46	20.65	.269	.163	.028	18.1

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
335	1957	May	Gallberry-holly			Semigranulated	T. B. Brewer, Lake View, S.C.	Lake View.
336	1957		Goldenrod	In comb	None	Liquid	Arthur T. Barker, Titusville, Pa.	Titusville.
337	1957	Oct. 1	Goldenrod			Solid granulation	Andrew McShaw, Transfer, Pa.	Crawford County.
338	1957	Sept. 28	do		None	Liquid	Ansel B. Moshier, Warner, N.H.	Sutton, Merrimack County.
339	1956	Oct. 15	Goldenrod-aster	Sample scraped directly from honeycomb.	do	Partly granulated	P. J. Hewitt, Jr., Litchfield, Conn.	Litchfield.
340	1956	do	do	C.U. Apiary	do	Liquid	Norman E. Gary, Ithaca, N.Y.	Tompkins County.
342	1957	Oct. 13	Goldenrod-buckwheat.	C.U. Apiary; unstrained.	do	Crystals	do	Ithaca.
343	1957	Sept. 10	Goldenrod-raspberry.	10% raspberry	do	Partly granulated	W. E. Lyman, Greenwich, N.Y.	Franklin County.
344	1957		Grape, scuppernong.			do	Michael McLaurin, Fayetteville, N.C.	Fayetteville.
345	1956	July	Gum, black-tupelo.	Unstrained (in comb)	None	Liquid	John Wood, Plymouth, N.C.	Plymouth, Washington County.
346	1956		Heartsease	Smartweed		Partly granulated	Walter Witherell, Westhampton, Mass.	Westhampton.
347	1957	Oct. 15	do	Produced 8/20–9/10 strained.	100°	Crystals	Harry Stewart, Winnebago, Minn.	Fairbault, Blue Earth and Martin Counties.
348	1957	October	Heartsease-clover	Also some aster		Soft granulation	Lloyd A. Lindenfelser, Tremont, Ill.	Tremont.
349	1957	Sept. 1	Heartsease-fall blend.		None	Liquid	Rudolph and Herb Studier, Glenville, Minn.	Glenville.
350	1957	Oct. 10	do	Catnip and white aster.	10 min	do	Ray Silver, Logansport, Ind.	Clay Township, Cass County.
351	1956		Holly			do	A. Strang, Lusby, Md.	Lusby.
352	1956		do		None	do	R. R. Boyer, Hollywood, Md.	St. Marys County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
335	7	1	17.4	20	39.67	28.39	0.97	9.52	1.21	----	2.8	4.01	27.44	8.14	35.58	0.297	0.159	0.057	----
336	5	2	16.4	7	40.61	33.75	.52	6.74	.41	----	1.6	5.01	14.11	.00	14.11	.000	.204	.027	24.0
337	7	4	17.8	9	38.42	32.52	.44	6.62	.37	----	3.8	4.50	26.45	3.90	30.35	.147	.360	.064	----
338	5	5	16.7	9	39.68	33.19	.57	6.36	.98	----	2.5	4.18	19.24	2.43	21.68	.126	.224	.044	50.8
Ave., 336-338	6	4	17.0	8	39.57	33.15	.51	6.57	.59	----	2.6	4.45	19.93	2.11	22.05	.091	.263	.045	37.4
339	8	0	17.0	9	35.65	29.00	.42	7.04	4.97	----	5.9	4.14	33.96	8.67	42.63	.254	.297	.055	----
340	9	0	21.4	10	36.08	31.45	.64	5.87	.89	----	3.7	4.02	35.15	8.81	43.96	.251	.221	.098	46.2
Ave., 339-340	9	0	19.2	10	35.87	30.23	.53	6.46	2.93	----	4.8	4.08	34.56	8.74	43.30	.253	.259	.077	----
342	8	4	17.4	11	37.47	31.91	.69	7.96	1.01	----	3.6	4.10	29.18	5.83	35.02	.200	.177	.078	----
343	4	1	18.9	8	40.60	31.96	.70	5.96	.63	----	1.2	3.97	20.31	2.85	23.16	.140	.166	.039	----
344	12	0	21.2	18	34.40	25.42	1.12	11.47	1.55	----	4.8	4.03	35.83	8.64	44.47	.241	.239	.082	----
345	7	1	17.6	15	41.49	31.64	.82	5.73	.79	----	2.0	3.93	22.56	9.34	31.90	.414	.137	.033	17.6
346	6	8	18.6	13	36.70	36.46	3.21	4.19	.42	----	.4	4.38	19.59	1.43	21.02	.073	.228	.042	----
347	5	1	20.6	11	37.76	29.49	.68	7.23	.83	----	3.4	3.88	21.80	3.77	25.57	.173	.094	.078	----
Ave., 346-347	6	4	19.6	12	37.23	32.98	1.95	5.71	.63	----	1.9	4.06	20.70	2.60	23.30	.123	.161	.060	----
348	5	0	19.5	14	36.62	29.97	2.27	6.49	1.76	0.34	3.1	3.60	23.34	6.33	29.67	.271	.154	.057	----
349	5	0	19.0	5	40.52	29.87	.69	6.70	.74	----	2.5	3.95	20.11	4.63	24.74	.230	.078	.048	35.3
350	6	1	17.3	12	37.64	31.82	1.71	5.91	.93	.00	4.7	3.60	29.96	11.16	41.12	.373	.110	.068	23.6
Ave., 349-350	6	1	18.2	9	39.08	30.85	1.20	6.31	.84	----	3.6	3.74	25.04	7.90	32.93	.302	.094	.058	29.4
351	8	0	17.4	16	38.46	25.99	.90	11.07	2.10	----	4.1	4.42	21.73	5.07	26.80	.233	.246	.024	----
352	8	0	18.7	16	39.50	25.30	1.09	9.06	2.21	----	4.1	4.31	19.45	3.81	23.26	.196	.158	.033	----
Ave., 351-352	8	0	18.1	16	38.98	25.65	1.00	10.07	2.16	----	4.1	4.36	20.59	4.44	25.03	.215	.202	.029	----

