

INTERNATIONAL HONEY: NUTRITIONAL COMPARISONS

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Abstract: Honey is a popular healthy natural sweetener used by many people around the globe. Variety of honey brands are available that originated from various countries of the world. The aim of this study was to collect honey available in the Maldives market, analyze and compare nutritional information of the honey. These honey samples of 17 brands originated from 10 different countries. These 17 brands were classic garden, Hosen Honey, Capilano Pure Honey, El Brezal, Alshifa, SONE, American Bee, American King Natural, Madurasa Original, Wang-Fu Pure Honey, Langnese, Fresh- Morning Honey, Countline Honey, Lisa Farm, Super Shef, Healthy Hives, and Laknaturals. The 10 different countries were India (n=8), Malaysia (n=8), Australia (n=4), Spain (n =2), Suadi Arabia (n =2), USA (n =2), Indonesia (n =2), Singapore (n =2), German (n =2), and Sri Lanka (n =2). The nutritional values tested in these 34 samples (including duplicates) were carbohydrates, protein, fat, crude fibre, and total sugar content. The results showed that the average total sugar content of the 17 brands honey was 70.19 ± 7.45 . The total sugar was lowest in Laknaturals brands of Sri Lanka (53.85 ± 0.64) and highest was Healthy Hives of India (77.55 ± 0.12). Average carbohydrate was 79.2 ± 0.78 , average protein was 0.1 ± 0.30 , average ash content was 0.02 ± 0.003 , moisture content was 14.3 ± 1.25 and acidity was 0.001 ± 0.0032 .

Keywords. Honey, Total sugar content, Maldives, carbohydrates, nutritional information

INTRODUCTION

Honey production is seasonal and based on factors such as availability of bee flora and colonies migration to different areas (Bhattarai, Pandey, Dutta, Timalsena, & Bam, 2021; GTZ, 2014). Sri Lanka produce both unifloral and multifloral honey (Silva, Seneviratne, Gunawardana, & Jayasinghe, 2018). In Australia honey is consumed as a sweetener and as a spread on porridge and breakfast cereals. Consumers purchase honey based on the value for money, brand reputation and its origin (Batt & Liu, 2012), for its nutritional value and health benefits. Honey contain antioxidants, ascorbic acid and phenolic compounds. Fourteen phenolic compounds

identified of honey consists of six flavonoids, eight phenolic acids and three glycosylated derivatives. Phenolic compounds contribute to antioxidant capacity and the antioxidant activity is a results of phenolic compounds and other minor compounds of honey (Alvarez-Suarez, Gonzalez-Paramas, Santos-Buelga, & Battino, 2010).

Honey contain different types of sugars where fructose and glucose are the main sugar type (Alvarez-Suarez *et al.*, 2010). The sucrose highlights the degree of the honey ripeness where high sucrose indicates early harvest which means the honey is harvested before ripened; prior conversion of sucrose into fructose and

glucose by invertase enzyme (Belay, Solomon, Bultossa, Adgaba, & Melaku, 2013). Sucrose level in honey should not exceed 5% (Bogdanov *et al.*, 1999). Indian honey brands (Cotton, Murraya, Dalbergia and Coriander) sugar profiles were assessed and found presence of fourteen sugars; monosaccharides, disaccharides, trisaccharides and oligosaccharides where monosaccharides dominated most. All the honey samples confirmed the Newtonian behaviour (Kamboj, Nayik, Bera, & Nanda, 2020).

After sugar water is the main honey component. The honey stability depends on moisture and water activity. Honey is stable at 20% moisture contents (Belay *et al.*, 2017). Types of hive affect moisture content, ash, and HMF of honey such as Hareenna forest honey of Ethiopia. The moisture, electrical conductivity, water insoluble solids and ash content vary based on the geographical location of the honey (Belay *et al.*, 2017). Mineral contents of honey from honey bee species such as Kelulut, Acacia and Tualang include calcium, sodium and potassium between the ranges of 545.76 to 570.66 mg/kg (Muhammad & Sarbon, 2021).

Intake of natural honey reduce total cholesterol levels, triglyceride levels and low density lipoprotein (LDL) level. Also, it increases the high-density lipoprotein (HDL) level. Therefore, intake of small quantity of honey is recommended for people suffering from dyslipidemia (Alkhalifah, Alabduljabbar, & Alkhenizan, 2021).

Honey from *Apis mellifera* was used as a biomonitor to map metal distribution around the globe. The metal used was lead (Pb) isotopic compositions and assessed metal compositions of the honey worldwide. The study pointed out the concentration of the metal composition is based on the infrastructure of a city, human activity, and due to large scale Pb processes, for example, global gasoline usage (Smith *et al.*, 2021).

