



# Non-Solidifying Characteristics of A Longan Honey Specimen Associated with its Sugar Content and Composition

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**Abstract** – A honey specimen from nectar of Longan flowers, which was obtained in My Tho City, Tien Giang Province, Vietnam, did not solidify during storage in a refrigerator for more than one month. The possible reason for this phenomenon was investigated by comparing it with three commercial honey products obtained in Japan, which had normal solidifying characteristics (solidified during refrigeration). The sugar content (77%) was lower in the Longan honey than in the Japanese honey (79 – 83%). However, the contents of sucrose, glucose and fructose, were 10, 32 and 35%, respectively, although they were 0.5 – 3, 34 – 37 and 41 – 45%, respectively in Japanese honey. Thus, the Longan honey contained a clearly larger amount of sucrose than Japanese honey. These findings suggested that the Longan honey was premature with insufficient condensation (lower sugar content) and insufficient conversion of sucrose to glucose and fructose, which probably prevented solidification during refrigeration.

**Keywords** – Longan Honey, Solidification, Sucrose, Sugar Content.

## I. INTRODUCTION

There are two types of honey; one made from nectar of flowers of a single species and the other from that of multiple species. Longan honey is made mainly from nectar of Longan flowers and is produced in Southeast Asian countries such as Vietnam and Thailand, and Southern China. Longan honey maintains a good reputation for its refreshing sweetness and invigorating scent. I visited Mekong Delta, Vietnam in December 2014, and purchased a bottle of Longan honey specimen at My Tho City, Tien Giang Province. After I brought it back to Japan, I stored it in a refrigerator for future analysis of its sugar content. I also obtained three commercial products of honey produced in different areas in Japan for use as references, and refrigerated them similarly. After one month or more, the three Japanese honey specimens had become solid, but the Longan honey remained liquid.

The sugar composition is a determinant of the solidification of honey. Honey contains glucose, fructose and sucrose as main components of sugars. In general, glucose and fructose contents are 30 – 50%, although the fructose content is higher than the glucose content in most cases and the sucrose content is less than 5% [1].

Honey from flowers of *Brassica* sp, mainly *B. napus* and *B. rapa*, contain a larger amount of glucose than fructose (for instance, 42% glucose against 34% fructose) and becomes solid easily even at room temperature. On the other hand, honey from black locust (*pseudoacacia*,

*Robinia pseudoacacia*) flowers remains liquid, and this is due to its high fructose content, e.g., 43% fructose against 28% glucose [1]. Therefore, I suspected that the Longan honey specimen would contain much more fructose than glucose, and analyzed the sugar content and composition in the Longan honey and three commercial honey specimens obtained in Japan.

## II. MATERIALS AND METHODS

### A. Honey Samples

Four commercial products were used. 1) ‘Longan’ honey (No.1) obtained in My Tho City, Tien Giang Province, Vietnam in December, 2014, probably collected by the bee *Apis cerena indica*, 2) honey sold under the name of ‘Kyo-mitsu’ in Nantan City, Kyoto Prefecture, Japan obtained from nectar of multiple flowers collected by *Apis cerena japonica*, 3) honey from nectar of multiple flowers collected by *Apis cerena japonica* and obtained from a farmer in Kawasaki Town, Miyagi Prefecture, located in the Tohoku district of Japan, and 4) honey produced from nectar of multiple flowers and obtained in Shimokawa town in Hokkaido, Japan.

### B. Measurement of Brix Value

Brix values of honey samples were measured using a refractometer (Model PAL-1, Atago Co., Ltd., Tokyo, Japan), which can measure Brix 0 – 53%. A sample of 0.5 g of each honey was diluted twice by adding 0.5 ml ultrapure water (>18 MΩ). Each sample was measured 6 times and the mean was calculated.

### C. Analysis of Dugar Composition

Table 1. Characteristics of four honey specimens.