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
353	1957		Holly-vetch		140°, for 30 min.	Liquid	H. J. Moulton, Portland, Oreg	Portland.
354	1957	July 12	Horsemint	Dry-poor yield unstrained.	None	do	Roy S. Weaver, Jr., Navasota, Texas.	Navasota, Grimes County.
355	1957	July 29	do		do	Some crystals	Joseph Coufal, Fayetteville, Texas.	Fayetteville.
356	1956		Knapweed, brown.	A star thistle		Granulated	Warren A. Malick & Son, Pottsville, Pa.	Pottsville.
357	1957	Aug. 15	Knapweed, Russian.			Liquid	W. R. Hettrick, Hamilton, Mont	Ravalli County.
358	1957	Sept. 14	Knapweed, Russian-white sweet clover.	Unstrained	None	Partly granulated	J. F. Meade, Pablo, Mont	Front Creek, Sanders County.
359	1957		Lespedeza	In comb	do	Liquid	G. E. Curtis, Graham, N.C	Aberdeen.
360	1956		Locust, black	Nearly pure		do	Claude Rose, Madison, Ind	Jefferson County.
361	1956	May 30	do	Strained	110°	do	Arthur G. Strang, Silver Spring, Md.	Lusby, Calvert County.
362	1956	June	do		135°	do	H. R. Swisher, Springfield, Ohio	Clarke County.
363	1957		Locust, black-tulip tree.	Also white clover (fermented).	None	do	Bruce Anderson, Chatham, Va	Chatham.
364	1957		Mallow weed		Slightly	Beginning to granulate.	C. M. Bledsoe, Phoenix, Ariz	Maricopa County.
365	1956	May	Manzanita			Granulated	Charles Arnold, Washoe City, Nevada.	Washoe City.
366	1957	June 1	do	Unstrained	None	Crystals	Hammond & Gentry, Oakdale, Calif.	Mariposa County.
367	1957	do	Marigold		do	Liquid	G. O. Stroope, Waxahachie, Texas.	Ellis County.
368	1956	May 1	Mesquite		do	Granulated	Melvin Beatty, Westmorland, Calif.	16 miles west of Westmorland.
369	1957	May 3	do	Almost pure	do	Soft granulation	Carl Powers, Parker, Ariz	Colo. River Indian Reservation.
370	1956		do		Some	Slight granulation	C. M. Bledsoe, Phoenix, Ariz	Pinal County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
353	6	0	16.5	21	37.93	31.05	0.82	8.30	2.13	0.69	2.4	3.89	22.42	10.38	32.80	0.463	0.131	0.051	----
354	3	1	18.9	5	37.36	34.25	1.01	5.05	.82	----	2.6	3.75	28.86	14.71	43.57	.511	.252	.039	----
355	5	1	18.6	11	37.38	33.00	1.01	6.00	.64	----	3.4	3.70	28.15	12.77	40.91	.454	.189	.050	21.7
Ave., 354–355	4	1	18.8	8	37.37	33.63	1.01	5.53	.73	----	3.0	3.72	28.51	13.74	42.24	.483	.221	.045	----
356	9	0	18.8	13	36.69	28.62	.60	7.57	3.09	----	4.6	4.17	34.36	7.47	41.83	.217	.345	.062	22.6
357	4	1	15.0	9	39.33	31.59	1.65	7.39	2.25	.00	2.8	3.62	17.72	5.83	23.56	.329	.071	.041	33.3
358	2	1	15.8	6	39.11	29.76	1.04	8.21	3.22	.00	2.9	4.09	14.76	7.51	22.27	.509	.109	.032	----
359	4	1	16.5	21	37.22	30.37	.84	8.84	1.38	.62	4.2	3.61	24.24	11.95	36.19	.493	.110	.063	43.5
360	1	0	15.8	13	43.29	24.34	.63	10.14	2.87	----	2.9	4.30	7.64	2.15	9.88	.281	.043	.019	7.5
361	5	0	17.8	16	40.67	27.14	1.00	9.21	1.89	----	2.3	4.10	13.47	3.97	17.44	.294	.069	.019	14.6
362	4	4	18.2	17	38.02	32.51	1.39	5.91	.94	----	3.0	3.82	14.53	5.96	20.49	.410	.044	.017	----
Ave., 360–362	3	1	17.3	15	40.66	28.00	1.01	8.42	1.90	----	2.7	4.03	11.88	4.03	15.94	.328	.052	.018	11.0
363	8	0	16.2	7	37.88	24.60	.67	11.77	3.38	----	5.5	4.99	34.03	2.00	36.03	.059	.595	.063	25.4
364	8	4	16.0	7	40.79	34.40	1.27	5.99	.43	----	1.1	3.82	29.72	16.68	46.39	.561	.247	.027	----
365	5	9	17.0	10	34.68	40.72	.37	5.35	.77	----	1.2	4.42	12.89	4.10	16.99	.318	.214	.038	7.8
366	4	5	18.7	16	35.07	33.48	1.23	7.16	2.02	.00	2.3	4.20	14.82	4.41	19.24	.298	.202	.019	----
Ave., 365–366	5	7	17.9	13	34.88	37.10	.80	6.26	1.40	----	1.8	4.30	13.86	4.26	18.12	.308	.208	.029	----
367	4	4	19.3	7	37.08	34.22	.93	5.30	.44	----	2.7	3.60	23.42	12.26	35.68	.524	.076	.034	27.3
368	5	8	16.2	15	38.70	36.93	.64	5.56	.47	----	1.5	4.19	12.56	3.18	15.74	.254	.104	.017	----
369	3	5	15.4	6	41.39	37.89	1.00	3.99	.26	.00	.1	4.20	12.50	2.28	14.78	.182	.124	.005	8.3
370	8	9	14.8	21	41.14	35.87	1.21	6.71	.32	----	.0	4.22	16.16	2.32	18.48	.144	.158	.013	----
Ave., 368–370	5	7	15.5	14	40.41	36.90	.95	5.42	.35	----	3.8	4.20	13.74	2.59	16.33	.193	.129	.012	----

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
371	1957	September	Mexican clover			Liquid	J. H. Girardeau, Jr., Tifton, Ga.	Tifton, Tift County.
372	1957		Mint			do	G. L. Hazeltine, Marion, Iowa	Marion.
373	1957	July	Mountain laurel	Toxic, produced above 2,600 ft.		do	Roy D. Brown, Del Rio, Tenn.	Cocke County.
374	1957	May 5	Mustard		None	do	Arthur G. Strang, Silver Spring, Md.	Gaithersburg.
375	1957		Oak, poison			do	Xavier Widmer, Medford, Oreg.	Medford.
376	1956		do			Granulated	William M. Perry, McMinnville, Oreg.	McMinnville.
377	1956	June 1	Orange	Strained	110°	do	William Ross, Valyermo, Calif.	Los Angeles County.
378	1956		do		None	Partly granulated	R. W. Taylor, Alhambra, Calif.	San Dimas.
379	1957		do			Crystals	L. B. Crawford, Santa Ana, Calif.	Orange County.
380	1957		Orange-grapefruit		None	Liquid	A. S. Howard, Lake Placid, Fla.	Lake Placid.
381	1957		do		do	Beginning to granulate.	R. N. Neeley, Orlando, Fla.	Orlando.
382	1957		do		do	Liquid	Henry Brown, Kissimmee, Fla.	Kissimmee.
383	1957		do		do	do	Keith Oderkirk, Haines City, Fla.	Haines City.
384	1957		do		do	do	L. T. Dyer, Lake Butler, Fla.	Lake Butler.
385	1957		do		do	do	J. D. Haynie, Gainesville, Fla.	Seville.
386	1957	Mar. 12	do		do	do	Conrad Kramer, Sharpes, Fla.	Minneola.
387	1957		do		do	do	Raymond Bailey, Tavares, Fla.	Tavares.
388	1957		do		do	do	Millard Coggshall, Minneola, Fla.	Minneola.
389	1957		do		do	do	Arthur Brew, Umatilla, Fla.	Umatilla.
390	1957		do		do	do	Frank Robinson, Gainesville, Fla.	Tavares.
391	1957		do		do	do	do	Clermont.
392	1957		Orange-grapefruit			do	A. T. Uzzell, Moore Haven, Fla.	Moore Haven.
393	1957		do	Strained	To strain	Crystals	E. S. Bostwick, Chowchilla, Calif.	Tulare County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
371	9	0	18.2	6	38.28	29.42	0.75	7.94	1.38	--------	4.0	3.90	42.23	13.56	55.79	0.321	0.268	0.067	27.8
372	1	2	18.8	7	38.84	33.33	2.10	4.93	.96	0.00	1.0	4.01	15.90	7.85	23.75	.494	.123	.019	15.0
373	1	1	15.6	15	35.30	24.21	.52	17.64	2.48	.00	4.3	4.49	11.36	1.22	12.58	.107	.219	.029	33.0
374	9	0	18.1	17	37.26	26.43	.45	11.11	1.68	--------	5.0	4.38	30.00	4.55	34.55	.152	.324	.070	18.8
375	4	1	15.6	9	37.74	28.90	.76	9.83	2.34	.00	4.8	4.41	15.58	5.16	20.74	.331	.180	.046	28.6
376	6	1	16.4	23	36.41	27.42	.55	10.49	3.24	--------	5.5	4.70	20.09	5.80	25.89	.289	.387	.056	--------
Ave., 375–376	5	1	16.0	16	37.08	28.16	.66	10.16	2.79	--------	5.2	4.53	17.84	5.48	23.32	.310	.284	.051	--------
377	5	5	17.8	15	38.65	33.52	1.35	5.64	1.02	--------	2.1	3.68	27.12	14.84	41.96	.548	.074	.029	--------
378	2	4	15.3	16	40.90	30.48	1.58	6.46	1.50	--------	3.8	3.73	22.80	11.39	34.19	.497	.088	.033	15.8
379	4	2	17.1	19	38.23	31.49	2.68	7.41	1.47	--------	1.6	3.60	22.77	13.12	35.89	.576	.084	.029	--------
Ave., 377–379	4	4	16.7	17	39.26	31.83	1.87	6.50	1.33	--------	2.5	3.67	24.23	13.12	37.35	.540	.082	.030	--------
380	8	0	--------	3	--------	--------	--------	--------	--------	--------	--------	3.90	30.36	10.34	40.70	.340	--------	--------	15.0
381	7	5	--------	3	--------	--------	--------	--------	--------	--------	--------	3.88	19.16	8.47	27.63	.442	--------	--------	10.9
382	5	4	16.1	6	38.78	31.86	2.03	8.76	1.42	.00	1.0	4.10	28.88	8.81	37.69	.306	.078	.015	6.9
383	5	3	--------	4	--------	--------	--------	--------	--------	--------	--------	4.08	13.94	4.90	18.84	.352	--------	--------	8.7
384	7	2	--------	4	--------	--------	--------	--------	--------	--------	--------	3.67	35.36	14.50	49.86	.412	--------	--------	11.5
385	4	2	--------	4	--------	--------	--------	--------	--------	--------	--------	3.88	25.49	11.25	36.74	.443	--------	--------	22.2
386	4	4	--------	4	--------	--------	--------	--------	--------	--------	--------	3.90	14.24	5.67	19.91	.397	--------	--------	7.3
387	6	5	--------	4	--------	--------	--------	--------	--------	--------	--------	3.83	18.57	7.99	26.56	.428	--------	--------	8.9
388	7	1	--------	3	--------	--------	--------	--------	--------	--------	--------	3.71	20.60	8.73	29.33	.425	--------	--------	9.8
389	5	4	17.6	6	38.41	31.78	2.41	6.73	1.45	.00	1.6	3.82	19.99	7.17	27.16	.358	.061	.010	9.1
390	4	8	--------	4	--------	--------	--------	--------	--------	--------	--------	3.85	14.68	5.81	20.49	.395	--------	--------	18.8
391	4	6	16.1	6	39.80	31.81	1.56	7.63	1.65	.00	1.4	3.83	14.93	5.87	20.80	.392	.061	.003	16.9
392	9	7	--------	4	--------	--------	--------	--------	--------	--------	--------	3.75	22.05	11.21	33.26	.508	--------	--------	9.1
393	4	4	16.0	15	38.56	32.56	5.12	5.51	.95	.46	.8	3.70	22.28	13.49	35.77	.606	.090	.028	--------
Ave., 380–393	6	4	16.5	5	38.89	32.00	2.78	7.16	1.37	--------	1.2	3.84	21.47	8.87	30.34	.415	.073	.014	11.9

