

HONEY IN NUTRITION

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Received for Publication September 25, 1955

Honey is the product of the bee's matchless alchemy, perfected through millions of years of processing. It is a processing completely the reverse of man's technology which produces refined sugar and other debased products bereft of all the most nourishing and valuable elements to leave a residue of dubious nutritional value.

By contrast, the bee creates a food including not only all the most valuable nutritive elements but also immune from spoilage, and permitting storage for almost indefinite periods. If milk, eggs, butter and other highly perishable foods could keep as long as honey preserving their original aroma, savor and vitamin content for years, the savings in vital food resources would be incalculable. Refrigeration would be unnecessary and contamination unknown.

Honey is also a pre-digested food and requires no further work of assimilation by the digestive glands and pancreas. In further contrast to man's processed foods which require supplementary vitamins and minerals to facilitate metabolism, honey carries its own components of necessary vitamins to complete absorption and utilization by the system. It does not draw upon the body's stores of vitamins and other bio-chemical elements; certainly an invaluable feature.

Before our age of technology brought an unworthy substitute — refined sugar — honey had always been the favorite delicacy in man's dietary. From the time immemorial he found it would renew his energy, was a delight to the palate and had excellent nutritional value.

Honey was included in the rations of Roman soldiers. It was combined with a paste of ground sesame seeds, forming a food both highly palatable and nourishing. For centuries this recipe known as Halvah has been eaten with relish throughout the Near East. Unfortunately the modern product on sale today only imitates the old sesame seed-honey confection by substituting corn syrup.

Roman soldiers were reputedly aware of the germicidal properties of honey and rubbed it on their wounds and injuries. These many unique features of honey inspired the ancient Romans, Greeks and Egyptians to inscribe tributes on their tablets and scrolls. Honey was served at banquets and religious festivals with great reverence. The wisdom of the ancients recognized its superb qualities by hailing it as "The Nectar of the Gods".

The modern chemist perpetuates this high regard for he has isolated in honey most of the necessary vitamins and minerals needed to sustain life, not only in the bee, but in humans. Its two principal sugars, levulose (fruit sugar) and dextrose (grape sugar) are particularly rich in fractions of the B complex. Sucrose, (cane sugar) is also present though only about two per cent in amount. The minerals of honey include iron, copper, phosphorus, silica, calcium, magnesium, potassium and sodium.

TABLE 2

Variation in Silica, Phosphorus, Calcium, and Magnesium Content of Light and Dark Floral honeys

Constituent	LIGHT HONEYS				DARK HONEYS			
	Minimum		Maximum		Minimum		Maximum	
	Pct. of ash	Mg. per kg.	Pct. of ash	Mg. per kg.	Pct. of ash	Mg. per kg.	Pct. of ash	Mg. per kg.
Silica (SiO ₂)	1.60	14	7.07	36	1.03	13	5.82	72
Phosphorus	1.03	23	9.55	50	0.84	27	6.67	58
Calcium	3.54	23	13.00	68	0.46	5	7.30	266
Magnesium	1.00	11	9.24	56	0.66	7	11.47	126

TABLE 1

ASH, SILICA, PHOSPHORUS, CALCIUM, AND MAGNESIUM CONTENT OF HONEY

Classification Samples	Ash	Silica		Phosphorus		Calcium		Magnesium	
		Pct. of ash	Mg. per kg.						
LIGHT HONEYS									
water-white 3	.045	4.83	24	7.23	31	10.83	50	4.39	18
white 11	.096	2.90	21	5.51	39	6.72	47	2.46	20
average --	.070	3.86	22	6.37	35	8.77	49	3.42	19
DARK HONEYS									
light amber 12	.125	3.42	37	4.00	42	5.05	60	2.59	32
amber 3	.221	2.22	46	2.92	52	3.03	60	1.76	36
dark 6	.120	2.97	26	4.10	48	2.63	33	2.96	38
average --	.155	2.87	36	3.67	47	3.57	51	2.77	35

According to Dr. Mykola H. Haydak of the University of Minnesota, though honey has an acid reaction it is really a potentially alkaline food. The acids of honey are mostly organic and break down into carbon dioxide and water in the human physiology and provide some of the elements necessary to heat formation.

