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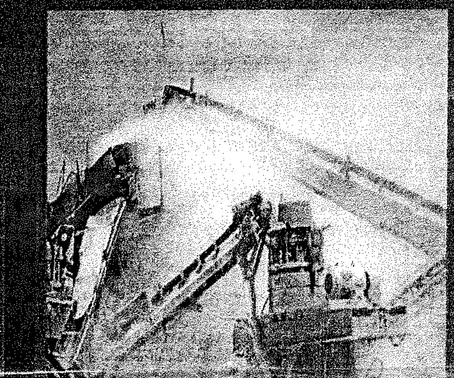

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QUALITY AND SENSORY ASSESSMENT OF HONEY SOURCED FROM DIFFERENT LOCATIONS IN IBADAN METROPOLIS, NIGERIA

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ABSTRACT

Honey is a sweet food made by Bees using nectar from flowering plants. It is known to be subjected to various use: as direct edible and for pharmaceutical purposes. In Nigeria, particularly in Ibadan metropolis, the demand for honey is ever increasing due to the burgeoning population increase and also consequent to it nutritional and medicinal benefits. By the reason of the high demand of honey and low supply of the product, getting pure and original honey from the market is becoming very difficult, leading to some folks taking advantage of the short fall thereby flooding the market with adulterated honey. It is however against this background that this study seeks to provide answers to the problem of identifying quality honey through proximate and sensory evaluation. Honey samples were obtained from three sources in Ibadan metropolis (UI, OO, and OJ) and analyzed for sensory and proximate properties such as fructose, sucrose. Maltose, glucose, moisture content, ash, protein, hydroxymethylfurfural (HMF), ascorbic acid, ether extract (fat), crude fibre, and nitrogen free extract (carbohydrate) content following Standard Association of Official Analytical Chemistry. The following range of values were determined for fructose, sucrose. Maltose, glucose, moisture content, ash, protein, hydroxymethylfurfural (HMF), ascorbic acid, ether extract (fat), crude fibre, and nitrogen free extract range from 12.4-20.4, 5.0-7.7, 0.0-0.17, 21.3-36.5, 23.3-36.6, 23.4-17.9, 0.50-0.26, 0.0-0.43, 7.4-7.6, 0.0-0.33, 0.0-0.23, 0.0-0.1, and 72.7-80.9, respectively. The three samples of honey are of good quality but OJ had the least. UI honey has the overall acceptability rating.

Keywords: Honeybee, Honey, Sensory assessment, Proximate analysis

INTRODUCTION

Honey has been reported as a plant product with excellent medicinal remedy for the treatment of diverse ailment and also an important source of sweetener (Abell *et al.*, 1996, Famuyide *et al.*, 2014). Honey is produced in Nigeria majorly by honey bee species (*Apis mellifera*). Bees have been observed to source for the nectar of different plant species, as a result, they produce honey that varies in quantity, quality, color and flavor (Oyeyemi, 2017). The composition and characteristics of honey have been closely linked to its geographical origin, environmental temperature, humidity and different plant species that bees visit during honey production (Joseph *et al.*, 2007; Alvarez-Suarez *et al.*, 2010; Amril and Ladjama, 2013). Despite these differences, the main constituents of honey have been stated to remain the same (Terrab *et al.*, 2003). Honey composition and quality also depend on several other factors such as humidity inside the hive, nectar sources, methods employed during honey extraction and storage. According to Eleazu *et al.*, (2012), Honey comes in a range of colours such as white, amber, red, brown and almost black. Its flavour and texture also varies with the flower nectar from which it was made. Most commonly available honeys are made from clover, alfalfa, heather and acacia flowers, however, honey can be made from a variety of different flowers including thyme and invender (Azenedo *et al.*, 2003; Alvarez-Suarez *et al.*, 2010). Adenekan *et al.* (2012) and Nnwanko *et al.* (2014) reported that the healing capacity of honey is strongly influenced by its physical and chemical properties.