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
394	1957		Palmetto		None	Liquid	Cecil W. Hoff, Eau Gallie, Fla.	Eau Gallie.
395	1956	Oct. 20	Palmetto, cabbage.			do	E. E. Chandler, Ft. Pierce, Fla.	Ft. Pierce.
396	1956	August	do	Fermented, frozen on receipt.	None	do	Vern Davis, Steinhatchee, Fla.	Steinhatchee.
397	1957		Palmetto, saw			do	A. T. Uzzell, Moore Haven, Fla.	Moore Haven.
398	1957	July	do			do	M. V. Coggshall, Minneola, Fla.	Brevard County.
399	1957	July	Pentstemon		None	Partly granulated	William E. Somnick, Gardiner, N.Y.	Ulster County.
400	1956		Pepperbush			Liquid	Justin Caswell, Middleboro, Mass.	Middleboro.
401	1956	Aug. 5	Peppermint		None	do	James Bunch, Sunnyside, Wash.	Yakima area.
402	1956	Aug. 15	do	Strained, 5% alfalfa	Mildly	Granulated	Charles G. Becker, Outlook, Wash.	Mabton, lower Yakima valley.
403	1956	June	Peppervine		None	Liquid	Erwin Glew, Paris, Texas	Little River County, Ark.
404	1956	Aug. 15	Privet			do	W. Wortham Maxwell, San Antonio, Texas.	San Antonio.
405	1957	June 27	do			do	do	Do.
406	1957	April	Prune			Soft granulation	Loren E. Vernon, Sonoma, Calif.	Healdsburg, Sonoma County.
407	1956	Nov. 6	Purple loosestrife		None	Liquid	Dudley Monroe, North Adams, Mich.	Hillsdale.
408	1957	August	do		do	Granulated	William E. Somnick, Gardiner, N.Y.	Ulster County.
409	1957		do			Liquid	M. Kushman, Cove City, N.C.	Cove City.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
394	6	0	17.4	10	38.19	29.49	0.76	9.58	1.56	----	3.0	4.51	10.87	4.84	15.71	0.445	0.262	0.019	11.8
395	5	0	19.7	13	37.96	31.20	.63	6.25	.99	----	3.6	3.61	37.62	6.97	44.94	.185	.084	.099	20.1
396	7	3	21.3	4	37.09	33.15	.52	4.07	.58	----	3.3	3.80	28.27	8.81	37.08	.312	.143	.042	----
Ave., 395-396	6	2	20.5	9	37.53	32.18	.58	5.16	.79	----	3.5	3.69	32.95	7.89	41.01	.249	.114	.071	----
397	6	2	15.1	7	37.40	30.88	.62	5.60	1.67	0.00	8.7	3.89	31.48	15.29	46.78	.485	.458	.019	21.1
398	7	1	18.0	8	39.07	30.96	1.04	7.36	1.70	.00	1.9	4.10	21.59	14.12	35.71	.654	.245	.024	7.7
Ave., 397-398	7	2	16.6	8	38.24	30.92	.83	6.48	1.69	----	5.3	3.98	26.54	14.71	41.25	.570	.352	.022	14.4
399	4	2	17.1	8	39.35	32.21	.68	6.93	.98	----	2.7	3.98	17.54	7.23	24.78	.412	.063	.036	----
400	8	4	17.8	12	36.30	31.30	.81	7.11	1.63	----	5.0	4.18	21.85	10.18	32.03	.465	.235	.053	12.0
401	8	4	16.4	10	41.98	31.16	.56	6.84	.78	----	2.3	4.74	28.16	3.20	31.26	.114	.385	.042	17.1
402	10	5	16.5	14	42.23	30.91	.45	5.89	.99	----	3.0	4.68	40.06	3.12	43.18	.078	.561	.047	----
Ave., 401-402	9	5	16.5	12	42.11	31.04	.51	6.37	.89	----	2.7	4.71	34.11	3.16	37.22	.096	.473	.045	----
403	10	0	17.8	18	36.20	25.32	.98	13.51	1.92	.56	3.7	3.92	23.98	8.35	32.33	.348	.148	.017	6.7
404	9	----	16.7	16	38.71	27.97	.80	6.60	.51	.69	8.0	3.80	40.73	18.76	59.49	.461	.191	.048	----
405	4	3	16.6	19	38.53	32.77	1.50	8.35	.74	----	1.5	3.58	28.94	14.77	43.71	.510	.120	.055	----
Ave., 404-405	7	3	16.7	18	38.62	30.37	1.15	7.48	.63	----	4.8	3.68	34.84	16.77	51.60	.486	.156	.052	----
406	8	6	19.4	15	36.94	28.09	.42	10.47	.77	----	3.9	6.10	11.80	.00	11.80	.000	.694	.095	----
407	6	4	18.6	8	38.51	31.34	.31	5.87	1.57	----	3.8	3.88	21.91	9.36	31.27	.427	.083	.049	----
408	7	1	17.1	7	37.93	30.82	.71	8.02	2.27	----	3.1	4.38	23.49	6.63	30.12	.282	.231	.049	----
409	1	0	19.1	21	36.82	27.54	.84	10.51	3.21	.78	1.2	3.52	17.88	7.30	25.18	.408	.062	.034	30.6
Ave., 407-409	5	2	18.3	12	37.75	29.90	.62	8.13	2.35	----	2.7	3.80	21.09	7.76	28.86	.372	.125	.044	----