Adulteration in honey was identified using mineral element chemometrics profiling tool. In this method the researchers identified 12 mineral elements by ICP-OES in 67 honeys which had higher mineral contents (Liu *et al.*, 2021). Honey adulterants detection methods were reviewed

by Naila *et al.* (2018) and these methods were used to detect adulterants in the honey imported to Maldives (Naila *et al.*, 2021).

In summary, honey is consumed for its nutritional value and health benefits. Honey contains sugars, minerals, metals and phenolic compounds. Metals in honey are used to trace the distribution of the metals on earth and minerals are used to identify honey adulteration.

The aim of this study was to compare nutritional information of international honey using the results of laboratory analysis.

MATERIALS AND METHODS

Materials

A 17 brands of honey samples were purchased randomly from the supermarkets of Male', capital city of the Maldives. The samples were coded and kept at room temperature until taken to the SGS Lanka Pvt Ltd, an accredited laboratory in Sri-Lanka.

Total sugar content

The total sugar content was carried out by the protocol LCHE/TM/SOP/097 at the SGS Lanka Pvt Ltd, Sri-Lanka.

DATA ANALYSIS

Results were analysed using IBM SPSS Statistics (Version 20). All the readings were done in duplicate and descriptive statistics was used to express mean and standard deviation (SD). Significant difference of total sugar content between brands were assessed using Post hoc, Tukey HSD. The results were expressed as mean and standard deviation (SD).

RESULTS AND DISCUSSION

Figure 1 describes the total sugar content of 17 brands of honey tested in this study. The lowest total sugar content (<60%) was found in Laknatural and Madurasa Original. The highest total sugar content (> 70%) was found in Sone, Countline honey, Healthy hives, Hosen honey, Alshifa, American bee, Wang-Fu pure honey, and Super shef. As per the nutritional label of the tested honey samples the average total sugar content was 59.93 ± 28.96 g/100g.

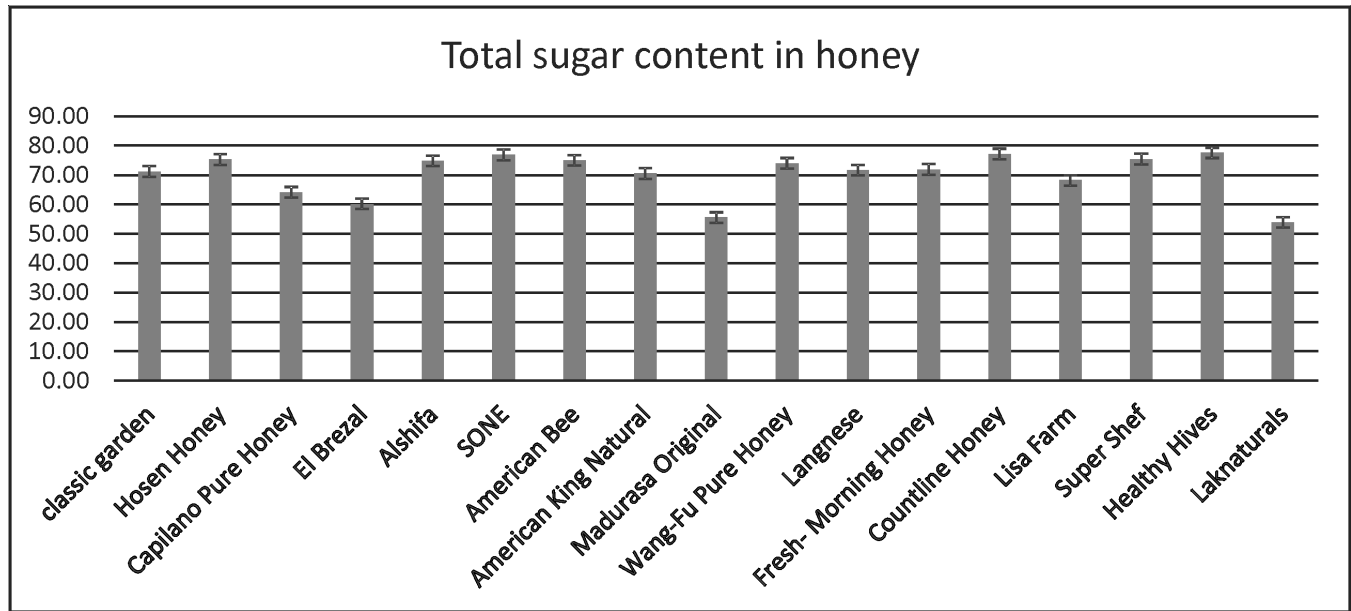


Figure 1: Total sugar contents analysed in honey (n=17)