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In Nigeria, particularly in Ibadan metropolis, the demand for honey is ever increasing because of the nutritional and medicinal benefits. Due to the rich botanical endowment and the natural biodiversity of Nigeria and the peculiarity of diverse culture and tradition affiliated to the use of honey, it has made commercial honey very lucrative. However, reports of the physico-chemical and sensory quality of available honey varies for different locations (Gulfraz *et al.*, 2011) and because of the high demand of honey and low supply of the product, getting pure and original honey from the market is becoming very difficult, leading to some folks taking advantage of the short fall thereby flooding the market with adulterated honey. The wide variety of honeys and the large number of sugar syrups or other ingredients that unscrupulous manufacturers dilute with (FAO, 2004) affects the quality of honey and deny human its benefits. It is however against this background that this study seeks to provide answers to the problem of identifying quality honey through sensory and proximate evaluation.

MATERIALS AND METHODS

Collection of honey samples

Three honey samples were each sourced from different locations in Ibadan metropolis, Nigeria. The samples were collected from different honey markets at different locations Oja -Oba (OO), University of Ibadan, Wildlife domesticated Unit (UI) and Oje (OJ). They were labelled as KAD, OO, UI and OJ samples respectively.

Sensory Evaluation

Thirty panelist were selected randomly for sensory evaluation to assess the different samples whereby each assessor was equipped with a sensory evaluation which consists of a 7-point hedonic scale form to indicate the perceived taste, colour, flavor/aroma, texture and overall acceptability.

Quality evaluation (proximate analysis)

This is usually carried out to determine the nutritional value of food and food based product. The components of honey samples which values were determined include: fructose, sucrose, maltose, glucose, moisture content, ash, protein, hydroxymethylfurfural (HMF), ascorbic acid, ether extract (fat), crude fibre, nitrogen free extract (carbohydrate) by difference.

Determination of Moisture Content

Moisture content determination was carried out using the air oven method. Crucibles were washed and dried in an oven. They were allowed to cool in the desiccator and weight was noted. A known weight of samples were then transferred into the crucibles and dried at a temperature between 103-105°C. The dry samples were cooled in a desiccators and the weight noted. They were later returned to the oven and the process continued until constant weights were obtained.

$$\% \text{ Moisture content} = \frac{\text{Weight Loss} \times 100}{\text{Weight of Sample}}$$

Determination of Ash content

A known weight of finely ground sample was weighed into clean, dried previously weighed crucible with lid (W_1). The sample was ignited over a low flame to char the organic matter with lid removed. The crucible was then placed in muffle furnace at 600°C for 6h until it turned ash completely. It was then transferred directly to desiccators, cooled and weighed immediately (W_2).

$$\text{Percentage of Ash} = \frac{W_2\text{-}W_1 \times 100}{\text{Weight of Sample}}$$

Protein Determination

The crude protein content was determined using micro Kjeldahl method as described in AOAC (2003). 0.2077g of sample was weighed into a long necked Kjeldahl flask. 1 tablet of Kjeldahl catalyst was added to the sample in the flask with 25cm^3 of conc. H_2SO_4. The flask was swirled, gently clamped in an inclined position and heated electricity in a fume cupboard. The heating continue until a clear solution was obtained. The clear solution was cooled, poured into a 100cm^3 volumetric flaskand made up to mark with distilled water 10ml of the resulting mixture was measured into the distillation set through the funnel. 5 cm^3 of boric acid was pipetted into a 100 cm^3 conical flask and placed at the receiving end of the distillatory. The

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conical flask was placed such that the delivery tube dipped completely into the boric acid inside the flask. 40% NaOH was used to liberated ammonia out of the digest under alkaline condition during the distillation 2 drops of methyl orange were always added to the round bottom flask containing the digested sample before 40% NaOH was added. As soon as the contents became alkaline, the red colour changed to yellow showing NaOH to be in excess. Steam was then generated into the distillation set using a steam chest. The liberated ammonia was trapped in the boric acid solution and about 50 cm^3 of the solution collected into a conical flask. The solution in the flask was titrated against 0.1M HC1 until the first permanent colour change was observed.

A blank sample was through the sample procedure and the titre value for the blank was used to correct the titre for samples.

% N = Molarity of HC1 X Sample titre - Blank titre) X 0.014 X DF X 100
Weight of sample used

% N was converted to the percentage crude protein by multiplying by 6.25.

Sugar analysis by HPLC-RI
The major sugar content of honey samples such as fructose, glucose, sucrose (α-D-glucopyranosyl b-D-fructofuranoside) and maltose (α-D-glucopyranosyl (1-4) D-glucopyranose) and HMF (hydroxymethylfurfuraldehyde) were analyzed by using a HPLC system coupled to a refractive index detector (Jasco, Easton, US). A XBridgeTM amide column with the dimension of 3.5 μm, 4.6× 150 mm was used for the separation. The column was kept at 25°C throughout the analysis. The mobile phase was 75% acetonitrile in deionized water with an isocratic flow rate of 2 ml/min. Honey samples (0.5 g) were dissolved in deionized water and vortexed vigorously before filtered for injection. The injection volume was 20 μl.