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
410	1957	Aug. 1	Raspberry		None	Crystals	W. E. Lyman, Greenwich, N.Y.	Hamilton and Franklin Counties.
411	1957	Aug. 1	do		130° for 20 min., 20″ vacuum.	Liquid	do	Do.
412	1956		do	Strained	140°	Crystals	George H. Dale, New Britain, Pa.	Bucks County.
413	1957		do	do	140°	Liquid	do	Do.
414	1957		Rhododendron	Poisonous (acetylandromedol found in sample) (in comb).	None	do	Raymond Presnell, Banner Elk, N.C.	Watauga County.
415	1957		Rosinweed			do	Ralph Wilson, Belmond, Iowa	Belmond.
416	1957	Sept. 6	do			Solid granulation	Harry J. Rodenberg, Wolf Point, Mont.	Wolf Point.
417	1956	June 30	Sage	Strained	110°	Partly granulated	William Ross, Valyermo, Calif.	Los Angeles County.
418	1956	June	do		None	Granulated	L. G. Gear, Los Banos, Calif.	Salinas, Monterey County.
419	1957		do	Strained	To strain	Liquid	E. S. Bostwick, Chowchilla, Calif.	Monterey County.
420	1957		Sage–wild buckwheat.			Soft granulation	I. C. Anderson, Lemon Grove, Calif.	San Diego County.
421	1957	Aug. 1	Sage, white–wild alfalfa.		None	do	Charles D. Morse, Lakeside, Calif.	Barona Indian Reservation, San Diego County.
422	1957		Salt cedar–natural fall blend.	Catsclaw, cotton, mesquite.	Some	Solid granulation	W. A. Burnham, Phoenix, Ariz.	Litchfield.
423	1956	July	Snowbrush	In comb	None	Liquid	C. G. Wenner, Glenn, Calif.	Mt. Lassen, 5,500–7,000 ft.
424	1956		Sourwood	Unstrained	do	do	Max A. Culp, Lenoir, N.C.	Lenoir, Caldwell County.
425	1956		do	In comb	do	do	Raymond Presnell, Shulls Mills, N.C.	Shulls Mills.
426	1957		do		do	do	M. C. Ludlam, Lynchburg, Va.	Amherst County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
410	4	1	18.0	9	40.64	31.46	0.73	6.45	0.94	----	1.8	3.72	21.53	6.74	28.27	0.313	0.102	0.032	14.0
412	10	0	17.2	27	35.50	28.57	.51	11.05	1.62	----	5.6	4.18	34.32	6.11	40.43	.178	.283	.087	----
413	10	0	16.9	15	27.25	25.60	.29	8.54	8.18	----	13.2	4.75	45.06	3.81	48.87	.085	1.028	.108	----
Ave., 410–413	8	0	17.4	17	34.46	28.54	.51	8.68	3.58	----	3.5	4.04	33.64	5.55	39.19	.192	.471	.076	----
414	0	0	16.1	5	33.62	26.49	.52	12.97	2.44	----	7.9	4.78	8.18	1.97	10.15	.240	.179	.028	39.0
415	4	0	18.3	12	39.64	31.03	.70	6.77	.63	----	2.9	3.88	25.56	7.70	33.26	.301	.105	.044	55.6
416	6	5	16.5	12	39.39	33.84	.80	5.67	.80	----	3.0	3.80	24.84	8.86	33.70	.357	.157	.057	----
Ave., 415–416	5	3	17.4	12	39.52	32.44	.75	6.22	.72	----	3.0	3.84	25.20	8.28	33.48	.329	.131	.051	----
417	5	2	17.2	14	38.69	29.47	.94	6.81	1.39	----	5.5	3.78	21.19	11.00	32.19	.519	.100	.041	----
418	6	2	16.9	15	40.69	30.06	1.06	6.88	1.15	----	3.3	3.90	24.27	10.65	34.92	.440	.140	.048	----
419	1	0	14.0	15	41.78	25.05	1.39	8.52	4.61	0.47	4.2	3.75	14.25	5.93	20.18	.416	.085	.022	----
Ave., 417–419	4	1	16.0	15	40.39	28.19	1.13	7.40	2.38	----	4.3	3.81	19.90	9.19	29.10	.458	.108	.037	----
420	7	2	16.4	16	38.86	28.76	.84	8.40	1.01	.51	5.2	3.87	28.00	9.33	37.33	.333	.137	.067	----
421	6	4	16.9	14	37.36	28.61	.86	10.07	1.56	.83	3.8	3.95	23.77	6.97	30.74	.293	.158	.059	----
422	8	9	14.0	10	40.25	36.61	2.41	4.43	.39	.00	1.9	4.12	30.15	9.73	39.88	.323	.352	.059	----
423	6	1	13.7	14	37.81	30.95	1.35	8.84	3.22	----	4.1	3.88	38.23	7.46	45.69	.195	.187	.059	34.5
424	6	0	17.8	15	39.20	25.23	.85	11.38	2.29	----	3.2	4.47	14.92	5.14	20.06	.344	.259	.014	15.6
425	7	0	16.9	15	39.45	23.12	.93	13.53	3.02	----	3.0	4.50	10.75	3.91	14.66	.363	.215	.019	8.6
426	3	0	16.6	7	40.73	25.48	.97	10.47	2.35	.00	3.4	4.65	14.89	1.23	16.13	.083	.217	.026	21.7
Ave., 424–426	5	0	17.1	12	39.79	24.61	.92	11.79	2.55	----	3.2	4.53	13.52	3.43	16.95	.263	.230	.020	15.3

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
427	1957		Sourwood-clover	From east Tennessee foothills.		Liquid	Roy D. Brown, Del Rio, Tenn	Cocke County.
428	1957		Sourwood-sumac	Also white clover (in comb).	None	do	Bruce Anderson, Chatham, Va	Chatham.
429	1957		Spanish needle			Crystals	Frank Fekel, Vineland, N.J	Bridgeport.
430	1956	Oct. 15	Spanish needle-heartsease.			Liquid	James S. Messner, Bareville, Pa	New Jersey, 1 mile south of Chester Ferry.
431	1957	Sept. 15	do			do	M. O. Raley, Paragould, Ark	Paragould.
432	1957		Spearmint			Beginning to granulate.	James E. Bunch, Sunnyside, Wash.	Sunnyside.
433	1956	Oct. 15	Sumac	Scraped from comb	None	Partly granulated	P. J. Hewitt, Jr., Litchfield, Conn	Litchfield.
434	1957		Sumac-white clover.	Some honeydew	do	Liquid	Bruce Anderson, Chatham, Va	Chatham.
435	1956	July 18	Sumac, staghorn-clover.		do	do	Arthur G. Strang, Silver Spring, Md.	Linden, Va.
436	1957	October	Sunflower, wild			Few crystals	M. V. Coggshall, Minneola, Fla	Hendry County.
437	1957	Sept. 16	Tallowtree-peppervine.	Not ripe (in comb)	None	Liquid	J. P. Eckles, Baton Rouge, La	Jeff Davis Parish.
438	1957		Thistle, blue			do	Walter Witherell, Westhampton, Mass.	Lake Champlain area, N.Y.
439	1957		Thistle, blue-clover.		None	Soft granulation	A. D. Hiett, Martinsburg, W. Va	Martinsburg.
440	1956	Aug. 20	Thistle, star	Strained	130°	Liquid	Jess Gentry, Oakdale, Calif	Stanislaus County.
441	1956	Sept. 10	do		None	Granulated	Leo I. Wenner, Hamilton City, Calif.	Hamilton City.
442	1957	Aug. 15	do			Liquid	Lloyd Fox, Fair Oaks, Calif	Sacramento Valley.
443	1957	August	do			Solid granulation	Loren E. Vernon, Sonoma, Calif	Sonoma.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
427	8	0	17.4	15	34.23	25.42	0.86	13.54	2.29	----	6.3	4.35	33.37	8.98	42.34	0.269	0.460	0.058	22.2
428	7	0	17.7	6	39.30	26.40	.90	9.71	1.74	----	4.2	4.48	18.71	5.80	24.51	.310	.262	.036	36.4
429	7	0	18.3	10	41.65	26.69	.89	7.84	.96	----	3.7	3.90	31.19	12.93	44.11	.415	.245	.081	----
430	8	1	16.6	11	41.86	29.49	.60	6.72	1.47	----	3.3	4.05	27.53	11.11	38.64	.404	.194	.059	32.6
431	7	1	17.3	7	39.74	31.01	.65	6.94	1.51	----	2.8	4.20	23.87	8.39	32.26	.352	.243	.057	43.5
Ave., 430–431	8	1	17.0	9	40.80	30.25	.63	6.83	1.49	----	3.1	4.12	25.70	9.75	35.45	.378	.219	.058	38.0
432	6	3	16.6	6	41.09	32.58	.43	5.98	.65	----	2.7	4.30	32.76	5.67	38.43	.173	.313	.045	----
433	10	2	17.6	9	31.46	24.39	1.77	8.21	6.90	----	9.7	4.42	37.74	6.36	44.10	.168	.931	.056	34.1
434	8	0	17.5	7	37.79	26.03	.77	10.17	2.43	----	5.3	4.56	26.91	5.41	32.32	.201	.326	.022	----
435	6	1	17.7	14	36.82	27.89	.63	9.86	2.59	----	4.5	4.25	22.68	4.16	26.84	.184	.203	.047	24.0
436	8	0	20.5	14	37.96	31.13	.89	6.64	1.04	0.35	1.5	3.90	29.17	10.38	39.55	.356	.154	.077	13.3
437	9	1	17.2	7	35.74	34.65	.88	6.51	.98	----	4.0	3.69	29.67	10.70	40.37	.361	.132	.051	23.6
438	2	1	16.4	17	37.30	31.27	1.28	8.43	2.53	.38	2.4	3.88	11.81	4.69	16.50	.397	.039	.033	----
439	6	0	18.8	21	37.00	29.84	.76	7.36	1.80	.62	3.8	3.80	28.29	11.23	39.46	.397	.147	.063	----
440	3	1	13.4	12	36.41	29.63	5.24	6.85	3.46	.98	4.0	3.61	21.13	12.37	33.50	.586	.056	.046	29.4
441	6	7	15.9	12	37.08	34.54	1.08	6.53	2.08	----	2.8	3.73	36.01	13.70	49.71	.380	.121	.069	----
442	3	1	17.3	9	36.98	31.91	1.53	6.87	2.76	.00	2.6	3.30	31.14	17.40	48.54	.559	.080	.055	36.4
443	4	1	16.8	12	37.16	28.47	1.24	7.44	2.66	----	6.2	3.68	22.41	12.44	34.85	.555	.130	.051	----
Ave., 440–443	4	3	15.9	11	36.91	31.14	2.27	6.92	2.74	----	3.9	3.54	27.67	13.98	41.65	.520	.097	.055	32.9