Table 1: Total sugar content in honey

Brand	Country	Total sugar	SD
classic garden	India	71.20	.848
Hosen Honey	Malaysia	75.30	.283
Capilano Pure Honey	Australia	64.15	.495
El Brezal	Spain	60.15	.350
Alshifa	Saudi Arabia	74.80	.300
SONE	India	76.85	.212
American Bee	India	75.00	.141
American King Natural	USA	70.55	.212
Madurasa Original	Indonesia	55.55	.071
Wang-Fu Pure Honey	Singapore	74.00	.141
Langnese	German	71.60	.283
Fresh- Morning Honey	Malaysia	71.90	.424
Countline Honey	Malaysia	77.15	.636
Lisa Farm	Malaysia	68.20	.000
Super Shef	Australia	75.40	.283
Healthy Hives	India	77.55	.121
Laknaturals	Sri Lanka	53.85	.636
Average		70.19	7.45

Total average sugar content of the honey samples tested was 70.2 ± 7.44 g/100g. As per the nutritional label of the tested honey samples the average total sugar content was 59.93 ± 28.96 g/100g. Thus, the honey products labelled and tested value for total sugar content is in agreement although it is noted that the variation of between the samples are great in the nutritional label of

the honey samples compared to tested honey samples. However, when looked into individual honey brand, for example, total sugar content of the Langnese brand as per the product label information varied between 70 to 75 g/100g which is in agreement with the average total sugar content (71.6 g/100g) of Langnese brand honey tested.

Literature reviews have highlighted the adulterants of honey with sugar syrups, rice syrups and foreign oligosaccharides. For example, honey brands of India were adulterated with sugar syrups, rice syrups and foreign oligosaccharides (Naila *et al.*, 2021; Singh & Barman, 2021).

HMF, free acidity and moisture variation of honey was found in East African countries. Honey quality maybe maintained by relevant training about marketing, storing, harvesting, honey processors, beekeepers and traders about to receive high quality for consumers (Mesele, 2021).

When the nutritional information of the honey samples (n=17) were screened minor amount of minerals were found; sodium (4.33 ± 4.82 mg/100g), potassium (72.42 ± 75.73 mg/kg), iron (0.1 ± 0.00 mg/kg) and salt (0.10 ± 0.00 mg/kg). Sodium content was labelled in 58.8% samples (n = 10) and 7 samples contained sodium between the ranges of 0.6 to 15 mg/100g.

Calcium was detected in 11% of the samples ($n = 2$) that ranged from 0.92 to 13 mg/kg, and these samples were MATA (natural honey) and Virginia green garden (Australian pure honey). Sodium was also present in 11% of the samples which were MATA (natural honey) and Virginia green garden (Australian pure honey), 6.83 mg/kg and 138 mg/kg, respectively. Iron was present in one sample (0.1 mg/kg) and the sample was MATA (natural honey). Salt (0.2 mg/kg) was present in 4 samples (23.53%). Thus, the variation in the nutritional composition of the honey tested in this study and the literature differed maybe due to variations in floral sources, cite, climatic condition, location and variation in species (Bhalchandra & Joshi, 2021).

As per the nutritional label of the tested honey samples the average carbohydrate was 62.62 ± 28.40 mg/kg. Total carbohydrate was not labelled in the Safa (Natural Honey) and the remaining samples' carbohydrate level ranged from 8.25 (MATA; Natural Honey) to 83.10 g/100g (Capilano; organic raw honey).

Protein content of the 88% of the samples varied from 0.05 to 0.5 g/100g and 11% ($n = 2$) did not contain protein. Another study found that honey to contain protein content of 0.88 to 3.50% (Yebooue *et al.*, 2021).

Average total fat content of the tested honey was 0.03 ± 0.044 mg/kg in which average saturated fatty acids was 0.06 ± 0.051 mg/kg. Only Langnese (Black Forest Honey, Pure Bee Honey, Forest Honey and Acacia Honey) had average total fat content of 0.02 g/100g (0.2 mg/kg) while other brands did not contain fat. Also, only Langnese brands contained saturated fatty acids content (0.02 g/100g). Another study also found fat content in honey although its fat content varied from 0.41 to 0.78 mg/100g (0.004 mg/kg) (Yebooue *et al.*, 2021).

According to Bhalchandra and Joshi (2021) nutritional quality of honey vary based on species, location, differences in floral sources, site and climatic conditions (Bhalchandra & Joshi, 2021).

As per the nutritional information label the energy obtained from the 17 brands of the honey varied between 300 to 1416 kcal with the average of 894.10 ± 501.78 kcal. The calories varied

between 33 to 338 with the mean calories of 216 ± 124.16 mg/kg. Yebooue *et al* (2021) reported the energy value of honey between 396.39 to 402.70 kcal/100g of honey (Yebooue *et al.*, 2021).

CONCLUSION

In conclusion, honey nutritional label and the laboratory analysis results of the same samples are in agreement although larger variation was observed among the nutritional labels of the honey samples. The sugar content between the honey samples also varied but the average values were comparable. Honey contains minor amount of minerals.

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