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Quality assessment of local and imported Honey sold in Katsina State, Nigeria

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ABSTRACT: The quality of different brands of honey sold in Katsina state was investigated. The samples were obtained from supermarkets, local shops and local homes, as part of local and imported brands. Several physico-chemical parameters such as water content, sugar content, pH, ash content, hydroxymethylfurfural (HMF), acidity and refractive index were evaluated. Similarly, other tests for adulteration were also carried out among the different brands studied. Analyses were carried out in triplicates and data was analysed using averages. The results for the physicochemical properties showed the following range of values for pH (3.95 to 5.1), moisture content (8.23 to 15.23%), ash content (0.06 to 0.36%), acidity (4 to 32 meqkg^{-1}). While the adulteration tests for hydroxymethylfurfural ranged from 74.7 to 119.1 mg/kg, sugar content from 75.607 to 77.427 g/100g. The adulteration test indicated the presence of added commercial invert sugar and absence of added glucose. Some traces of molasses were also detected in samples obtained from supermarkets and local shops, however, none from local villages were observed. It was concluded that most samples obtained from local villages showed better quality than samples collected from supermarket and Islamic stores.

Keywords: Adulteration, ash content, honey, invert sugar, molasses, supermarket.

INTRODUCTION

Honey is a sweet dark golden viscous liquid substance made by honey bees from the nectar and sweet deposits from plants, modified and stored in the honeycomb to ripe and mature (Olugbemi et al., 2013). Buba et al. *(*2013) reported that honey is a sticky and viscous solution and it is known to contain about 80 to 85% carbohydrate (mainly glucose and fructose), 15 to 17% water, 0.1 to 0.4% protein, 0.2% ash and minor quantities of amino acids, enzymes and vitamins as well as other substances like phenolic antioxidants. There are basically two types of honey; Comb honey which is honey in its original comb or portions thereof and extracted honey: that is when it is removed from the comb and presented in several forms, as liquid, crystallized or granulated and partially crystallized. According to Adams et al. (2010), the aroma, flavour, colour and composition of honey is dependent on its source.It is a complex mixture and presents very great variations in composition and characteristics due to its geographical and botanical origin and its main features depending on the floral origin or the nectar utilized by bees (Nigussie et al., 2012; Khahl, et. al., 2012; Cantarelli et. al. 2008).

Honey has been found in some instances by some researchers to possess antibacterial activities where antibiotics were ineffective (Stokes et al., 1993; Molan and Belt, 2000). The potent activity of honey against antibiotic-resistant bacteria has led to renewed interest for its application (Cooper et al., 2002; Effem et al., 1988). Honey contributes to the health and nutritional status of human depending on its quality. It's colour, flavor, viscosity and aroma are the first physical characteristics usually perceived by the consumer and play important role in honey acceptability/marketability locally. Other physico-chemical properties such as pH, moisture content, sugar content, total acidity, proline content and ash content have been found to be of immense assistance for comparison with imported honey (Kayode and Oyeyemi, 2014). In Nigeria, the demand for honey is increasing because of its nutritional and medicinal values. This is supported by its abundant supply, which makes the production very common

However, there are variation on methods of harvest and treatment and this calls for quality assessment to ascertain the level of purity of each brand being sold in the market.

Therefore, the objective of this study is to investigate the quality of different brands of honey sold in Katsina state, Nigeria.

MATERIALS AND METHOD

Sample collection

Fresh samples of honey were collected from designated areas in pre-cleaned polythene bottles. Each sample was properly closed with tight-fitting lid and labeled before taken to the laboratory for analysis. Samples obtained from supermarkets were labeled A and D. These were considered to be imported. Then, samples obtained from local shops were labeled B and C, these were also considered to be locally processed. Lastly, samples obtained from local sources were labeled E, F and G, these were obtained from local apiarists across the State.

Reagents

The reagents used were of analytical grade. They were purchased from BDH Chemical company limited without further modification.

