



Agricultural Marketing
ORIGINAL ARTICLE

Quality evaluation of some selected commercial honey products available in the market of Bangladesh

Md Mamunur Rahman^{1*}, Poly Karmoker² and Md Zinnatul Alam³

¹Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur

²Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh

³Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur

ARTICLE INFO

Article history:

Received: 26 September 2017

Received in revised form: 02 November 2017

Accepted: 13 November 2017

Available online: 20 November 2017

Doi: 10.5455/faa.279019

Academic Editor: Mohammad Tofazzal Hossain Howlader

Keywords:

Honey

Quality parameters

Commercial products

ABSTRACT

Natural honey is one of the most valued items in the market due to its unique properties and diversified usages. To ascertain the biochemical properties of commercially available honey products in Bangladesh, an experiment was conducted at Entomology and Horticultural laboratory in Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU). Honey samples of eight different commercial brands were collected and subjected to analyze analyzed on different bio-chemical parameters. Significant differences in nutritional qualities were observed. Highest TSS (total soluble solids) and total reducing sugar were observed in the product Premium honey brand of Australia, however moisture content, protein and ash percentage were found the lowest. Other foreign honey brands provided better results compare to some local originated honey products based on particular parameters especially for moisture and electrical conductivity. The results of this study suggested that although locally originated commercial honey products such as BSCIC honey, Litchi and Mustard honey from BSMRAU have meet some international quality standard level however other parameters like moisture contents and EC needs to be improved.

Copyright © 2017 Rahman et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Honey, a sweet, thick, viscous fluid of agreeable taste and aromatic odor, is produced by honeybees from nectars extracted from the nectarines of flowers or from the secretion of living parts of plants. It has a greater density (1.5g/cm³) than water (1g/cm³ at 4°C), having a strong hygroscopic character, relatively low heat conductivity, low surface tension and various (Adebiyi et al., 2004). Honey is significantly sweeter than table sugar and has attractive chemical properties for baking. It has attractive flavor, which led some people to prefer it to sugar and other sweetness.

Honey is used for nutritional, medicinal and industrial purposes and it is an important commodity in the international market; serving as foreign exchange earner for many countries. However, beekeeping is not considered as a profit making venture in Bangladesh although there are some indigenous community who are engaged in this profession and locally collect, process and market honey. To ensure the proper market value and return handsome profits, composition of honey is very

important.

The quality of honey depends on its physical and chemical properties. It is a natural food mainly composed of sugars and water together with minor constituent such as minerals, vitamins, amino acids, organic acids, flavonoids and other phenolic compounds and aromatic substances. The major constituents of honey (75%) are monosaccharides (fructose and glucose), with low quantities of disaccharides (sucrose) and polysaccharides. Honey contains different quantities of minerals ranging from 0.02 g/ 100 g to 1.03 g/100 g, with potassium being the most abundant element comprising approximately one-third of the total mineral content (Chakir et al., 2011). The major chemical properties include its color, density, electrical conductivity, moisture contents. Both bio-chemical composition is particularly variable, depending on its source of collection, preservation and processing techniques and can considered as the important indicator for analyzing the honey quality.

*Corresponding author: mamunur111@gmail.com

Though quality and composition of honey are negatively affected by the other factors such as overfeeding with sucrose and other sucrose variants, harvesting prior to maturity, unhealthy, storage conditions and overused veterinary drugs but its general chemical composition play the main role as its use is mainly confined as a nutritional supplements in addition to its medicinal value.

In Bangladesh, to the best of our knowledge, there is no previous research works has done so far on biochemical analysis for quality determination of different locally produced and imported honey products necessary for appropriate grading. Therefore, the present study was designed to find-out the bio-chemical composition and grading of different locally produced and imported honey samples available in Bangladesh.

METHODOLOGY

Sample Collection and Preparation

Eight (8) honey samples available in the market were collected and used for the study. All the samples were collected freshly in sterile containers (labeled with numbers, place and date of collection) and stored at ambient temperature until analyzed. Unwanted material such as wax sticks, dead bees and particles of combs were removed by straining the samples through cheesecloth before analysis.

Biochemical Analysis

Determination of percent Total soluble solid and moisture content:

For measuring the TSS content of honey in different honey samples, honey refractometer (Manufacturer: Mettler Toledo, model: Refracto 30GS) was used. Honey samples were kept at 20°C and from each samples 5 drops of were dropped so that the honey will cover the blue area completely. Moisture content was measured according to AOAC (2005).