Minerals determine the acid or alkaline potential and the preponderance of calcium, magnesium, potassium and sodium make honey a potentially alkaline food. Chlorine, phosphorus and sulphur predominate in acid foods. Honey therefore ranks quite favorably with fruits and vegetables for its alkaline value.

The flavor and color of honey is determined by the variety of the flower or plant from which the nectar is collected. The U. S. Government color classifications of honey are water white, extra white, white, extra light amber, light amber, amber and dark. Grades of honey are not related to color but upon the purity of extracted honey as well as the finish and whiteness of cappings in comb section honey.

Natural honeys carry slight amounts of pollen grains which determine the type. Natural honey is somewhat cloudy which has unfortunately created the practice of clarification, the equivalent of processing in foods. Despite contentions that the original minerals, enzymes and flavoring substances are not lost in clarification, involving heating to temperatures of about 150 degrees Fahrenheit and filtering out so-called impurities, careful analyses of clarified honeys prove otherwise.

Haydak and associates at the University of Minnesota have investigated this aspect thoroughly, finding a significant loss of vitamin content after clarification, as shown on Table 3.

Haydak attributes loss of vitamin values to the removal of pollen, proving again that interfering with the natural content of a food robs it of quality.

Light honeys are more acid than the darker varieties which are richer in iron, copper and manganese. Darker honeys are therefore especially favorable for enriching the blood and increasing hemoglobin content. This was proven in human nutrition. The subjects were European children selected for their uniformity in age, physical constitution, hemoglobin counts, dietary intake and environmental conditions. Those children supplied with dark honey as a dietary supplement revealed consistently higher hemoglobin counts than those without this supplement.

More thorough experiments along these lines with rats by Haydak and associates at the Minnesota Agricultural Experiment Station, confirmed the above findings. The rats were divided into three groups, all of whom were fed a uniform diet supplemented with milk and dark honey, in one group, milk

TABLE 3

Vitamin Content per 100 gm. of Clarified and Unclarified Honey

Sample	Thiamine microgm.	Riboflavin microgm.	Panto- thenic acid microgm.	Nicotinic acid microgm.	Ascorbic acid mg.
Commercial samples					
(A) Unclarified	5.1	80.0	100.0	400.0	2.1
(B) Clarified	3.6	62.0	92.0	290.0	1.9
Decrease %	30.0	22.5	8.0	27.5	9.5
(A) Unclarified	5.9	61.0	81.0	720.0	2.0
(B) Clarified	4.3	33.0	63.0	610.0	1.6
Decrease %	27.1	45.9	22.2	15.3	20.0
Laboratory process					
(A) Unclarified	8.4	93.0	176.0	870.0	2.7
(B) Clarified	5.4	64.0	97.0	460.0	1.9
Decrease %	35.7	31.2	44.9	47.1	29.6

and light honey in another, and milk and beet sugar in the third. Dark honey was found superior to light honey for forming hemoglobin and both surpassed sucrose.

It has only been in recent years that the vitamin content of honey has been accurately established. Analyses of Haydak, Palmer, Tanquary and Vivino at the Minnesota Agricultural Experiment Station in 1942, are summarized in Table 4.

Similar analyses completed by Kitzes, Schuette and Elvehjem at the Wisconsin Agricultural Experimental Station found lower nicotinic acid and pyridoxine values than those at Minnesota. (See Table 5) Variations could be due to different methods of assay, extraction or of the origins of the samples of honey. Both series of analyses did agree on the loss of pantothenic acid in aged honey, indicating the possible instability of that vitamin in an acid solution.

Diabetics should not eat honey various authorities believe, on the grounds that the dextrose can be dangerous, although the levulose is harmless and usually well tolerated. However Dr. C. Jarvis advocates honey for diabetics, maintaining that lack of potassium and acid really cause the affliction and sugar has little bearing on its real cause. According to Dr. Jarvis' theory, the pancreas requires potassium and acid for its work and cannot handle sugar if they are lacking. Honey supplies them and its sweetness counteracts the palatable bitterness of potassium so necessary to the metabolism of

diabetics. Honey is therefore the ideal medium for the consumption of potassium.