Physico-chemical analysis

The pH and total soluble solids of juice samples were measured using standardized instrumental methods of analysis (AOAC 1990). The acidity was determined by titration against 0.1M NaOH using 3 to 4 drops of phenolphthalein as indicator. The amount of alkali consumed was noted and the acidity was calculated using appropriate formular. The ash content was determined by muffle furnace ignition method while the moisture content by indirect distillation drying methodology. The sugar content was determined using refractometer to obtain values in ˚Brix. The results obtained were converted to g sugar/100g of sample. The adulteration tests such as Hydroxymethylfulfural was determined according to the reported method of De Toledo (2017). The absorbance of the test samples was measured against the reference sample at 284 and 336 nm. The Fiehe's test for invert sugar was carried out according to the reported method of De Toledo (2017). 2ml of ether extract was evaporated over water bath. Then, 2 to 3 ml of resorcinol (1g resublimed in 5 ml of conc. HCl) was added to the mixture. A cherry red colour indicated presence of invert sugar. The Iodine test for added glucose was also carried out according to Alqarni et al. (2014). A sample of honey was diluted with some amount of distilled water to 25 ml. 1.5 g potassium iodide and 0.5 g of iodine crystals were added to the solution and thoroughly mixed. Presence of glucose would turn the mixture red or violet. The molasses test was carried out as prescribed by the AOAC (2012). A piece of cotton wool was dipped in honey, and then lit with fire. Presence of crackling sound indicated presence of molasses in the sample.

Data analysis

The results of the physico-chemical parameters and qualitative tests for the honey samples are summarized in Table 1 and 2 respectively. Each analysis was carried out in triplicate and mean value for each result was computed using simple statistics.

RESULT AND DISCUSSION

The results for each parameter analysed are described below. Comparative analyses between each result with recommended value set by CODEX 2001 was also discussed.

pH values

The mean pH values of the 7 samples ranges from 3.95 to 5.12. Adebiyi et al. (2004) reported the pH of the Nigerian honey samples from 4.31 to 6.02, with a mean of 4.75. The pH determination could also be correlated with other authenticity parameters to verify adulterations. From the result, all the 7 samples were within the limits set by Codex Alimentarius Commission (2001a) which is within the range of 3.4 to 6.1. From the analysis, the highest and the lowest values were obtained from honey sample A and D which were obtained from supermarket and Islamic stores respectively. Similarly, the samples obtained from local villages gave higher pH, even though did not exceed the limit. The pH values obtained in this study agreed with the previous works of Kayode and Oyeyemi (2014) who reported pH range of 4.10 to 4.65 for fifteen honey samples in Nigeria. Naturally, irrespective of its geographical origin, honey is acidic (Khalil et al., 2012; Adebiyi et al., 2004).

Moisture content

The moisture or water content for all samples was observed to be between 8.23 to 15.23%. Sample C obtained from Islamic store had the highest concentration while that from local villages (sample G) had the least. As proposed by Codex Alimentarius Commission (2001a), lower moisture content below 20%, elongates honey shell life. The Moisture content is one of the most important parameters that contribute to the quality of honey as it

Table 1. Physico-chemical properties of honey samples.

sample	pH	Ash (%)	Moisture (%)	Refractive index	Acidity (meq/kg)	HMF (mg/kg)	Sugar (%)
A	4.39	0.25	10.24	1.5018	4	99.45	76.121
B	5.12	0.36	8.96	1.5081	18	103.3	76.675
C	4.08	0.15	15.23	1.4819	23.3	95.4	76.438
D	3.95	0.22	13.44	1.4941	14.5	119.1	75.963
E	4.01	0.32	9.33	1.4868	17.3	93.9	77.427
F	4.51	0.06	12.82	1.4790	32	74.7	77.387
G	4.11	0.07	8.23	1.4890	24	115.4	75.607

Table 2. Summary of qualitative analysis (adulteration test).