Determination of specific gravity:

The specific gravity was measured according to the method proposed by (Muhammad et al., 2013) using the following formula:

$$\text{Specific gravity at } 27^\circ\text{C} = \frac{C-A}{D-A}$$

C= weight of the specific gravity bottle with honey

A= weight of the empty specific gravity bottle

D= weight of the specific gravity bottle with water

Determination of Total Reducing Sugar

Two gm of honey was taken into a 500ml standard flask dilute with water and mixed thoroughly condense and volumed upto 500ml with water. Using separate pipette, pipette out 5ml of each solution A and solution B in to a 250ml conical flask. Add about 16ml of honey solution from a burette add a few pumices and dilute with water heat to boiling over a flame and add 1ml methylene blue indicator solution while keeping the solution boiling complete the filtration within 3 minutes the end point is indicated by the change the color from blue to red (Ranganna, 1979).

$$\text{Approximate TRS \% by weight} = \frac{500*N*100}{V*W}$$

N = normality of Fehling's solution.

V = volume of honey solution required for titration.

W = weight of honey taken.

Determination of Sucrose

One hundred ml of prepared honey solution was pipetted out in

to 250 ml conical flask, 1ml of concentrated HCL was added and heated until boiling. The mixture was kept aside overnight to neutralize the inverted honey solution with sodium carbonate. The solution was transferred into 250ml standard volumetric flask and total reducing sugar in the mixtures was determined (Ranganna, 1979).

$$\text{Approximate total reducing sugar \% after inversion} = \frac{2.5*500*100*N}{W*V}$$

N= Normality of Fehling's solution

W= Weight of honey taken

V= Volume of honey solution

2.5= Dilution constant

$$\text{Sucrose \%} = (\text{Approx. TRS\% after inversion} - \text{Approx. TRS\% before inversion}) * 0.95$$

Protein Determination:

Percent protein present in honey was measured through hydrolyzing the protein and estimating the amino acids alone that gave the exact quantification. The blue colour developed by the reduction of the phosphomolybdic-phosphotungstic components in the Folin-Ciocalteu reagent by the amino acids tyrosine and tryptophan present in the protein plus the colour developed by the biuret reaction of the protein with the alkaline cupric tartarate are measured in the Lowry's method (Lowry, et al., 1951).

500 mg of the weighted sample was homogenized well with a pestle and mortar in 5-10 ml of the buffer. Pipetted out 0.2, 0.4, 0.6, 0.8 and 1 ml of the working standard into a series of test tubes while 0.1 ml and 0.2ml of the sample extract in two other test tubes were pipetted. In all test tube, the volume was made up to 1ml and the tube with 1 ml of water served as the blank. 5 ml of reagent C to the each tube including the blank was added and mixed well and was waited for 10 min. Then, 0.5 ml of Folin-Ciocalteu reagent was added and was mix well and incubated at room temp in the dark for 30 min. Blue color was developed and the reading was taken at 660 nm. A standard graph was drawn and calculated the amount of protein of the sample. The amount of protein was expressed in mg/g or 100 g samples.

Determination of Ash

Two gm of honey was weighed accurately and placed in to a crucible. 4/5 drops of vegetable oil was added to prevent spattering. Then, the mixture was heated carefully over a low flame until swelling ceased ignite in a muffle furnace till white ash was obtained. The dish was cooled in a desecrator and weighed repeated to constant weight Muhammad *et al.*, (2013).

$$\text{Ash \% by mass} = \frac{(W2-W)*100}{(W1-W)}$$

W2= Weight of the crucible with ash

W1= Weight of the crucible with the material taken for test

W= Weight of the empty crucible

pH Determination

pH of the honey samples were determined by using a pH meter (HORIBA D-51) as per instruction of the manual supplied by the manufacturer.

Electrical Conductivity Determination

Electrical conductivity was measured by the solution of 20 g dry matter of honey in 100 ml distilled water and was poured into electrical conductivity cell. The determination of electrical

conductivity is based on the measurement of the electrical resistance, of which the electrical conductivity is the reciprocal (Wang and Sastry, 1993).

Cell constant was measured by using the following formula:

$$K=11.69*1/G$$

K= the cell constant in cm^{-1}

G= the electrical conductance in mS, measured with the conductivity cell calculation and expression of results

The EC was calculated by using the following formula:

$$SH=K.G$$

S_H = Electrical conductivity of the honey solution in mS.cm^{-1}

K= Cell constant in cm^{-1}

G= Conductance in mS

Statistical Analysis

Complete Randomized Design (CRD) was used for experiment layout and means were separated by Duncan Multiple Range

Test using MSTAT-C software.