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
444	1956	August	Thistle, star-ladino clover.	Half and half, not strained.	None	Granulated	William C. Koehnen, Glenn, Calif.	Glenn County.
445	1957		Thistle star-honeydew.	Very dry season		Liquid	Xavier Widmer, Medford, Oreg.	Medford.
446	1957		Thyme	From Finger Lakes Co-operative, Groton, N.Y.		Crystals		Catskill Mountains, N.Y.
447	1957		Titi		None	Granulated	Paul Cutts, Chipley, Fla	Chipley.
448	1956		Titi, spring		do	Soft granulation	Wm. W. Wicht, Hattiesburg, Miss.	Hattiesburg.
449	1956	Aug. 10	Trefoil, birdsfoot-vetch.	75-85% birdsfoot trefoil.	do	Beginning to granulate.	Charles Mraz, Middlebury, Vt.	Addison County.
450	1956		Trefoil, birdsfoot-clover.	Small amounts of red and sweet clover (WSC Apiary).		do	Carl A. Johansen, Pullman, Wash.	Pullman.
451	1957	Aug. 1	Tulip tree		None	Liquid	Thomas H. Litz, Baltimore, Md.	Baltimore County.
452	1957	July 4	do		do	do	Arthur G. Strang, Silver Spring, Md.	Gaithersburg.
453	1957		do	From mountains		do	Roy D. Brown, Del Rio, Tenn.	Cocke County.
454	1957		do			do	Allen D. Brooks, Charlestown, Ind.	Charlestown.
455	1956		Tulip tree-basswood.			do	A. J. Elsner, Flourtown, Pa.	Lehigh County.
456	1956	July	Tulip tree-clover		Heated	do	Mrs. A. Storm, Maple Glen, Pa.	Maple Glen.
457	1957		do			do	D. A. Wyrosdick, Knoxville, Tenn.	Knox County.
458	1957		Tulip tree-honeydew.	Also white clover (in comb).	None	do	Bruce Anderson, Chatham, Va.	Chatham.
459	1956	July	Tulip tree-natural spring blend.	Miscellaneous wild flowers.		do	James S. Messner, Bareville, Pa.	Lionville, Chester County.
460	1956		do	Clover, vetch, berries (in comb, NCSC, Apiary).	None	do	W. A. Stephen, Raleigh, N.C.	Raleigh.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
444	7	5	16.6	13	36.89	33.07	0.99	6.12	1.87	-------	4.5	3.70	37.28	14.74	52.02	0.394	0.117	0.064	-------
445	8	3	15.2	7	36.68	28.46	.68	9.63	2.93	0.00	6.4	4.69	34.33	5.39	39.72	.157	.450	.082	41.4
446	8	1	16.8	20	37.13	31.20	.85	8.83	1.70	.34	3.2	4.80	22.41	5.47	27.88	.244	.384	.057	-------
447	9	2	17.7	6	39.23	31.78	.50	7.01	.46	.00	3.3	4.60	17.16	2.05	19.21	.120	.287	.006	16.5
448	7	1	17.5	33	40.85	25.95	1.30	7.43	1.37	-------	5.6	4.41	16.88	1.95	18.83	.116	.144	.040	-------
449	1	2	15.5	10	38.16	31.44	2.15	7.98	2.80	-------	2.0	3.90	13.56	5.04	18.60	.372	.026	.029	10.3
450	4	1	13.8	9	40.76	31.33	1.48	9.18	1.52	-------	1.9	4.09	11.35	4.27	15.62	.346	.042	.028	15.0
451	8	0	17.4	5	35.54	27.35	.60	9.63	2.19	-------	7.3	4.65	26.15	2.30	28.45	.088	.308	.052	-------
452	10	0	16.9	14	32.74	23.08	.14	14.64	4.23	-------	8.3	4.63	42.68	4.24	46.93	.099	.620	.091	33.3
453	11	0	17.9	15	34.19	25.79	.89	11.92	2.99	-------	6.3	4.21	39.06	7.10	46.16	.182	.420	.063	18.5
454	11	0	18.2	18	36.11	27.18	1.11	10.08	2.44	.29	4.6	4.45	45.24	5.18	50.43	.115	.492	.098	13.2
Ave., 451–454	10	0	17.6	13	34.65	25.85	.69	11.57	2.96	-------	6.6	4.45	38.28	4.71	42.99	.121	.460	.076	21.7
455	8	0	16.1	11	34.08	27.32	.90	11.47	2.93	-------	7.2	4.84	26.46	4.34	30.80	.164	.438	.072	30.0
456	10	0	15.8	12	35.32	27.69	.79	9.48	2.13	-------	8.8	4.60	44.20	3.14	47.34	.071	.435	.116	33.7
457	10	1	16.9	14	31.67	22.03	.90	15.37	4.15	.67	8.3	4.70	47.19	3.81	51.00	.075	.755	.102	42.9
Ave., 456–457	10	1	16.4	13	33.50	24.86	.85	12.43	3.14	-------	8.6	4.65	45.70	3.48	49.17	.073	.595	.109	38.3
459	10	9	15.8	14	31.97	32.63	.95	6.87	4.41	-------	7.4						.152	.027	14.4
460	10	0	16.5	17	36.33	25.30	.78	12.13	2.74	-------	6.2	4.54	37.15	3.47	40.62	.094	.428	.078	17.6
Ave., 459–460	10	5	16.2	16	34.15	28.97	.87	9.50	3.58	-------	6.8	4.54	37.15	3.47	40.62	.094	.290	.053	16.0

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
461	1957		Tulip tree–summer blend.	Clover and swamp sources.		Partly granulated	Frank Fekel, Vineland, N.J	Quinton.
462	1957		Tupelo	Purchased by Coggshall.		Liquid		W. Florida.
463	1957		do			do	J. A. Glenn, Wewahitchka, Fla	Wewahitchka.
464	1957		do			do	R. R. Davis, Wewahitchka, Fla	Do.
465	1957		do			do	Homer Coe, Wewahitchka, Fla	Do.
466	1957		do			do	Joe Whitfield, Wewahitchka, Fla	Do.
467	1957		do			do	Carl Culbreath, Apalachicola, Fla.	Apalachicola.
468	1956		Unknown	In comb, deep blue color.	None	do	Dan S. Moss, Enfield, N.C	Halifax County.
469	1956	June	Vetch		160°	Granulated	C. G. Wenner, Glenn, Calif	Petalum.
470	1956	May	do			do	Loren Vernon, Sonoma, Calif	Sonoma County.
471	1957	July 15	do			Liquid	M. O. Raley, Paragould, Ark	Paragould.
472	1957		do	In comb	None	do	William M. Perry, McMinnville, Oreg.	McMinnville.
473	1957		do	Produced in May		do	Lloyd Fox, Fair Oaks, Calif	Sacramento Valley.
474	1957	June	do		None	Partly granulated	J. Oren Kane, Banks, Oreg	Polk County.
475	1957	May	do			Soft granulation	Loren E. Vernon, Sonoma, Calif	Santa Rosa, Sonoma County.
476	1957	Spring	Vetch–birdsfoot trefoil.			Granulated	Delmar L. Smith, Central Point, Oreg.	Central Point.
477	1956		Vetch, hairy	Unstrained		Liquid	Hugh O. Walker, Tulsa, Okla	Tulsa County.
478	1956	July	do		None	do	Erwin Glew, Paris, Tex	Lamar County.
479	1957	June 14	do	From new combs, unstrained.	do	do	S. J. Head, Mer Rouge, La	Morehouse Parish.
480	1957		do		do	Partly granulated	J. W. Wright, Newburg, Oreg	Newburg.
481	1957		do			Liquid	John Bean, Leoma, Tenn	Leoma.
482	1957		do	Nearly pure uncapped and drained.	Below 100°	do	W. D. Haskell, Portland, Oreg	Portland.
483	1957	June	do		None	Scattered crystals	Oliver Petty, Albany, Oreg	Monmouth, Polk County.
484	1957	do	do		Yes	Small crystals	do	Do.
485	1957	July 10	do	Unstrained; traces of bachelor buttons and blackberry.	None	Soft granulation	do	Do.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
461	8	2	17.8	8	38.47	30.26	0.70	7.53	0.95	-------	4.3	4.60	24.51	6.29	30.80	0.253	0.361	0.058	-------
462	6	0	18.4	10	42.25	29.37	.94	6.89	1.22	0.00	.9	4.09	20.41	9.86	30.27	.483	.149	.029	15.8
463	8	0	18.0	19	43.83	25.55	1.31	7.53	1.16	-------	2.6	3.80	30.58	14.56	45.14	.476	.140	.060	18.6
464	7	0	17.4	19	44.26	23.83	1.30	8.31	1.20	-------	3.7	3.83	25.87	12.75	38.62	.493	.108	.045	17.1
465	7	0	18.3	19	42.98	25.42	1.29	8.53	1.05	-------	2.4	3.98	24.54	8.03	32.57	.327	.128	.046	18.1
466	7	0	18.5	19	42.52	25.59	1.24	8.24	.82	-------	3.1	3.80	27.93	13.11	41.05	.470	.129	.051	19.1
467	6	0	18.4	19	43.80	25.91	1.17	8.31	1.22	-------	1.2	3.81	23.44	8.43	31.87	.360	.113	.047	18.1
Ave., 462-467	7	0	18.2	18	43.27	25.95	1.21	7.97	1.11	-------	2.3	3.87	25.46	11.12	36.59	.435	.128	.046	17.8
468	12	0	19.6	12	34.97	24.18	.91	10.72	3.40	-------	6.2	4.20	25.47	8.76	34.23	.344	.267	.049	-------
469	3	6	16.6	15	37.75	33.13	1.62	7.09	1.46	-------	2.3	3.55	21.58	10.60	32.18	.489	.055	.031	16.9
470	4	6	17.7	17	39.34	33.07	.63	5.92	1.23	-------	2.1	3.92	15.73	8.30	24.03	.529	.096	.035	21.7
471	5	2	18.2	9	37.85	32.11	.98	6.21	1.58	.56	2.5	3.80	24.96	11.24	36.20	.450	.135	.023	21.1
472	0	0	16.9	9	38.29	28.48	1.88	8.79	2.64	-------	3.0	3.72	17.76	10.48	28.24	.590	.071	.029	5.9
473	4	1	15.7	12	38.38	31.90	1.39	7.65	2.01	-------	3.0	3.45	29.16	14.50	43.66	.497	.119	.056	-------
474	1	1	16.7	11	38.98	31.27	1.57	7.52	2.27	.00	1.7	3.66	15.20	3.99	19.20	.263	.055	.026	-------
475	4	4	17.4	15	37.69	31.70	1.32	7.46	1.63	-------	2.8	3.90	18.83	8.69	27.53	.462	.130	.034	-------
Ave., 469-475	3	3	17.0	13	38.33	31.67	1.34	7.23	1.83	-------	2.5	3.68	20.46	9.69	30.15	.469	.094	.033	16.4
476	6	4	15.9	20	37.35	32.18	1.69	6.26	1.34	.00	5.3	3.80	28.13	13.55	41.68	.482	.127	.079	-------
477	6	9	15.8	12	38.41	32.86	2.11	6.12	1.64	-------	3.1	3.70	22.48	10.68	33.16	.475	.081	.044	6.1
478	1	1	15.9	17	38.46	30.60	.96	8.98	2.29	.56	2.2	3.80	11.25	5.92	17.17	.527	.038	.017	10.0
479	1	4	19.1	1	37.34	32.30	1.59	4.66	1.65	-------	3.4	3.61	22.58	10.64	33.22	.476	.061	.035	24.2
480	2	1	15.8	8	38.48	30.58	2.01	7.73	2.34	.00	3.1	3.89	14.36	8.64	23.00	.602	.043	.024	-------
481	1	1	17.2	13	40.34	25.51	1.17	10.95	2.18	1.09	1.6	4.00	11.69	2.45	14.14	.210	.048	.026	11.3
482	1	1	16.8	16	37.90	29.37	1.60	9.40	2.43	-------	2.5	3.73	12.44	4.68	17.12	.376	.066	.023	-------
483	1	1	16.1	19	36.55	30.21	5.48	7.39	2.78	.91	.6	3.70	14.42	8.02	22.44	.556	.039	.027	-------
484	1	0	15.2	19	39.11	33.17	1.10	6.57	.64	-------	4.2	3.62	13.66	8.68	22.31	.635	.100	.037	-------
485	2	1	15.0	18	37.22	31.16	2.25	8.49	2.74	.93	2.2	3.70	16.72	7.88	24.60	.471	.025	.036	-------
Ave., 477-485	2	2	16.3	14	38.20	30.64	2.03	7.81	2.08	-------	2.5	3.73	15.51	7.51	23.02	.481	.056	.030	12.9