Vitamin K the blood clotting factor has been proven an element in honey. Chicks were fed vitamin K deficient rations, thinning their blood until bruises often led to uncontrolled bleeding and death. At this point, honey was incorporated into their rations, with a definite and immediate improvement in blood clotting capacity. Vitamin K is also known to inhibit tooth decay by halting the formation of acid bacteria in the mouth. Cane sugar loses its vitamin K in the process of refining which substantiates the contention refined sugars cause tooth decay but natural sugars like honey and unrefined cane are preventives.

Clarification removes two valuable elements, vitamin F and the Wulzen factor, inherent in the beeswax of comb honey. Vitamin F is polyfunctional

TABLE 4

Vitamin Content of Territorial United States honeys (per 100 gm).

ORIGIN	NECTAR SOURCE	Thi- mine B ₁	Ribo- flavin B ₂	Ascorbic acid Vit. C	Pyri- doxine B ₆	Panto- thenic acid	Nico- tinic acid (niacin)
		microgm.	microgm.	mg.	microgm.	microgm.	mg.
U. S. A.							
Washington	Mixed	6.4	73	.6	300	87	0.78
Washington	Clover and Alfalfa	6.8	67	1.5	227	96	.24
Washington	Black locust	7.4	68	1.4	233	100	.47
Washington	Fireweed	8.2	81	4.1	397	56	.13
Oregon	Locust	4.3	35	.5	260	103	.04
Oregon	Alfalfa - sweet clover	4.3	36	1.3	430	175	.92
Oregon	Fireweed	2.2	62	1.4	260	87	.84
Oregon	Wild buckwheat	4.3	56	2.8	250	180	.16
California (1941)	Star thistle	8.6	137	6.5	410	90	.11
California (1941)	Orange	8.6	35	2.5	210	150	.16
California	Orange	4.3	42	1.9	310	63	.13
California	Sage	3.0	36	5.4	320	56	.04
Texas	Rattan	6.5	87	2.3	440	190	.23
Long Island	Mixed	6.5	46	2.0	240	155	.26
Florida	Tupelo (1940)	4.3	58	2.1	250	118	.44
New York	Buckwheat	8.6	62	1.3	250	47	.13
Tennessee	Crimson clover	8.6	--	2.3	400	--	.56
Hawaii	Algaroba	8.6	46	2.3	250	50	.32
Idaho	Dandelion	6.4	87	2.5	267	192	.11
Montana	Clover	3.3	77	3.2	416	141	.18
Minnesota	Mixed (1941)	6.5	--	1.9	310	--	.11

acting as a synergist for vitamin D by making calcium available to bones and teeth, assisting in the assimilation of organic phosphorus, being useful in reproductive processes, properly nourishing the epithelial structures and relating to the functioning of the thyroid. The Wulzen factor is helpful in the treatment of arthritic conditions.

Dr. Hydak experimented both upon himself and associates with milk and honey as an exclusive diet. It was sufficient for about thirty days to maintain a feeling of well being without diminution of physical or mental powers. Signs of a vitamin C deficiency then began to appear and Dr. Haydak concluded this vitamin was not present in sufficient amounts in honey to counteract its loss in milk pasteurization. As yet, unpasteurized milk has not been used in this interesting experiment.

Honey is well known to athletes, deep sea divers, mountain climbers and others engaged in strenuous and hazardous occupations as a quick restorative of energy. This can be attributed to its well balanced components, integrating their action to both restore and maintain blood sugar levels. Dextrose absorbs immediately into the blood stream; levulose much more slowly. Consequently honey not only restores blood sugar levels quickly but maintains it for some time.