RESULTS AND DISCUSSION

Moisture Content, pH and electrical conductivity of different honey samples:

The moisture content is important for honey shelf life. Density, viscosity and hygroscopicity also are the important parameters depend on the moisture content of honey. Honey with higher water content flows faster than that with lower one. Different honey samples with their moisture contents, EC, and pH are presented in Table 1. The highest moisture content was found in Sundarban honey from Bangladesh (22.5%), which is statistically similar with the moisture content of BSCIC honey from Bangladesh (21.5%) and Mustard honey (BSMRAU, Bangladesh) (21.5%). On the other hand, the lowest moisture content was found in Premium honey from Australia (17.8 %), followed by Florence honey from China (18.4 %), Dabur honey from India (18.6 %), and Crown honey from USA (19.3 %), respectively. So, it is found that Sundarban honey have the highest moisture content and the trends also found to be similar in mustard and litchi honey of BSMRAU and also in the BSCIC honey.

Table 1. Percent (%) moisture content, Specific gravity, pH and electrical conductivity of different honey samples

S.L.	Samples	moisture content (%)	Specific gravity	pH	Electical conductivity mS.cm^{-1}
1	S ₁	21.5 ab	1.40 c	5.16 d	0.47 c
2	S ₂	21.5 ab	1.59 a	5.18 d	0.49 c
3	S ₃	21.0 b	1.22 d	5.31 c	0.52 bc
4	S ₄	22.5 a	1.20 e	5.17 d	0.54 bc
5	S ₅	18.6 cd	1.42 bc	5.45 a	0.42 c
6	S ₆	17.8 d	1.43 b	5.29 c	0.59 b
7	S ₇	19.3 c	1.40 c	5.18 d	1.00.a
8	S ₈	18.4 cd	1.42 bc	5.35 c	0.25 d
	Standard range (NHB, 2010)	17.0-17.5	1.39-1.42	4.5-4.8	0.1-3
	CV (%)	1.23	1.47	0.70	1.08
	Level of Significance	**	**	**	**

** = Significant at 1% level of significance

S₁ = BSCIC Honey (Bangladesh); S₂ = Mustard Honey (BSMRAU, Bangladesh);

S₃ = Litchi Honey (BSMRAU, Bangladesh); S₄ = Sundarban Honey (Bangladesh)

S₅ = Dabur Honey (Indian); S₆ = Premium Honey (Australian);

S₇ = Crown Honey (USA); S₈ = Florence Honey (China)

According to Schroeder *et al* (2010), typical moisture percentage in honey is 17.2%. Premium honey from Australia is found to be low moisture content and Dabur honey from India and Florence honey of china also provided the results similar to USDA standard (White and Donar, 1980). So the quality of the honey originated in Bangladesh provide inferior results to the other foreign samples regarding the moisture content. Maintaining the standard moisture level is out most important factor for honey processing. Besides, as honey is highly hygroscopic so special consideration is needed during its storage. Besides, weather condition, duration of honey in the hive, nectar source are also a matter of consideration for ensuring the better quality of honey in storage (NHB, 2010).

Density is another physical characteristic for determining its quality. Honey density, expressed as specific gravity, is greater than water density by about 50%, and it also depends on the moisture content of the honey. Table (1) represents that the lowest specific gravity was observed in Litchi (1.22) and sundarban (1.2) whereas the highest value obtained from

Mustard honey (1.59) originated from BSMRAU. Australian Premium Honey, Indian Dabur honey, chinese Florence honey and American Crown honey provided 1.43, 1.42, 1.42 and 1.40, respectively. So the foreign honey provided almost similar results of specific gravity but the honey originated from Bangladesh showed significant variation. That might be due to different nectarian sources (monofloral and polyfloral) and as well as different environmental condition during honey harvesting period. The honey of low specific gravity with high moisture content settles above the denser and initiate quick fermentation as mentioned by Schroeder (2010). So, appropriate processing technology should be followed along with its packaging standard.

While considering pH, among the studied samples the highest pH value was observed in Dabur honey from India (5.45) and the lowest value was observed in BSCIC honey from Bangladesh (5.16) which is statistically similar with Sundarban honey from Bangladesh (5.17), Mustard honey (BSMRAU, Bangladesh) (5.18), and Crown honey from USA (5.18),

respectively.

Dabur honey is found less acidic compare to other honey samples. BSCIC honey, litchi honey, sundarban honey and crown honey were found comparatively more acidic. So, in this parameter the honey samples originated from Bangladesh provides better result as it correlates with the findings NHB (2010) where the pH of the typical honey was calculated as 3.80.