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
486	1956		Vetch, hairy-natural blend.	Also fruit trees and cucumbers.	Liquid		John T. Harley, Tulsa, Okla	Creek County.
487	1956		Vetch, milk-dandelion.		115°	Complete coarse granulation.	J. W. Holzberlein, Meeker, Colo	Meeker.
488	1956		Willow, black		150°	Liquid	E. C. Bessonet, Donaldsonville, La.	Donaldsonville.
489	1957	May	Willow		None	do	Erwin Glew, Paris, Tex	Chicot County, Ark.
490	1956		Wing stem-lespedeza.	In comb	do	do	L. H. Little, Shelbyville, Tenn	Shelbyville.
491	1956	July	Winter cress		135°	do	H. R. Swisher, Springfield, Ohio	Clark County.
492	1956	September	Honeydew, alfalfa	Honeydew from spotted alfalfa aphid on alfalfa.	None	Granulated	W. E. Riggles, Delhi, Calif	Hilmar.
493	1957		Honeydew, cedar	Sierra Nevada Mts., 4,000 ft.		Liquid	Lloyd Fox, Fair Oaks, Calif	Northern Calif.
494	1957	October	do	Scraped from capped comb, strained.	Warmed	do	A. R. Banta, Los Molinos, Calif	Viola, Shasta County.
495	1957		do	Elevation 2,800 ft	110°	Solid granulation	C. G. Wenner, Glenn, Calif	Manton, Tehama County.
496	1956	Oct. 15	Honeydew, hickory.		None	Partly granulated	P. J. Hewitt, Jr., Litchfield, Conn	Litchfield.
497	1956	Oct. 5	Honeydew, oak		do	Granulated	Leo I. Wenner, Hamilton City, Calif.	Paskereta.
498	1957		do		do	Liquid	Cecil W. Hoff, Eau Gallie, Fla	Eau Gallie.
499	1957		do	Produced in August		do	Lloyd Fox, Fair Oaks, Calif	Sacramento Valley.
500	1957	September	do	Elevation 5,000 ft	120°	Soft granulation	C. G. Wenner, Glenn, Calif	Mt. Lassen area, Shasta County.
501	1957	Fall	do			Granulated	Delmar L. Smith, Central Point, Oreg.	Central Point.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
486	7	4	18.6	12	37.82	31.08	0.62	7.64	1.59	----	2.8	4.12	20.21	5.52	25.73	0.273	0.134	0.048	22.2
487	6	4	16.1	3	38.73	36.25	.25	5.44	.90	----	2.3	4.59	12.70	1.91	14.61	.150	.160	.048	12.2
488	6	6	17.2	13	42.60	33.55	.86	4.51	.14	----	.9	4.20	14.62	3.78	18.40	.258	.072	.030	9.8
489	7	2	18.5	7	38.99	31.46	1.09	6.21	.81	----	2.9	3.89	19.69	5.96	25.65	.302	.115	.026	----
Ave., 488–489	7	4	17.9	10	40.80	32.51	.98	5.36	.48	----	1.9	4.02	17.16	4.87	22.03	.280	.094	.028	----
490	7	0	17.2	10	38.31	28.24	1.15	8.62	1.53	0.68	5.0	4.10	19.08	7.66	26.74	.401	.128	.051	21.4
491	7	2	19.5	16	37.02	32.25	1.11	5.75	.67	----	3.7	3.70	21.68	8.26	29.94	.380	.057	.016	----
492	11	6	17.8	12	35.12	31.86	.68	5.51	2.12	----	6.9	4.25	53.48	3.84	57.32	.072	.480	.149	31.3
493	11	1	12.2	9	23.91	23.34	.83	5.85	11.50	.00	22.4	4.42	66.02	10.47	76.49	.159	1.097	.049	----
494	10	1	15.2	18	26.22	27.94	.74	6.08	8.70	----	15.1	4.71	49.91	6.16	56.07	.123	1.047	.047	----
Ave., 493–494	11	1	13.7	14	25.07	25.64	.79	5.97	10.10	----	18.7	4.54	57.97	8.32	66.28	.141	1.072	.048	----
495	10	2	16.0	16	25.36	26.49	.46	6.66	8.64	----	16.4	4.50	49.90	7.36	57.26	.148	.859	.049	----
496	10	1	15.3	9	31.10	23.89	1.02	8.96	7.78	3.56	8.4	4.70	33.76	3.99	37.75	.118	.670	.046	----
497	9	1	14.7	11	33.38	28.61	.68	10.96	2.43	----	9.0	4.70	49.84	2.00	51.84	.040	.522	.133	----
498	12	1	18.2	8	38.12	29.51	1.14	8.67	1.28	.38	2.7	3.90	36.62	14.09	50.71	.385	.212	.053	6.7
499	10	0	16.2	9	34.59	26.61	.63	10.59	2.47	----	8.9	4.70	64.57	2.58	67.27	.040	.799	.223	41.4
500	10	2	17.7	16	33.70	27.20	1.01	10.99	2.81	.00	6.6	4.80	47.80	5.23	53.04	.109	.758	.126	----
501	9	2	17.9	18	34.42	25.24	.75	11.06	1.81	----	8.8	4.40	56.24	6.16	62.40	.110	.603	.098	----
Ave., 497–501	10	1	16.9	12	34.84	27.43	.84	10.45	2.16	----	7.2	4.35	51.01	6.01	57.05	.137	.579	.127	----

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments [1]	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
502	1956	Oct. 1	Honeydew, oak-star thistle.	From foothills	110°	Granulated	C. G. Wenner, Glenn, Calif.	West of Corning.
503	1956	Early August.	Honeydew	Largest honeydew flow on record here (in comb).	None	Liquid	Robert M. Mead, White River Junction, Vt.	White River Junction.
504	1956	August	do	In comb	do	Granulated	Arthur G. Strang, Silver Spring, Md.	Fauquier County, Va.
505	1957	Summer	do	do		Liquid	William Thompson, Lenoir, N.C.	Lenoir, Caldwell County.