Honey No.	Origin	Color	Solidifying character	Fermentation odor	Apparent stickiness
1	My Tho City, Vietnam	Dark reddish brown	–*	+	+
2	Nantan City, Kyoto Prefecture	Pale yellow	++	–	++
3	Kawasaki Town, Miyagi Prefecture	Dark reddish brown	++	–	+++
4	Shimokawa Town, Hokkaido	Reddish brown	+	–	++

\*Degrees are from no (–) to strong (+++) in this order.

Fructose, glucose and sucrose contents of honey were analyzed by HPLC [2]. A 1.0 g specimen of each honey was dissolved in 100 ml of ultrapure water, and ca. 0.5 ml of diluted sample was filtered through a membrane filter unit (DISMIC 03CPO45AN, pore size 0.45  $\mu\text{m}$ , Toyo Roshi Kaisha, Ltd., Tokyo, Japan). A 10  $\mu\text{l}$  sample was injected into an HPLC system (LC-20AD, Shimadzu Corporation, Kyoto, Japan), equipped with a Rheodyne injector (Model 7725, Sigma-Aldrich Japan, Tokyo, Japan) and a column [Shodex Asahipak NH2P-50 ( $\phi$ 4.6 x 250 mm), Showa Denko K.K., Tokyo, Japan], and eluted with a mixture of acetonitrile and water (75:25, v/v) at a column temperature of 30°C. Elution of sugars was monitored with a refractive index detector (RID-20A, Shimadzu), and the data were calculated using an automatic integrator (Chromatopak R8A, Shimadzu).

### III. RESULTS AND DISCUSSION

#### A. Appearance and Solidifying Nature of Four Honey Specimens

Table 1 shows the characteristics of honey specimens analyzed in the present study. The color of the Longan honey (No. 1) and the honey from Miyagi (No. 3) was dark reddish brown. The honey from Hokkaido (No. 4) was reddish brown, and the honey from Kyoto (No. 2) was pale yellow (Fig.1). Marked solidification was observed in No. 2 honey and No. 3 honey and less solidification in No. 4 honey, whereas no solidification occurred in No. 1 honey (Fig. 1). No. 1 honey remained liquid for about 2 years in a refrigerator. After melting of the solidified honey by heating at 60°C for 3 h, the odor and viscosity of the 4 honey specimens were compared. No. 1 honey and No. 2 honey had a refreshing fruity odor, but the former had a slight fermented odor as well. No. 3 honey and No. 4 honey had a heavy burnt smell. The apparent stickiness was highest in No. 3 honey, followed by No. 2 honey, No. 4 honey and No. 1 honey, in this order.

#### B. Sugar Content and Composition of Fructose, Glucose and Sucrose in Honey Specimens

Four honey specimens were subjected to HPLC analysis to know their sugar composition. Fig. 2 shows



Fig. 1. Photographs of honey specimens after storage in a refrigerator for one month. No. 1, Longan honey ; No. 2 honey from Kyoto Prefecture, Japan; No. 3, honey form Miyagi Prefecture, Japan; No. 4 honey from Hokkaido, Japan

the elution profiles of sugars in No. 1 honey and No. 4 honey (typical sample of three Japanese honey specimens). The Longan honey (No.1) exhibited distinct peaks of fructose, glucose and sucrose, whereas No. 4 honey exhibited distinct peaks of fructose and glucose and only a small peak of sucrose. No. 2 and No. 3 honey also exhibited a small peak of sucrose (data not shown). The contents of the three sugars were calculated and shown in Table 2. The sugar contents are almost equal to the soluble solid contents. The Longan honey (No.1) contained 34.8 % fructose, 31.8 % glucose and 10.3% sucrose, whereas the three commercial specimens of honey obtained in Japan, had 41.3 – 45.2% fructose, 34.4 – 36.9% glucose and 0.5 – 3.1% sucrose. There was a marked difference in sucrose content between the Longan honey and the other three honey specimens; that is, 10.3 % vs. less than 3.1%. Table 2 also shows the sugar contents of the honey specimens, which were calculated as the sum of fructose, glucose and sucrose contents. The sugar content was highest in No. 3 honey (82.7%), followed by No. 2 honey (80.5%), No. 4 honey (79.4%) and the Longan honey (No.1) (76.9 %).

