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Mineral Constituents of Honey Produced in Korea

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Abstract

Four kinds of honey from acacia, bush clover, chestnut and polyflowers were anlayzed for 9 minerals including sodium/ potassium ratio, and ash content. The ash content ranged from 0.11 to 0.24% with the mean of 0.16% as potassium was found in higher concentration than other minerals. Chestnut honey had a greater quantity of mineral than others and the lowest value of sodium/potassium ratio. The correlation coefficient of $r = 0.582^{**}$ was obtained for potassium and sodium. Potassium and sodium had also a high positive correlation with calcium, magnesium, iron and manganese.

Introduction

Honey is the nectar and saccharine exudations of plants which were gathered, modified and stored in the comb by honeybees. It is the only sweetening material that can be stored and used as it is produced in nature.[1]

There has been a considerable lack of information concerning nutritional aspects of honey. Consumer groups and regulatory agencies are demanding an accurate description of the nutrient content and its quality. Over the past several years, the consumption of honey in Korea has been increasing steadily. Product quality and nutritional considerations appear to have influenced this trend.[2]

White[3] reported that individual honey varies in the amount of specific minerals present. Doner *et al.*[4] pointed out that the mineral level criteria, especially Na/K ratio in honey may be used to demonstrate the adulteration of honey. Therefore, the evaluation of mineral concentrations in honey becomes a major importance with respect to both its quality and adequacy for human nutrition. This study was performed to obtain detailed information on the mineral content of honey produced in Korea.

Materials and Methods

A total of 58 samples of honey were received from the Korea Beekeeping Association. Samples were refrigerated immediately when received and were not heated.

A wet ashing procedure was used to prepare the samples for mineral analysis. One gram of sample was placed into a 100 *ml* Erlenmeyer flask and 20 *ml* ternary solution were added for digestion until the organic material was oxidized, evaporated, until the remaining residue became clear. The digested solution was transferred to 100 *ml* volumetric flask through Whatman No. 44 filter paper and diluted to volume with deionized-distilled water. All glasswares were thoroughly washed before use with 1% hydrochloric acid to remove trace of metals and kept apart from other glasswares.[5]

Atomic absorption spectrophotometer (Varian model AA-275) with an air-acetylene flame was used to measure K, Na, Ca, Mg, Fe, Cu, Mn and Zn at 766.5 *nm*, 589 *nm*, 422.7 *nm*, 285.2 *nm*, 248.3 *nm*, 324.8 *nm*, 279.5 *nm* and 213.9 *nm*, respectively. The concentration of the respective material was read in ppm directly from the instrument using appropriate standards. Phosphorus content was determined photometrically by the ammonium metavanadate method[6] with a double-beam spectrophotometer (Shimadzu UV-210A) at a wavelength of 470 nm. Data were expressed as ppm.

Total ash was determined on 2*g* of the samples in muffle furnace at 600°C following AOAC method.[7]

Data were analyzed using VAX 11/785 computer system with the Cro·· Research Integrated Statistical Package. The statistical significance of difference among honey samples was obtained with Duncan's multiple range test. The statistical test was also used to analyze correlation between minerals in honey.

Results and Discussion

The wide variability of honey composition is reflected in the ash content. The frequency distribution of ash con-

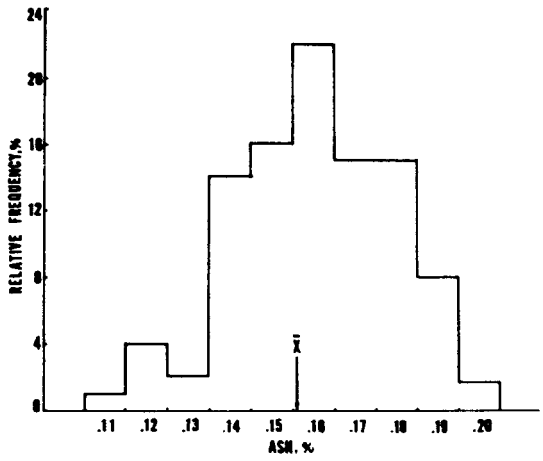

Fig. 4. Frequency distribution of ash content in the honey

tent for the tested honey samples closely approached a normal distribution (Fig. 1). The ash content ranged from 0.11 to 0.24% with the mean value of 0.16%.

Data on the ash content in honey by floral sources are presented in Table 1. Chestnut honey had the highest ash, followed by polyflower, acacia and bush clover honey, respectively, which also differed from one another in terms of ash.

The overall mean ash of 0.16% of honey is far below from the 0.6% figure reported as low quality.[8]

The data obtained by potassium and sodium analyses of the honey are presented in Table 2. Potassium and sodium were found at average levels of 459 *ppm* and 48*ppm*, respectively. Potassium was found in higher concentration than any other elements in all samples.