[1] Comments in parentheses are authors; others are producers.

TABLE 27.—*Composition of honey samples and averages of selected groups*—Continued

Sample No.	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
			Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg.*	*Meq./kg.*	*Meq./kg.*		*Percent*	*Percent*	
502	10	0	14.6	11	34.48	25.73	0.99	11.11	3.72	0.40	9.4	4.88	53.62	0.36	53.98	0.007	0.711	0.133	-------
503	8	3	18.2	12	33.05	25.12	1.05	9.16	5.57	.95	6.9	4.58	30.29	4.33	34.62	.143	.468	.058	48.4
504	10	8	17.3	15	28.94	19.23	.44	5.11	2.82	13.43	11.1	4.30	41.00	8.96	49.96	.219	1.185	.108	-------
505	12	0	16.4	8	32.82	24.41	.79	12.48	4.10	.00	9.0	4.80	53.95	5.68	59.63	.105	.890	.124	-------
Ave., 504-505	10	4	17.3	12	31.60	22.92	.76	8.92	4.16	-------	9.0	4.51	41.75	6.32	48.07	.156	.848	.097	-------
ALL HONEY (490 SAMPLES)																			
Average	5	3	17.2	12	38.19	31.28	1.31	7.31	1.50	-------	3.1	3.91	22.03	7.11	29.12	.335	.169	.041	-------
ALL HONEYDEW (14 SAMPLES)																			
Average	10	2	16.3	12	31.80	26.08	.80	8.80	4.70	-------	10.1	4.45	49.07	5.80	54.88	.127	.736	.100	-------
ALL HONEY AND HONEYDEW (504 SAMPLES)																			
Average	5	3	17.2	12	38.00	31.13	1.30	7.35	1.60	-------	3.3	3.92	22.80	7.07	29.85	.329	.186	.043	[2] 20.6
ALL 1956 HONEY (191 SAMPLES)																			
Average	6	4	17.0	14	37.92	31.15	1.32	7.44	1.69	-------	3.4	3.96	22.16	7.05	29.21	.336	.173	.041	-------
ALL 1957 HONEY (313 SAMPLES)																			
Average	5	3	17.3	11	38.36	31.37	1.31	7.22	1.38	-------	2.9	3.88	21.95	7.15	29.10	.334	.166	.041	-------

[1] See p. 6 for explanation of color and granulation codes.
[2] Average for 263 samples.

TABLE 28.—*Average composition of honey and honeydew samples classified by State of origin*

State	Number	Color[1]	Granulation[1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen
				Percent	*Month*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*
Maine	1	7	5	18.8	27	35.70	33.90	1.98	5.88	2.32	1.4	4.10	24.11	4.82	28.93	0.200	0.180	0.067
New Hampshire	2	7	3	16.1	10	39.26	32.17	.74	6.91	2.27	2.5	4.14	22.60	5.51	28.12	.228	.210	.047
Vermont	3	2	4	15.6	10	38.24	32.37	1.61	7.72	2.59	2.0	3.92	13.67	5.28	18.95	.387	.041	.029
Massachusetts	7	7	3	17.2	14	36.72	31.68	1.57	7.18	1.80	3.8	4.12	19.15	5.41	24.56	.291	.203	.043
Rhode Island	15	7	2	16.6	15	36.34	29.47	.88	9.51	1.76	5.4	4.14	22.25	6.96	29.22	.306	.343	.045
Connecticut	4	9	1	17.3	3	35.27	27.86	1.07	7.83	4.70	5.9	4.16	32.96	8.51	41.47	.269	.480	.045
New York	17	5	2	17.5	9	38.57	31.80	1.29	6.94	1.45	2.5	3.85	22.15	6.54	27.73	.312	.133	.046
New Jersey	8	8	1	17.4	11	37.87	28.81	.85	8.63	2.04	4.3	4.13	28.79	7.63	36.41	.278	.287	.055
Pennsylvania	27	7	2	17.7	10	36.22	30.59	.94	7.44	2.01	5.1	3.98	27.84	6.33	34.17	.243	.252	.053
North Atlantic	84	6	2	17.3	12	37.05	30.65	1.10	7.67	1.99	4.2	4.01	24.60	6.55	30.97	.280	.239	.049
Ohio	7	6	2	18.2	15	38.16	32.56	1.58	6.14	.98	2.2	3.77	21.79	8.38	30.31	.395	.082	.029
Indiana	8	6	2	17.5	13	38.83	30.75	1.30	7.02	1.39	3.1	3.73	28.52	9.64	38.18	.351	.162	.057
Illinois	9	4	2	18.2	13	38.06	32.49	1.49	6.13	.98	2.5	3.74	21.88	7.00	28.88	.311	.114	.042
Michigan	7	4	3	17.6	11	38.37	32.73	1.24	5.84	1.36	2.7	3.82	22.18	8.65	30.83	.394	.099	.041
Wisconsin	16	3	3	18.2	14	38.01	31.76	.97	6.84	1.34	2.8	3.86	18.51	6.37	24.88	.340	.099	.036
East North Central	47	4	3	18.0	13	38.23	31.97	1.25	6.50	1.23	2.7	3.79	21.82	7.64	29.48	.352	.110	.040
Minnesota	26	4	2	18.9	12	37.95	31.70	.99	6.54	1.24	2.6	3.83	18.72	5.88	24.60	.318	.093	.037
Iowa	17	3	2	18.7	9	38.94	32.59	1.06	5.86	.99	1.9	3.84	18.81	6.52	25.32	.350	.098	.038
Missouri	7	6	2	17.0	12	37.65	30.31	1.93	6.89	2.48	3.6	3.92	26.01	10.25	36.26	.411	.141	.062
South Dakota	4	1	5	16.6	8	38.72	33.57	2.23	5.97	.81	2.1	3.88	11.43	3.87	15.27	.337	.031	.022
Nebraska	7	3	4	16.9	13	38.37	33.22	1.38	6.23	.97	2.9	3.89	15.41	7.09	22.50	.463	.068	.032
Kansas	2	4	2	17.2	11	38.31	33.58	2.27	6.07	1.12	1.6	3.84	20.48	9.82	30.29	.474	.070	.042
West North Central	63	4	3	18.2	11	38.27	32.13	1.29	6.32	1.26	2.5	3.86	18.78	6.69	25.46	.360	.092	.039
Delaware	1	9	0	17.0	5	37.06	29.63	.87	8.68	1.30	5.5	4.28	26.44	6.25	32.69	.236	.275	.041
Maryland	16	8	1	17.1	15	36.68	27.15	.78	10.24	2.44	5.6	4.27	27.54	4.53	32.06	.201	.284	.048
Virginia	11	7	0	17.2	10	37.91	26.42	.80	10.27	2.44	4.9	4.20	24.07	4.27	28.34	.190	.303	.040
West Virginia	2	7	0	18.6	21	37.46	30.43	.87	7.00	1.92	3.1	3.79	28.76	10.88	39.61	.379	.152	.067
North Carolina	11	7	1	17.8	16	37.53	27.04	.98	10.40	2.18	4.0	3.99	21.57	6.78	28.35	.333	.201	.043
South Carolina	1	7	1	17.4	20	39.67	28.39	.97	9.52	1.21	2.8	4.01	27.44	8.14	35.58	.297	.159	.057
Georgia	7	5	1	17.2	10	39.90	29.67	.76	8.15	1.35	3.0	4.03	20.00	5.87	25.86	.277	.139	.033
Florida	37	6	2	18.2	9	39.19	29.35	1.03	7.86	1.25	3.1	3.91	22.78	8.73	31.52	.388	.191	.039
South Atlantic	86	7	1	17.7	12	38.24	28.25	.91	9.06	1.81	4.0	4.01	23.71	6.99	30.70	.312	.220	.042

