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Analysis of Honey

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Honey, a food rich in carbohydrates that has unique flavoring properties, is the nectar and sweet exudations of plants, gathered and transformed by honey bees and stored in the comb. Connecticut Statutes define honey as the natural product of the honey bee taken from the nectar of flowers, transformed by the bee, and then taken from the honeycomb and marketed in a liquid, candied, or granulated form (4).

Each year over 17 million gallons of honey are harvested by beekeepers in the United States (1). About 4% of the United States harvest is exported, but over nine million gallons are imported. Of the amount imported 40% is from Mexico, 28% from Australia, 17.6% each from Argentina and China, and 14% from Canada (1).

Honey bees convert the nectar gathered from plants primarily into glucose and fructose, but if the bees are fed largely sucrose, some of the sucrose will be unchanged during the modification process and therefore be detectable.

Hundreds of honey types and blends are known but only about 30 are of commercial significance (3). Types include liquid, crystallized or partially crystallized honey. Type also may indicate what gives the honey its characteristic flavor; for example, buckwheat, wildflower, and clover. Honey is also designated as extracted or strained. Extracted honey is separated from the uncrushed comb, usually by centrifugation. Strained honey is removed from the crushed comb by filtration or sieving.

Honey ranges in color from white to very dark. Standards for grades of honey are established by the United States Department of Agriculture (2). Grades primarily deal with color, clarity, flavor and aroma, and absence of such defects as particles of comb or propolis (the resinous material used to make the hive). Grades A and

B honey must contain at least 81.4% soluble solids and grade C at least 80% (2).

In Connecticut 733 beekeepers tend 3691 hives (7). Operations range from hobbyists with one hive to commercial beekeepers with 63 hives. Commercial beekeepers rent their hives to orchardists and other farmers to pollinate, for example, fruit trees and cucumbers.

This Bulletin reports analysis of honey collected in Connecticut during 1985 to test for pesticide residues. This shows if the bees had consumed pollen or other materials with pesticide residues and if any residues were incorporated into the honey. Since honey is primarily a source of carbohydrate we analyzed for glucose and fructose. We also determined acid and lactone to test for certain sources of sugars scavenged by bees. Because microbes can grow and spoil the honey if the water content exceeds 17%, water content was measured for compliance with the standard for solids content. Tests for ash content measure inorganic constituents in the honey.

METHODS

Honey samples were collected by inspectors of the Food Division of the Connecticut Department of Consumer Protection and inspectors of the Entomology Department of The Connecticut Agricultural Experiment Station. During August and September, 1985, 58 samples were collected in Connecticut at food stores, roadside markets and directly from beekeepers.

The water content was analyzed by AOAC method 31.119 (solids content is 100% minus water content); ash by method 31.120; sugars by method 31.145-31.149; and total acid, free acid,

and lactone by method 31.168 (5). Pesticides were tested by FDA screening method 211-13d (6) which reveals many chlorinated and organophosphate pesticides.

RESULTS AND DISCUSSION

The brand name or producer is shown in Table 1. Towns not followed by a State name are in Connecticut. Twenty-nine of the samples were produced in Connecticut and nine were from the neighboring states of Rhode Island, Massachusetts and New York (Table 1). Honey produced in the United States may be mixed with imported honey, but the country of origin must be printed on the label. Eight samples contained honey from a foreign country: Basics (USA, Mexico, Argentina); Edwards Finast, National, and Shop Rite (USA, Canada, Argentina); Natural Pure (Canada, Argentina), Sue Bee Clover (USA, Canada); and Vermont Maple Orchards and Natural Sales (Canada) (Table 1).

Water content varied from about 14 to 17%, with an average of 16% (Table 1). All samples were within the normal range and complied with the standard for minimum solids content of 81.4% for grade A honey.

The average ash content was 0.23% with a range from 0.04 to 0.63% (Table 1). These values are normal (3).

Total carbohydrates in honey can range from 43 to 71% (3). The major proportion of the carbohydrates in honey is fructose and glucose. Some sucrose may be present, but large amounts indicate that the bees were fed sucrose or sucrose was added to the honey. Fructose ranged from about 30 to 46%, with an average of 37%. Glucose averaged 31% and ranged from about 22 to 39%. Although some samples were slightly above the normal range for glucose and fructose (3), adulteration is not indicated since honey varies with the sources scavenged by the bees or the season (3). No samples contained sucrose. Honey may also contain small quantities of other sugars such as maltose, but much less than glucose and fructose.

We also tested for total acids to determine if products were within the normal range. The average was 41 milliequivalents per 100 grams and ranged from about 23 to 71. Several samples were low in total acidity according to

published values (3), but we attach no importance to this since acid in honey can vary depending on sources scavenged by the bees.

Free acids and lactones were determined to calculate the ratio of lactone to free acid, which is labeled "Ratio L:FA" in Table 1. An inordinately low ratio suggests the bees may have fed on insect honeydew in addition to nectar and pollen (3). The results indicate little or no feeding on honeydew.

None of the samples tested had detectable pesticide residues. The samples appeared normal in color and clarity.