Sample	Fiehe's test	Iodine test	Molasses test
A	Positive	Negative	Positive
B	Positive	Negative	Positive
C	Negative	Negative	Positive
D	Positive	Negative	Positive
E	Positive	Negative	Negative
F	Positive	Negative	Negative
G	Positive	Negative	Negative

affects its shelf life and processing characteristics (Malika et al., 2005; Bogdanov et al., 2008). From the results, all the samples analysed were within the standard limits of moisture content in honey.

Ash content

The ash content of the samples ranged from 0.06 to 14.22%, where the honey samples obtained from local villages had the least ash content (sample F) while the one obtained from local shops had the highest value of 0.36%. Codex Alimentarius Commission Standard (2001a) proposed not more than 0.6% ash content for normal honey. The variability in the ash content observed could be explained by the floral origin, geographical location and level of maturity of the honey. All the samples have met the standard limits of honey

Ash content represents the mineral content of the honey. The ash content values were within the range (0.095 to 0.518%) reported by Adebiyi et al. (2004). Saxena et al. (2010) reported a range of 0.03 to 0.43% ash content in some Indian honeys of different botanical origins. Baroni et al. (2009) reported 0.2 and 0.07% ash content in northern and southern Cordoba province, Argentina, respectively. dos Santos et al. (2008) reported the ash contents of honey from three geographical zones ranged from 0.04 to1.03 and the zones had significant effect on the ash contents of honey samples. Values obtained in this study are in agreement with standard values of less than 0.6% specified by the Codex Standard. According to White and Doner (1980), dark honey is higher than lighter honey in ash (mineral) and contains significant qualities of minerals. In this study, the honey harvested using modern method, though lighter in colour, had significantly higher ash content. The higher percentage of ash could be due to the nectar and flora of plant fed on by the bees which in turn increased the honey's mineral content.

Acidity

The free acidity values of the sample vary from 4 to 24 meq/kg. The Codex Alimentarius Committee on Sugars (2001) permits a maximum value of 50.00 meq kg^{-1} for free acidity. Higher values may be indicative of fermentation of sugars into organic acids. However, the presence of different organic acids, geographical origin and harvest season can affect the honeys' acidity (Codex Standard for Honey, 2001a). From the result, all the 7 samples were within the limit standard of acidity in honey, indicating absence of undesirable fermentation in the samples.

Refractive index

Sample F showed the least refractive index of 1.4790, while sample B showed the highest value of 1.5081. All the seven samples were within the standard limits of refractive index. This is in agreement with the results of Adebiyi et al. (2004). The refractive index could be used to determine the level of adulteration and hence quality, as described by Adebiyi et al. (2004).

Hydroxymethylfurfural

The level of hydroxymethyfurfural varied between 74.7 to

115.4 mg/kg. Sample F had the least HMF value while sample G had the highest HMF value. All the samples have exceeded the maximum value of HMF set by Codex Alimentarius commission which states that "the Hydroxymethylfurfural content of honey after processing and/or blending shall not be more than 40 mg/kg. However, in the case of honey of declared origin from countries or regions with tropical ambient temperatures, and blends of these honeys, the HMF content shall not be more than 80 mg/kg". The HMF content is widely recognized as a parameter in evaluating the freshness of honey. This is a byproduct of fructose decay and formed during storage or during heating. Thus, presence of HMF is considered the main indicator of honey deterioration. The excessive value of HMF indicates overheating during processing, prolonged storage or adulteration with invert sugars (Adebiyi et al., 2004). Thus, its concentration increases with storage and or pro-longed heating of honey. Therefore, results of the analysis indicated that all the samples have one form of adulteration or the other.

Sugar content

From the result of the analysis, the sugar content ranged from 75.607% for sample G to 77.427% for sample E. The highest and least sugar content in honey samples were both obtained from locally sourced. The amount of sucrose is a very important parameter in evaluating the honeys' maturity. The sucrose content in honey is analysed with the purpose of identifying any improper manipulation of honey, and high levels may indicate a variety of adulterations, such as addition of cheap sweeteners like cane sugar or refined beet sugar. Early harvest also indicates that the sucrose was not completely transformed into glucose and fructose; or prolonged artificial feeding of honeybees with sucrose syrups, resulting in high commercial profits (Escuredo et al., 2013; Tornuk et al., 2013; Amril and Ladjama, 2013). Due to these factors the Codex Alimentarius Committee on Sugars (2001a) stipulates a maximum value of 5 g of total sugar in 100 g of floral honey and from the analysis of total sugar content, it has shown that all the seven have exceeded the limits set by codex, which indicated adulteration in all the samples.