The Sports College of Canada strongly recommends honey for athletes. It proved to restore energy quickest over all other forms of sugar to subjects exhausted by a treadmill. At the last Olympic games, 70 per cent of the Marathon contestants were confirmed consumers of honey. Long distance swimmers and mountain climbers also rely on honey not only to revive energy but for its tonic effect on the most heavily worked muscle of the body during strenuous effort – the heart.

Honey is now well recommended for sufferers with weak hearts, for the aged and to overcome surgical shock. In post operative cases, honey is often injected intravenously instead of pure glucose which often entails unfortunate after effects. European physicians have been prescribing 65 per cent dry or whole milk with 25 per cent honey and 10 per cent glucose in cases of nutritional imbalance, alimentary dystrophy, post operative loss of proteins, cardiovascular disease, nervous exhaustion and asthenia. Reports have been extremely favorable.

Obviously honey is universally acceptable, equally suitable to the healthy, the ill, the weak, the strong, the young and old. No age barrier exists; infants are given honey which has proven highly effective in building weight and preventing diarrhea accompanying an inability to absorb calcium and other elements. Honey has been proven superior to other sugars, including corn syrup, for its assistance in the retention of calcium.

Similar tests on the retentive capacities of honey and corn syrup in relation to magnesium produced identical results. Magnesium is concentrated

most in the skeletal system, in the proportion of one to forty parts of calcium. The soft tissues, utilize more magnesium than calcium, though not the quantity the skeletal system requires. Magnesium has a number of functions, including the activation of the phosphatase and glycolytic enzyme system, and preventing muscular and nervous irritability.

The bacteriocide properties of honey are quite extraordinary, due to several factors, one being the acids present and another a hygroscopic capacity which forms an unfavorable environment for bacterial life. The bacterial killing substance, inhibin, has also been recently isolated and this combination of high acid, hygroscopic and germicidal factors accounts for the unique purity of honey and its remarkable preservability. When eaten it is very probable honey also acts as an internal cleanser.

Such admirable qualities make honey the ideal food, and one that cannot be adulterated to any great extent. Even the clarified honeys retain worthwhile fractions of their original elements and like any other natural food, will not arouse an excessive craving. Refined sugar products are notorious for this pernicious effect which leads to an unnatural appetite for candies, pastries and soft drinks. Our per capita sugar consumption of over 100 pounds per annum compared to less than 2 pounds of honey is proof of that. The intense sweetness of honey, double that of refined sugars, is immediately satisfying and the slow absorption of levulose maintains a satiated feeling which prevents excessive intake. Refined sugar products are immediately absorbed and the system can develop an exaggerated capacity for consumption.

Modern science endorses the reverence of the ancients for "The Nectar of the Gods." Though lacking modern scientific knowledge, the ancients knew all about flavor, color, aroma, fermentation, crystallization and the preservability of honey. For practical purposes their knowledge was sufficient and modern research has paralleled their empirical conclusions.

TABLE 5

Comparison of aged and new honeys. (Wisconsin results) All values are in micrograms per 100 gm.

	Riboflavin	Pantothenic acid	Nicotinic acid	Thiamine	Pyridoxine
Honeys of Years 1935-1939					
MEAN	21.8 ± 3.0	20.4 ± 2.4	124.4 ± 11.6	3.5 ± 2.5	7.6 ± .66
RANGE	9-64	9-60	63-600	1.4-6.2	9-14
Honeys of Years 1940-1942					
MEAN	26.3 ± 2.1	54.4 ± 3.6	108.5 ± 9.1	4.4 ± .50	10.0 ± 1.1
RANGE	7-60	20-360	72-590	2.2-12	4-27

For many years nothing of startling importance in the study of honey developed until the recent amazing and sensational interest in the queen bee's royal jelly. Many popular articles have publicized the purported power of royal jelly to reactivate sexual functions and prolong life. Mr. R. B. Willson, director of the American Honey Institute and active in other organizations of the industry has written a most factual and interesting review of the current status of royal jelly.

Though reporting many interesting developments, Mr. Willson's report leans to caution and scientific objectivity. Because sex stimulation and a wish for longevity can give rise to misguided and fanciful notions, this review is all the more valuable. It is free of the ballyhoo numerous writers have used to extoll royal jelly as the long awaited elixir which will extend life for extra decades.