Determination of Ascorbic Acid
One red pepper was weighed and grounded up with a little glacial acetic acid in a mortar. The extracts were transferred quantitatively with distilled water into a 50 ml. volumetric flask. It was made up to the mark with more water and filtered rapidly. 10ml of the filtrate was taken into aconical flask with one drop of dilute acetic acid. It was then titrated against the redox dye, 2:6 dichlorophenol indophenol solutions in the burette. The volume of dye required to decolorize the 10 ml of the sample was noted. The titration was repeated, using a standard ascorbic solution (1 mg. pure vitamin per 100 ml.) in place of the pepper extract. Hence, the amount of ascorbic acid per 100 g. of pepper was calculated.

Determination of Ether extract
The soxhlets extraction method (AOAC, 1996) was used. This method could only give the approximate fat content in a sample because all the substances soluble in chosen solvent (Petroleum ether, 40° C - 60° C boiling range) were extracted from the sample. A known weight of sample was weighed into a weighed filter paper and folded neatly.

This was put inside pre-weighed thimble (W_1). The thimble with the sample (W_2) was inserted into the soxhlets apparatus and extraction under reflux was carried out with petroleum ether (40° C - 60° C boiling range) for 6h. At the end of extraction, the thimble was dried in the oven for about 30 minutes at 100° C to evaporate off the solvent and thimble was cooled in a desiccators and later weighed (W_3).

The fat extracted from a given quantity of sample was then calculated:

$$\% \text{ Fat (w/w)} = \frac{\text{Loss in Weight of sample} \times 100}{\text{Original Weight of Sample}}$$

$$= \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Determination of Crude Fibre
Two hundred (200ml) freshly prepared 1.25% H_2SO_4 were added to a known weight of the residue obtained from fat extraction and this was brought to quick boil. Boiling was continued for 30 minutes. The mixture was filtered and residue washed until it was free from acid. The residue was transferred quantitatively into a digestion flask, 1.25%

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NaOH was added and brought to boiling point quickly. Boiling was continued for 30 minutes. The mixture was filtered and residue washed free of alkali. The residue was then washed with methylated spirit, thrice with petroleum ether using small quantities. It was allowed to properly drain and the residue was transferred to a silica dish (previously ignited at 600° C and cooled). The dish and its content were dried to constant weight at 105° C. The organic matter of the residue was burnt by igniting for 30 minutes in a muffle furnace at 600° C. The residue was cooled and weighed. The loss on ignition was reported as crude fibre (AOAC, 1996).

Determination of Nitrogen free extract (Carbohydrate)

The carbohydrate content was calculated by difference.

% CHO = 100-(Sum of the percentages of moisture, ash, fat, protein and crude fibre)

Statistical method

Analysis of variance, descriptive analysis and correlation analysis were used for the data analysis.

RESULT AND DISCUSSION

Means with similar alphabet along the same column are not significantly different at 0.05 significance level

Table 1 shows that the honey sample from the department of Wildlife and Ecotourism, University of Ibadan (UI) has the highest flavor (5.61), this is followed by Oja-oba (5.4) and the least from Oje market. This could be linked to location as some of the marketers other than UI get their honey from outside Ibadan with different vegetation and nectar source. The first physical observation of honey that is usually encountered by the consumers is its color (Bogdanov et al., 2004). However, there was no significant difference (p>0.05) in the flavor of all the samples. In the same manner, for texture, the highest value was observed from the samples from UI (5.7) while Oja-oba had the least texture (5.1). Hence, location does not significantly (p>0.05) affect the honey texture. Table 1 equally revealed that UI (5.8) honey sample significantly taste better than Oja-oba (5.7) and Oje (4.4) respectively.