Adulteration test

Three adulteration tests were carried out on the honey samples, these were Fiehe's test (Table 2), Iodine test (Table 2), and molasses test (Table 2). The Fiehe's test carried out on the seven honey samples showed that all the samples have commercial invert sugar present except sample C. Similarly, the result of iodine test did not show any sign of added glucose in the honey samples, while the molasses test indicated the presence of added molasses in samples A, B, C and D.

Conclusion

Results of the physic-chemical assessment of honey produced from Katsina state of Nigeria, revealed that it had not been sternly adulterated hence most of the results were found to be in conformity with permissible levels. Majority of the honey samples were of good quality when compared with Codex Alimentarius (2001b) honey specifications. The pH, moisture content, total titrable acidity and refractive index of the entire samples were within the standard limits set by Codex Alimentarius. While the ash content was within the standard limit except for sample D which exceeded the limits set by Codex Alimentarius Commission. The total sugar content and HMF values for all the samples exceeded the limits set by Codex Alimentarius (2000). This indicated high level of HMF adulteration. This also suggested that, the samples analysed have either been stored for long period, undergo some form of overheating or adulterated with invert sugar.

For the adulteration test carried out on the samples, according Fiehe's test, all the sample were adulterated with commercial invert sugar except sample C, while for iodine test, all the samples indicated absence of added glucose. The test for presence of molasses indicated that, samples A, B, C and D were adulterated with molasses, while samples E, F and G indicated no addition of molasses in the honey samples. While the results indicated full compliance to international standard limit for most of the samples analysed, however, some form of adulteration has also been discovered in some of the samples analysed as indicated. It can be concluded that, samples obtained from local villages proved to be better in terms of quality than those obtained from local shops and imported ones sold at supermarkets.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

Adams, B. A, Osikabor, B., Olomola, A., & Adesope, A. A. A. (2010). Analysis of Physical and Chemical Composition of Honey Samples in Selected Market in Ibadan Metropolis. *Journal of Agriculture and Social Research*, 10(2), 31-36.

Adebiyi, F. M, Akpan, I., Obiajunwa, E. I., & Olaniyi, H. B. (2004). Chemical/Physical Characterization of Nigerian Honey *Pakistan Journal of Nutrition,* 3(5), 278-281.

Alqarni, A. S., Owayss, A. A., Mahmoud, A. A., & Hannan, M. A. (2014). Mineral content and physical properties of local and imported honeys in Saudi Arabia. *Journal of Saudi Chemical Society*, 18(5), 618-625.

Amril, A., & Ladjama, A. (2013). Physicochemical characterization of some multifloral honeys from honeybees Apis mellifera collected in the Algerian northeast. *African Journal of Food Science*, 7(7), 168-173.

AOAC (1990). Official Method of Analysis of the Association of Analytical Chemists.

AOAC (2012). Official Method of Analysis of the Association of Analytical Chemists.

Baroni, M. V., Arrua, C., Nores, M. L., Fayé, P., del Pilar Díaz, M., Chiabrando, G. A., & Wunderlin, D. A. (2009). Composition of honey from Córdoba (Argentina): Assessment of North/South provenance by chemometrics. *Food Chemistry*, 114(2), 727-733.

Bogdanov, S., Jurendic, T., Sieber, R., & Gallmann, P. (2008). Honey for nutrition and health: a review. *Journal of the American College of Nutrition*, 27(6), 677-689.

Buba, F., Gidado, A., & Shugaba, A. (2013). Analysis of biochemical composition of honey samples from North-East Nigeria. *Biochemistry & Analytical Biochemistry*, 2(3), 7p.