Statistical analysis showed that there were significant

Table 1. Ash content in honey of various floral sources

Floral sources	Ash content, %		C.V.
	Mean±SD	Range	%
Acacia	0.167±0.023	0.12-0.23	14.1
Bush clover	0.160±0.018	0.12-0.19	11.0
Chestnut	0.188±0.029	0.11-0.24	15.3
Polyflower	0.167±0.014	0.14-0.19	8.3
Total mean	0.161±0.020	0.11-0.24	12.6
L.S.D. 0.05	0.11		
L.S.D. 0.01	0.015		

*SD: Standard deviation

Table 2. Sodium and potassium content and their ratio in honey of various floral sources

Floral sources	Sodium ppm	Potassium ppm	(Na/K)×1000
Acacia	35±13	194±65	198±82
Bush clover	34±15	273±81	130±61
Chestnut	53±25	1211±386	42±12
Polyflower	60±29	516±265	131±61
Mean	48±26	459±363	138±76
L.S.D. 0.05	22	262	74
L.S.D. 0.01	30	357	101

differences among floral sources. There were also significant variations among samples within the same floral sources.

Honey has long been known to be relatively poor in sodium but rich in potassium. A suggestion had been made that examination of the sodium/potassium ratio was useful because high fructose corn syrup(HFCS) is refined by ion-exchange treatment and the original cations present in HFCS are replaced by sodium.[4] It is, therefore, possible to conclude that the high Na/K ratio indicates an adulteration of pure honey.

The concentration and the statistical comparison of other minerals are presented in Table 3. Calcium, magnesium and phosphorus were found in higher concentration than iron, copper, zinc and manganese in all samples. Calcium and magnesium levels were higher in the chestnut honeys than in other honeys, while phosphorus was higher in the bush clover honeys than in other honeys. Especially, the level of calcium in chestnut honey was 5.8 to 14.8 times greater than in other honeys. There were also significant variations among different floral sources and within the same floral sources.

Honey was a relatively poor source of iron, copper, zinc and manganese for the human diet although significant differences were found among floral sources. White[3] stated that mineral content of honey is highly variable, reflecting contributions of the plant, climate and environmental conditions.

The correlation coefficients between minerals of 58 honeys are presented in Table 4. The correlation of $r=0.582^{**}$ was obtained for potassium vs. sodium. Potassium and sodium levels of honey had a high positive correlation with calcium, magnesium, iron and

Table 3. Mineral contents of honey of various floral sources

Floral sources	Mineral, *ppm*						
	Ca	Mg	P	Fe	Cu	Zn	Mn
Acacia	14±9	8±3	53±17	4±3	2±2	3±1	1±1
Bush clover	32±8	14±4	75±18	6±2	3±2	5±3	1±1
Chestnut	207±196	68±51	53±8	9±4	3±2	4±1	2±1
Polyflower	36±8	25±13	68±22	9±5	3±2	4±1	2±1
Mean	47±81	23±25	65±21	7±4	3±2	4±2	2±1
L.S.D. 0.05	118	31	20	4	2	2	1
L.S.D. 0.01	161	42	27	5	2	3	1

Table 4. Correlation coefficients among minerals for 58 honeys

Minerals	Correlation coefficients							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Potassium(1)	—							
Sodium(2)	0.582*	—						
Calcium(3)	0.760**	0.300*	—					
Magnesium(4)	0.776**	0.410**	0.906**	—				
Phosphorus(5)	-0.028	0.085	-0.167	-0.152	—			
Iron(6)	0.453**	0.547**	0.250	0.241	0.185	—		
Copper(7)	0.058	0.110	0.077	0.029	0.053	0.059		
Zinc(8)	0.120	0.085	0.078	0.109	0.209	0.176	-0.047	—
Manganese(9)	0.398**	0.281*	0.235	0.287*	0.161	0.346*	0.078	0.078

* and **: Significant at the 5 and 1% levels probability respectively.

manganese. Calcium had a high positive relation with magnesium, and manganese had a correlation with magnesium and iron at 5% level.

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농촌진흥청 농촌영양개선연수원 · *한국양봉협회

아카시아, 싸리, 밤 및 잡화의 4개 밀원꿀 58종을 공시재료로 하여 Na, K, Ca, Mg, P, Fe, Cu, Zn, Mn 의 무기성분, Na/K비율 및 회분에 대한 정량분석과 각 성분간의 상관관계를 조사하였다. 회분함량은 0.11~0.24%이였으며, K함량은 평균 459±363*ppm*, Na은 48±26*ppm*, Ca은 47±81*ppm*, Mg은 23±25*ppm*, P은 65±21*ppm*, Fe은 7±4*ppm*, Cu은 3±2*ppm*, Zn은 4±2*ppm* 및 Mn은 2±1*ppm*으로서 밀원에 따라 큰 차이가 있었다. K과 Na함량은 0.582**의 유의상관이 있었으며, Ca, Mg, Fe 및 Mn함량과도 정의 상관이 있었다.