Honey contains minerals and acids, serving as electrolytes, which can conduct the electrical current. At present it is the most useful quality parameter for the classification of different honey sample. EC of all honey samples were found quite close to each other (Table 1). However Crown honey of America provide

significantly the highest EC (1.0) and Florence honey of China had the lowest EC and statistically different from rest of the honey samples. Other brands samples indicate statistically similar EC value (Table 1).

Presence of protein, ash, reducing sugar and total soluble sugar (TSS) in different honey samples:

Honey is the rich source of different nutrients and it comprises protein, fat, carbohydrates, vitamins, minerals and many other components. The presence of the percentage of protein, ash, reducing sugar and total soluble sugar in the collected honey samples are presented in table 2.

Table 2. Percent (%) protein, ash, reducing sugar and TSS contents in different honey samples

S.L.	Samples	% Protein contents	% Ash contents	Reducing sugar (%)	% TSS Content
1	S ₁	0.16 c	0.89c	60.00 c	77.00 b
2	S ₂	1.73 a	0.98 b	60.07 c	76.00 b
3	S ₃	0.16 c	1.05 b	59.00 cd	76.00 b
4	S ₄	1.73 a	0.99 b	59.23 cd	73.00 c
5	S ₅	0.97 b	0.79 d	63.21 b	80.00 a
6	S ₆	0.16 c	0.65 e	65.20 a	81.00 a
7	S ₇	0.97 b	1.30 a	58.70 d	79.85 a
8	S ₈	0.16 c	0.73 de	64.17 ab	80.00 a
Standard range (NHB, 2010)		0.04-0.7	0.2-0.5	63.0-66.0	79.0-81.0
CV (%)		1.52	1.65	1.36	2.89
Level of Significance		**	**	**	**

** = Significant at 1% level of significance

S₁ = BSCIC Honey (Bangladesh); S₂ = Mustard Honey (BSMRAU, Bangladesh);

S₃ =Litchi Honey (BSMRAU, Bangladesh); S₄ =Sundarban Honey (Bangladesh)

S₅ =Dabur Honey (Indian); S₆ =Premium Honey (Australian);

S₇=Crown Honey (USA); S₈ =Florence Honey (China)

Protein

Significantly, the highest % protein was observed in Mustard honey (BSMRAU, Bangladesh) (1.73) and Sundarban honey (Bangladesh) (1.73), which were statistically different from all other samples. The lowest % of protein (0.16) was observed in BSCIC honey from Bangladesh, Litchi honey of BSMRAU, Bangladesh, Premium honey of Australia and Florence honey of China, respectively (Table 2). Generally, honey diet contains a very little amount of protein ranges from 0.04% to 0.7% (Terrab, 2002).

Therefore, the BSCIC honey, Litchi honey of BSMRAU, Premium honey of Australia and Florence honey of china provided same results and it indicates the quality of the mentioned sample. Since other nitrogenous substances are known to occur in honey, the true value of protein content was somewhat lower. The presence of proteins causes honey to have a lower surface tension otherwise, which produce a marked tendency toward foaming and retention of air bubbles (White and Donar, 1980). So, the honey with low protein content is better in storage and safe for consumption.

Ash contents

The ash content of honey means the residue, which is obtained by a defined procedure and expressed as a percentage by weight. The table represents that the highest amount of ash was observed in Crown honey from USA (1.30) that statistically differs from all other samples. Significantly, the lowest value was found in Premium honey from Australia (0.65) samples (Table 2).

So, the premium honey of Australia provides better results and the Crown honey of USA offers maximum ash contents indicating that the sample have more residue than that of others. Litchi and Mustard honey of BSMRAU and BSCIC honey rank the moderate classes according to USDA range at 0.2-0.5% (White and Donar, 1980) .

Reducing sugar contents:

Significantly the highest % of reducing sugar was observed in Premium honey from Australia (65.20%), followed by Florence honey from China (64.17%) and Dabur honey from India (63.21%) respectively (Table 2). The lowest % of reducing sugar (58.70 %) was recorded in Crown honey from USA, which was statistically similar with Lithci honey (BSMRAU, Bangladesh) (59.00%) and Sundarban honey from Bangladesh (59.23%), respectively. Honey is a mixture of sugar and other compounds. With respect to carbohydrates, honey is mainly fructose (about 38.5%) and glucose (about 31.0%), making it similar to the synthetically produced inverted sugar syrup, which is approximately 48% fructose, 47% glucose, and 5% sucrose (Honey, 2017, in Wikipedia).