Cantarelli, M. A, Pellerano, R. G., Marchevsky, E. J., & Camiña, J. M. (2008). Chemical composition of argentina honey. *Journal of the Argentine Chemical Society*, 96(1-2), 33-41.

Codex Alimentarius Commission (2001a). Codex standard for honey FAD, Rome. *Alinorm*, 1,19-26.

Codex Alimentarius Commission (2001b). Codex Standard 12. Revised codex standard for honey, standard and standard methods 11 (1-7)

Codex Alimentarius, Alinorm 01/25 (2000). Draft revised standard of honey, codex procedure: EU Directive (L 10/47).

Cooper, R. A., Halas, E., & Molan, P. C. (2002). The efficacy of honey in inhibiting strains of Pseudomonas aeruginosa from infected burns. *The Journal of Burn Care & Rehabilitation*, 23(6), 366-370.

De Toledo, V. D. A. A. (Ed.). (2017). *Honey Analysis*. Published by InTech, Janeza Trdine 9,51000, Rijeka, Crotia.

dos Santos, J. S., Núbia, S. S., Maria, L., Pires, S., Sabrina, N. S., & Julian, J. L. (2008). Honey classification from semi-arid, Atlantic and transitional forest zones in Bahia, *Journal of the Brazilian Chemical Society*, 19(3), 502-508.

Effem, S. E. E. (1988). Clinical observation on the wound healing properties honey. *British Journal of Clinical Chemistry*, 75, 679-681.

Escuredo, O., Míguez, M., Fernández-González, M., & Seijo, M. C. (2013). Nutritional value and antioxidant activity of honeys produced in a European Atlantic area. *Food Chemistry*, 138(2-3), 851-856.

Kayode, J., & Oyeyemi, S. D. (2014). Physicochemical investigation of honey samples from bee farmers in Ekiti- State, Southwest, Nigeria. *Journal of Plant Sciences*, 2(5), 246-249.

Khalil, M., Moniruzzaman, M., Boukraâ, L., Benhanifia, M., Islam, M., Sulaiman, S. A., & Gan, S. H. (2012). Physicochemical and antioxidant properties of Algerian honey. *Molecules*, 17(9), 11199-11215.

Malika, N. A. M. A. N., Mohamed, F. A. I. D., & Chakib, E. A. (2005). Microbiological and physicochemical properties of Moroccan honey. International Journal of Agriculture and Biology, 7(5), 773-776.

Molan, P., & Betts, J. (2000). Using honey dressings: the practical considerations. *Nursing Times*, 96(49), 36-37.

Nigussie, K., Subramanian, P. A., & Mebrahtu, G. (2012). Physicochemical analysis of Tigray honey: An attempt to determine major quality markers of honey. *Bulletin of the Chemical Society of Ethiopia*, 26(1), 127-133.

Olugbemi, O., Ikeme, C. H., & Dioha, I. J. (2013). Physicochemical Analysis of Honey from Umuahia, Abia State, Nigeria. *Research Journal in Engineering and Applied Sciences*, 2(3), 199-202.

Saxena, S., Satyndra, G., & Arum, S. (2010) Physical, biochemical and anti-oxidant properties of some Indian Honeys. *Food Chemistry,* 118(2), 391-397.

Stokes, E. S., Ridway, G. I., Wren, G. M. (1993). Clinical Microbiology. 7th edition. London Arnold. Pp. 20-30.

Tornuk, F., Karaman, S., Ozturk, I., Toker, O. S., Tastemur, B., Sagdic, O., Dogan, M., & Kayacier, A. (2013). Quality characterization of artisanal and retail Turkish blossom honeys: Determination of physicochemical, microbiological, bioactive properties and aroma profile. *Industrial Crops and Products*, 46, 124-131.

White, J. W., & Doner, L. W. (1980). Honey composition and properties. *Beekeeping in the United States Agriculture Handbook*, 335, 82-91.