Kentucky	5	6	3	17.3	18	37.96	30.61	1.05	8.58	1.21	3.3	4.07	20.77	4.38	25.15	.197	.289	.043
Tennessee	12	6	1	17.8	13	36.29	27.06	1.13	10.97	2.25	4.3	4.03	27.25	7.17	34.42	.268	.296	.048
Alabama	1	6	0	16.0	21	39.14	30.06	.70	8.49	1.19	4.4	4.30	16.29	3.17	19.46	.195	.196	.044
Mississippi	7	4	2	17.7	23	38.15	30.44	1.04	7.70	1.49	3.2	3.88	18.17	5.09	23.26	.267	.102	.037
Arkansas	7	6	2	18.5	10	38.02	30.89	1.08	7.20	1.37	2.8	3.81	25.17	9.31	34.47	.365	.158	.036
Louisiana	8	6	3	17.8	10	38.01	31.72	1.02	6.86	1.13	3.4	3.88	22.75	7.70	30.45	.340	.152	.043
Oklahoma	10	5	4	17.0	14	38.17	31.78	1.66	7.03	1.42	2.9	3.81	22.94	8.27	31.18	.370	.122	.044
Texas	18	5	4	17.2	10	37.92	33.21	1.07	6.13	1.01	3.1	3.85	27.66	10.20	37.85	.388	.204	.035
South Central	68	6	3	17.5	13	37.75	31.04	1.15	7.65	1.39	3.3	3.89	24.40	7.92	32.31	.326	.192	.041
Montana	25	2	6	16.1	10	39.48	33.39	2.31	6.12	1.07	1.6	3.89	12.50	5.11	17.77	.407	.057	.028
Idaho	4	3	6	15.0	10	39.91	34.03	1.57	6.50	.93	2.0	3.90	12.40	4.75	17.15	.389	.054	.024
Wyoming	13	2	4	16.1	11	39.15	33.50	2.55	6.18	.88	1.6	3.83	12.20	4.12	16.23	.335	.042	.022
Colorado	10	4	3	16.0	8	39.35	32.16	1.20	6.99	1.42	2.8	3.97	20.72	5.20	25.91	.276	.190	.050
Intermountain West	52	2	5	16.0	10	39.41	33.22	2.08	6.35	1.08	1.9	3.89	14.03	4.86	18.95	.363	.081	.031
Arizona	12	6	7	16.0	9	39.70	36.03	1.56	4.99	.46	1.2	4.07	24.10	6.80	30.91	.275	.294	.031
Utah	1	4	2	14.2	6	41.54	32.02	1.16	7.14	1.29	2.6	4.00	18.89	5.45	24.34	.289	.123	.015
Nevada	2	4	9	15.6	9	36.09	36.64	3.97	5.75	.89	1.2	4.30	10.11	3.04	13.15	.294	.132	.030
Washington	8	5	4	16.2	12	40.76	32.05	.89	6.99	.97	2.1	3.95	26.20	7.30	33.49	.295	.207	.041
Oregon	19	4	2	16.0	17	37.43	30.13	1.57	8.64	2.46	3.5	3.86	21.15	8.01	29.15	.403	.161	.045
California	60	5	5	16.3	15	38.46	32.20	1.57	6.82	1.45	3.1	3.82	24.33	9.35	33.68	.391	.171	.047
Alaska	2	5	1	15.5	24	39.19	30.27	.86	9.73	2.42	2.4	4.07	13.10	3.95	17.05	.299	.083	.033
West	104	5	4	16.1	14	38.61	32.33	1.55	6.99	1.48	2.8	3.88	23.26	8.31	31.57	.365	.184	.043

[1] See p. 6 for explanation of color and granulation codes.

TABLE 29.—*Average composition of "single-source" honey and honeydew samples classified by plant family*

Family	Number	Color [1]	Granulation [1]	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen
				Percent	*Months*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Meq./kg*	*Meq./kg*	*Meq./kg*		*Percent*	*Percent*
Anacardiaceae	3	7	1	16.5	14	35.20	26.90	1.03	9.51	4.16	.7	4.49	24.47	5.77	30.24	0.263	0.499	0.053
Aquifoliaceae	8	6	1	17.3	14	39.63	29.02	.79	8.30	1.46	.3	4.24	17.29	4.46	21.74	.255	.173	.028
Asclepiadaceae	1	4	0	16.1	16	35.35	28.34	2.63	7.20	5.30	4.7	3.90	15.84	6.99	22.83	.441	.103	.040
Boraginaceae	1	2	1	16.4	17	37.30	31.27	1.28	8.43	2.53	2.4	3.88	11.81	4.69	16.50	.397	.039	.033
Clethraceae	1	8	4	17.8	12	36.30	31.30	.81	7.11	1.63	5.0	4.18	21.85	10.18	32.03	.465	.235	.053
Compositae	18	6	2	17.5	12	38.19	31.17	1.15	7.18	1.45	.3	3.88	24.98	7.48	32.46	.284	.202	.055
Cruciferae	2	8	1	18.8	17	37.14	29.34	.78	8.43	1.18	.4	3.93	25.84	6.41	32.25	.266	.191	.043
Cucurbitaceae	2	6	5	17.1	11	37.60	33.55	2.15	5.54	1.03	.3	3.81	26.20	9.81	36.05	.385	.149	.033
Cyrillaceae	2	8	2	17.6	20	40.04	28.87	.90	7.22	.92	.4	4.49	17.02	2.00	19.02	.118	.216	.023
Ericaceae	10	5	2	17.1	13	36.64	28.61	.82	10.36	2.21	.4	4.44	15.18	3.95	19.14	.260	.233	.031
Fagaceae	9	10	1	16.5	12	34.39	26.12	.86	11.14	3.15	.8	4.50	42.60	5.02	47.63	.131	.647	.099
Juglandaceae	1	10	1	15.3	9	31.10	23.89	1.02	8.96	7.78	8.4	4.70	33.76	3.99	37.75	.118	.670	.046
Labiatae	12	5	3	17.0	12	39.00	31.90	.99	6.46	1.36	.3	3.91	26.00	8.89	34.88	.365	.231	.043
Leguminosae	108	4	3	17.1	12	38.47	31.96	1.67	6.92	1.35	.2	3.80	19.13	7.63	26.76	.403	.097	.033
Lythraceae	3	5	2	18.3	12	37.75	29.90	.62	8.13	2.35	.3	3.80	21.09	7.76	28.86	.372	.125	.044
Magnoliaceae	4	10	0	17.6	13	34.65	25.85	.69	11.57	2.96	.7	4.45	38.28	4.71	42.99	.121	.460	.076
Malvaceae	11	5	8	16.1	10	39.41	36.53	1.16	4.97	.49	.1	4.22	25.07	6.25	31.33	.239	.331	.036
Myrtaceae	2	6	3	17.0	18	39.35	32.27	1.43	6.84	.80	.2	4.14	18.96	7.51	26.46	.383	.204	.050
Nyssaceae	6	7	0	18.2	18	43.27	25.95	1.21	7.97	1.11	.2	3.87	25.46	11.12	36.59	.435	.128	.046
Oleaceae	5	5	4	16.3	19	39.33	30.58	1.23	7.26	1.49	.3	3.76	25.51	11.19	36.70	.419	.127	.040
Palmae	4	6	1	18.3	8	37.94	31.14	.71	6.57	1.30	.4	3.89	25.97	10.01	36.04	.416	.238	.041
Pinaceae	3	10	2	14.5	14	25.16	25.92	.68	6.20	9.61	1.8	4.53	55.28	8.00	63.27	.143	1.001	.048
Polygonaceae	14	8	3	17.7	12	36.79	30.10	.92	7.17	1.71	.5	4.01	30.76	6.42	37.18	.214	.237	.059
Rhamnaceae	1	6	1	13.7	14	37.81	30.95	1.35	8.84	3.22	4.1	3.88	38.23	7.46	45.69	.195	.187	.059
Rosaceae	6	8	2	17.4	16	36.20	27.65	.65	9.85	2.64	.6	4.22	28.31	3.45	29.50	.145	.473	.070
Rubiaceae	1	9	0	18.2	6	38.28	29.42	.75	7.94	1.38	4.0	3.90	42.23	13.56	55.79	.321	.268	.067
Rutaceae	3	4	4	16.7	17	39.26	31.83	1.87	6.50	1.33	.2	3.67	24.23	13.12	37.35	.540	.082	.030
Salicaceae	2	7	4	17.9	10	40.80	32.51	.98	5.36	.48	.2	4.02	17.16	4.87	22.03	.280	.094	.028
Scrophulariaceae	1	4	2	17.1	8	39.35	32.21	.68	6.93	.98	2.7	3.98	17.54	7.23	24.78	.412	.063	.036
Tamaricaceae	1	7	9	14.3	12	40.84	39.11	.78	3.66	.13	1.2	4.09	29.05	8.84	37.89	.304	.240	.069
Tiliaceae	3	4	3	17.4	15	37.88	31.59	1.20	6.86	1.44	.3	4.05	16.78	6.58	23.70	.382	.084	.022
Verbenaceae	1	5	4	22.3	6	36.05	31.61	.45	5.18	.59	3.5	3.93	22.28	6.61	28.89	.298	.119	.017
Vitaceae	2	11	0	19.5	18	35.30	25.37	1.05	12.49	1.74	4	3.97	29.91	8.50	38.40	.295	.194	.050

[1] See p. 6 for explanation of color and granulation codes.

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