Honey's remaining carbohydrates include maltose, sucrose, and other complex carbohydrates. According to Battaglini *et al* (2007), reducing sugar percentage in honey recorded as 62-65% and this findings correlates with this study in case of Indian Dabur honey, Florence honey of China and Premium honey of Australia. Reducing sugar content is relatively lower in the honey sample originated from Bangladesh. This might be due to the environmental impacts on different honeybee performance and nectar source as mentioned by Hoover *et al* (2014).

Total Soluble Solids (TSS) contents

Data regarding total soluble solids of different brands of honey shows that Premium Honey of Australia had the highest 81.00% and Sundarban honey of Bangladesh had the lowest (73.00%) total soluble solids than other brand of the honey (Table 2) originated from different countries. As total soluble solids indicate the purity of honey sample from different inert matter, so from the present studied samples, the Premium honey, Dabur and Florence honey provided more soluble solid contents that was also mentioned by Zafar (2008).

CONCLUSION

The findings of this study denoted that the commercial honey samples from Bangladesh have meet the requirements of quality set by different International organizations in terms of pH, Electrical conductivity, % protein, reducing sugar and ash contents despite of its inferior quality in terms of moisture content. As moisture content is one of the important factor that has direct influence on the shelves life and influence other chemical properties, so the Bangladeshi beekeepers and honey processing organizations should emphasized on this matter for improving and maintaining the quality that met some foreign honey like crown honey of USA and Premium honey of Australia.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this paper.

ACKNOWLEDGEMENT

This study was financially supported by Research Management Committee (RMC) of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Bangladesh in the fiscal year 2010-2011.

References

- Adebiyi FM, Akapan I, Obiajunawa EL. and Olaniys HB. 2004. Chemical/ Physical characterization of Nigerian Honey. *Park. J. Nutr.* 3: 278-281
- AOAC. 2005. Official Methods of Analysis. 18th edn. Association of Official Analytical Chemists; Arlington, VA, USA
- Battaglini M. and Bosi C. 2007. Physico-chemical characterisation of monofloral honey on the basis of its sugar composition and specific rotation. *Sci. Tech. degli Alimenti* 3(4): 217-221
- Chakir, A., Romane, A., Barbagianni, N., Bartoli, D., Ferrazzi, P., 2011. Major and trace elements in different types of Moroccan honeys. *Australian Journal of Basic and Applied*

Sciences 5 (4), 223–231

- Honey. (2017). In Wikipedia, The Free Encyclopedia. Retrieved 01:29, (<https://en.wikipedia.org/w/index.php?title=Honey&oldid=808053964>)
- Hoover S.E.R., Hoover T.M. 2014 Impact of Environmental Change on Honeybees and Beekeeping. In: Gupta R., Reybroeck W., van Veen J., Gupta A. (eds) *Beekeeping for Poverty Alleviation and Livelihood Security*. Springer, Dordrecht
- Lowry, O.H., N.J. Rosebrough, A.L. Farr, and R.J. Randall (1951) Protein Measurement with the Folin Phenol Reagent. *J. Biol. Chem.* 193:265-275.
- Muhammad, A., Ayub, M., Zeb, A., Wahab, S. & Khan, S. (2013). Physicochemical Analysis and Fatty Acid Composition of Oil Extracted From Olive Fruit Grown in Khyber Pakhtunkhwa, Pakistan. *International Journal of Basic & Applied Sciences*, 13, 36–39.
- NHB (National Honey Board) 2010. Honey and Bees: Chemical composition of Honey. <http://www.honey.com/nhb/about-honey/honey-and-bees/>
- Ranganna, S. (1979). *Manual of Analysis of Fruits and Vegetables products*. Tata McGraw-Hill Publishing Company Ltd., New Delhi. 2-95 and 634.
- Schroeder A, Horn, H. and Pieper HJ. 2010. The correlation between moisture content and water activity in honey. *Deutsche Lebensmittel- Rundschau* 101 (4): 139-142
- Terrab A, Diez MJ. and Heredia FJ. 2002. Chromatic characterisation of Moroccan honeys by diffuse reflectance and tristimulus colorimetry. *Food Science and Technology International* 8 (4): 189-195
- Wang, W.C. & Sastry, S.K. (1993). Salt diffusion into vegetable tissue as a pretreatment for ohmic heating: Electrical conductivity profiles and vacuum infusion studies. *Journal of Food Engineering*, 20, 299–309.
- White JW and Doner LW (1980). Beekeeping in the United States, *Agriculture handbook number 335*, 82 – 91. <http://beesource.com/resources/usda/honey-composition-and-properties/>
- Zafar A, Safder MN, Siddiqui, N. and Sial MU. 2008. Chemical analysis and sensory evaluation of branded honey collected from Islamabad and Rawalpindi market. *Pakistan J. Agric. Res.* 21: 1-4