It is admittedly difficult to remain unimpressed on realizing that royal jelly can transform a tiny insect into a glamorous, highly sexed queen bee. However, comparing the queen bee to a worker bee is misleading because the worker is actually a castrated, immature specimen which lives a shortened life span of two to six months. The difference in size, life span and procreative ability is known to be due to the deprivation of nutritional elements only the queen bee is fed. She may therefore be only the normal while workers and drones become subnormal from being denied the hormonal elements needed to stimulate full growth and development.

The future queen's special food is responsible for her comparative longevity and amazing fertility which enables her to lay more than her own weight in eggs each day for long periods. J. Langer an Austrian scientist, made the first important and fundamental discovery about royal jelly in finding it was a secretion of the pharyngeal glands of worker bees. It is comparable to the milk of mammals, also a product of glands, and is regarded consequently as the "milk" of honey bees. It also has the pungent odor and taste of cheese, conforming to the characteristic of milk products.

In recent years, McCleskey and Mellampy, Haydak and Vivino and Chedeling and Williams have devoted some study to royal jelly. They found a remarkable preservability in royal jelly despite its content of 65 per cent moisture, 12½ per cent protein, 6 per cent fat and 4 per cent undetermined. Ordinarily exposing such a substance to the 90 to 95 degree temperature of the hives would result in decay but the jelly is immune to it.

When equal parts of royal jelly were inoculated into a bacterial broth, all bacteria were dead in one minute; some in 15 seconds. When this proportion was reduced to one part jelly to ten parts bacterial culture, all bacteria were dead in 30 minutes. Certainly this is a high tribute to the germicidals the jelly contains, far surpassing that of commercial carbolic acids available today.

Haydak and Vivino confirmed the vitamin assay of royal jelly previously completed by Pearson and Burgin who found in it a high concentrated source of pantothenic acid, the factor of the great family of the B complex associated with longevity.

Royal jelly is still unproven clinically in spite of the many enthusiastic reports and claims. Much of this originated in France where royal jelly has recently been the subject of many popular articles. Similar publicity has come from several beauty cream manufacturers capitalizing on its rarity and glamor by incorporating it into various brands of expensive creams.

Amist this furor, the cautious scientific work of qualified investigators proceeds, though at a slow pace. In all probability the nutritive value of royal jelly will be eventually proven; whether it is much better than ordinary honey remains to be seen. It will require the same accurate clinical testing which has established honey as a highly desirable and nutritious food.

In brief, the scientific work of any authenticity on royal jelly has established these principal facts; – that it is a glandular secretion comparable to the milk of mammals; that it is of variable vitamin content for larvae of different ages though quite uniform in its gross composition; that it has both a sex factor and a longevity factor demonstrable on insects and certain mammals. Its value in human nutrition requires further study.

SUMMARY AND CONCLUSIONS

Honey is a remarkable product of natural food processing through the agency of the bee. It is almost totally immune from decomposition, universally suitable to the old, the young, the robust or ailing; fits well into every diet and though extremely palatable, never can lead to excessive craving. It permits but little modification and is undoubtedly nutritionally best as comb honey with pollen included.

Now that the world is becoming more and more conscious of the value of unrefined foods in human nutrition, the place of honey in the diet deserves high consideration. Uncooked honey is excellent as a spread on waffles, biscuits and all other forms of bread; as a sweetener in sandwich fillings and with various kinds of butters. It can be served as a sauce with ice cream and some varieties also can be used to make ice cream in place of sugar.

Practically every dessert can be made with honey, including pies, meringues, jellies, confections, candied fruits, cakes and cookies. Honey can be substituted for sugar in salad dressings, baked ham, custards and puddings. All in all it has a multitude of uses which it has filled admirably throughout the history of man as a highly pleasant, palatable food which is also nutritionally superior.

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Reprint No. 119

Price - 10¢

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Milwaukee, Wisconsin