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TABLE 1--ANALYSIS OF HONEY

Brand or producer	Moist- ture,%	Ash,%	Fruc- tose,%	Gluc- ose,%	Acids total meq/kg	Ratio L:FA(a)
A. Avitabile, Bethlehem	15	0.47	34	26	47	0.46
Arthur Paine, Stony Creek	17	0.32	37	28	52	0.45
Balanced(clover)	15	0.09	39	35	26	0.70
Basics*	16	0.16	39	32	32	0.70
Candlewood Valley Apiary, Brkfld Cntr	16	0.63	43	32	47	0.42
Dawes Hill(clover), Newfield, NY	17	0.14	39	32	32	0.74
Don Taylor(wildflower), Danbury	17	0.46	37	27	49	0.44
Drapers Apiaries, Millerton, PA	15	0.15	46	39	44	0.64
Drapers Apiaries, Millerton, PA	15	0.15	40	34	43	0.76
Dutch Gold, Lancaster, PA	17	0.17	39	36	38	0.69
Early Brook, Haddam	17	0.58	34	25	54	0.39
Edwards Finast*	16	0.06	36	31	28	0.77
Farm Product(orange blossom), Bally, PA	16	0.07	34	27	29	0.86
Farmer Apiary, Bristol	17	0.40	38	28	46	0.51
G. L. Bailey, Mansfield Center	16	0.40	33	27	52	0.45
Golden Blossom, Doylestown, PA	15	0.10	32	27	35	0.74
Golden Blossom, Doylestown, PA	14	0.11	39	34	71	0.29
Golden Blossom, Doylestown, PA	14	0.11	42	36	34	0.72
Health Foods Pure	17	0.24	37	33	61	0.31
Henry Ellis(buckwheat), Harwinton	17	0.20	38	32	66	0.37
Henry Ellis(creamed), Harwinton	16	0.17	38	33	39	0.54
Henry Ellis(wildflower), Harwinton	15	0.20	38	34	40	0.67
Henry Ellis, Harwinton	16	0.11	38	31	40	0.73
Hidden Meadow Farm, Easton	16	0.59	34	23	48	0.35
Hilltop Honey Farm(clover), Griswold	15	0.10	37	31	34	0.52
Honeycomb Apiaries(buckwheat), Cromwell	17	0.16	33	29	52	0.49
Joseph Sutula, Hamden	16	0.18	38	29	35	0.45
Krasdale(clover)	16	0.08	39	34	36	0.51
Laviana's Orchards, Kensington	17	0.42	38	31	56	0.49
Laviana's Orchards, Kensington	16	0.40	33	25	59	0.38
Mark's Apiary, S. Glastonbury	14	0.11	34	31	34	0.74
Middlefield Apiaries, Middlefield	15	0.44	39	31	52	0.43
Moorland Apiaries(clover), Hopedale, MA	15	0.08	43	37	30	1.07
Moorland Apiaries, Hopedale, MA	17	0.21	38	32	33	0.50
Moorland Apiaries, Hopedale, MA	16	0.08	39	35	30	0.75
National, St. Paul, MN*	16	0.09	39	33	33	0.44
Natural Pure, Onsted, MI*	17	0.08	38	34	32	0.91

TABLE 1--ANALYSIS OF HONEY (Continued)

Brand or producer	Moist- ture,%	Ash,%	Fruc- tose,%	Gluc- ose,%	Acids total meq/kg	Ratio L:FA(a)
Natural Sales(clover)*	16	0.04	38	36	23	1.22
Omer Hebert, Woodstock	17	0.62	34	27	45	0.37
Richardson's Bee Farm, New Hartford	17	0.18	40	36	36	0.79
Richardson's Bee Farm, New Hartford	17	0.58	32	22	49	0.38
Sandt's(buckwheat), Easton, PA	16	0.11	37	33	45	0.47
Shop Rite	16	0.08	38	33	31	0.53
Shop Rite*	16	0.07	37	32	27	0.61
Sue Bee (clover)*	15	0.07	33	29	29	1.02
Sunny Acres Apiary, Sprngfld Cntr, NY	16	0.13	34	28	47	0.74
Thomas Anastasio, Haddam	16	0.46	40	28	47	0.41
Uncle Rogers & Sons, Fairfield	15	0.13	34	25	25	0.50
Vermont Maple Orchards, Essex, VT*	17	0.05	38	34	26	0.96
Vincent Kay, New Haven	15	0.34	33	26	40	0.53
Vincent Kay, New Haven	15	0.19	36	31	37	0.55
Wilder's Apiaries, Ashaway, RI	17	0.17	38	33	39	0.70
Wilder's Apiaries, Ashaway, RI	15	0.28	39	35	52	0.91
Wilder's Apiaries, E. Greenwich, RI	17	0.17	34	29	40	0.52
William Pfander, Essex	15	0.16	39	27	30	0.69
Wilton Gold, Wilton	14	0.52	30	22	43	0.39
Wilton Gold, Wilton	16	0.45	36	28	42	0.44
Wixson's, Dundee, NY	15	0.10	37	32	35	0.96
Average	15	0.23	37	31	41	0.61
Minimum	14	0.04	30	22	23	0.29
Maximum	17	0.63	46	39	71	1.22

(a) = ratio of lactone to free acid

Asterisk (*) indicates labeled as containing imported honey