The ability of honey to solidify is dependent on its fructose and glucose contents. That is, when the ratio of fructose to glucose (F/G ratio) is < 1.1, the honey would become solid at a low temperature, but not when it was

Table 2. Sugar content and composition of fructose, glucose and sucrose of four honey specimens.

Honey No.	Sugar content (%)	Fructose (%)	Glucose (%)	Sucrose (%)
1	76.9	34.8	31.8	10.3
2	80.5	43.1	36.9	0.5
3	82.7	45.2	34.4	3.1
4	79.4	41.3	35.0	3.1

> 1.1 (personal communication from Dr. Minh Tri, Nong Lam University, Vietnam, February 3, 2015). For example, *Acacia* (actually from nectar of pseudoacacia) honey which is known to remain liquid, contains 43% fructose and 28% glucose, i.e., F/G ratio is 1.5, as described in Introduction. The Longan honey was suspected to have an F/G ratio larger than 1.1. However, as shown in Table 2 all four honey specimens had an F/G ratio larger than 1.1. Especially, the Longan honey, which did not solidify, had an F/G ratio (1.18) larger than those of No.1 (1.09) and No.2 honey (1.17), which solidified. These findings suggested that fructose and glucose contents were not directly related to the solidification of honey during refrigeration.

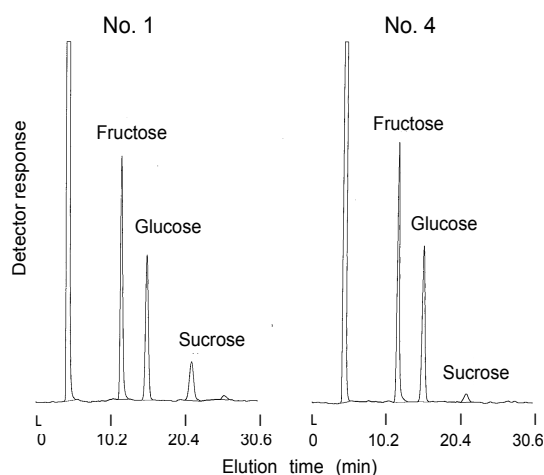


Fig. 2. Elution profiles of sugars in honey specimens after HPLC analysis. No. 1, Longan honey; No. 4 honey from Hokkaido, Japan

Honey is made from nectar collected by bees in their nest. Usually, nectar contains 65.4 – 80.0% water and 20.3 – 34.6% sugars, in which sucrose accounts for 11.2 – 77.4%. In the nest, nectar is condensed by evaporation of water (usually to less than 20%) and sucrose is converted to fructose and glucose by  $\alpha$ -glucosidase which comes from the bee's stomach until sucrose content declines to less than 5%, which results in maturation of honey [3]. Among the four honey specimens, the Longan honey had the lowest sugar content of 77%. In addition, the Longan honey contained the largest amount of sucrose, which was three times that of the other three honey specimens. Therefore, the high water content of 23%, which was calculated from sugar contents (77%), by ignoring the presence of other minor constituents such as amino acids, minerals and so on, and the high sucrose content suggested that the Longan honey had not completed the process of maturation. In other words, it is a premature honey harvested at a late stage of maturation.

#### IV. CONCLUSION

The Longan honey obtained in Vietnam did not solidify during storage in a refrigerator for a long period, and this phenomenon might be related to its high water and sucrose contents, which was due to incomplete maturation during the process of honey production.

#### REFERENCES

- [1] T. Watanabe. *Dictionary of Honey, New edition*. Tokyo: Shinju-shoin, 2003, ISBN 4-88009-213-4 (In Japanese).
- [2] Y. Tsuchihashi, K. Shintaku, S. Mikano-Tanaka, H. Ito, and J. Azuma. "Evaluation of productivity and quality of honey from some *Echium* plants." *Bulletin of Koshien Junior College*. vol. 29. 2011. pp. 20–25 (In Japanese with English abstract).
- [3] T. Echigo. "Science of honey." *Journal of Cookery Science of Japan*. vol. 26. 1993. pp. 47–53 (In Japanese).

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