Table 1: Sensory Evaluation of Honey

PARAMETERS			SAMPLES	P-value
	OO	UI	OJ	
Flavour	5.4±0.51	5.6±1.89	4.7±1.63	0.373ns
Texture	5.1±0.87	5.7±0.48	5.6±1.35	0.348ns
Taste	5.7±0.83a	5.8±1.26a	4.4±1.42a	0.031*
Colour	5.8±0.78	6.3±0.67	5.5±1.35	0.205ns
Acceptability	5.9±0.87a	6.4±0.69a	4.9±1.28b	0.007*

Ns=Not significant (p>0.05) *==significant (p<0.05)

In terms of acceptability, UI has a significant level of acceptability (6.4) followed by Oja-oba (5.9) and Oje (4.9), respectively. There was no significant difference in the colour of the honey samples. UI Honey sample has the best colour compared to the two other locations. It has been proven from other sensory assessment from different locations that the difference in composition and sensory quality of the honey samples may be influenced by factors such as: geographical and botanical origin of the flora, type and activity of the bee, the extraction technique employed and the storage conditions (Escuredo *et al.*, 2011; Al-Habsi and Niranjan, 2012; Eleazu *et al.*, 2013), hence the similarity in the findings of this study. Colors of honey are largely influenced by several factors such as the nectar source, plant species, processing and packaging techniques. It was also observed from the finding of this study that their differences in the texture of all samples. The disparity of honey in terms of texture may be as result of the level of technicality and harvest procedure of the bee-keeping.

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Table 2 shows that there is significant positive correlation between the taste of the honey samples and flavours (r=0.81, p<0.05). Acceptability and flavor (r-0.38, p<0.05), colour and texture (r=0.48, p<0.05), color and taste (r=0.40, p<0.05), acceptability and taste (r=0.63, p<0.05) and acceptability and colour (r=0.68, p<0.05). This implies that people correlates taste with flavour, colour and taste, colour and texture to be the yardstick for quality honey. On the other hand, there is no significant correlation between texture and flavor (r=0.13, p<0.05), colour and flavour (r=0.25, p<0.05), taste and texture (r=0.10, p<0.05) and acceptability and texture (r=0.24, p<0.05).

Quality Evaluation

The result for proximate analysis were presented in Table 3. The value for fructose, sucrose. Maltose, glucose, moisture content, ash, protein, hydroxymethylfurfural (HMF), ascorbic acid, ether extract (fat), crude fibre, and nitrogen free extract range from 12.4-20.4, 5.0-7.7, 0.0-0.17, 21.3-36.5, 23.3-36.6, 23.4-17.9, 0.50-0.26, 0.0-0.43, 7.4-7.6, 0.0-0.33, 0.0-0.23, 0.0-0.1, and 72.7-80.9, respectively.

Table 2: Correlation matrix of sensory evaluation

	Flavor	Texture	Taste	Colour	Acceptability
Flavor	1				
Texture	0.13	1			
Taste	0.81**	0.10	1		
Colour	0.25	0.48**	0.40*	1	
Acceptability	0.38*	0.24	0.63*	0.68**	

*=significant at 0.05 **=significant at 0.01

Table 3: Honey samples proximate analysis

Parameters	OO	UI	OJ	P-value
Fructose	20.4±0.40a	16.2±0.20b	12.4±0.20c	0.000*
Sucrose	5.0±0.11a	5.0±0.15a	7.7±0.15b	0.000*
Maltose	0.13±0.05a	0.17±0.05a	0.00±0.00b	0.011*
Glucose	36.5±0.15a	40.2±0.20b	21.3±0.20c	0.000*
Moisture content	17.9±0.15a	18.3±0.15b	23.4±0.15c	0.000*
Ash	0.26±0.05a	0.23±0.05a	0.50±0.10b	0.009*
Protein	0.43±0.05a	0.40±0.00a	0.00±0.00b	0.000*
Hydroxymethylfurfural (HMF)	7.6±0.11a	7.4±0.05b	9.1±0.15c	0.000*
Ascorbic acid	0.33±0.05a	0.17±0.05b	0.00±0.00c	0.000*
Ether extract	0.23±0.05a	0.16±0.05b	0.00±0.00c	0.000*
Crude fibre	80.80±0.05a	80.8±0.05a	72.7±0.05c	0.000*
Nitrogen free extract range	0.1±0.05a	0.1±0.05b	0.00±0.05c	0.000*

*=significant (p<0.05)

The nutrient content

The result in table three shows that the biochemical composition of all honey samples were mostly of the same range with Codex Alimentarius 2001 (Rodriguez et al., 2004) honey specification value. It was found that the honey samples from OJ would be prone to granulation because of high moisture content of above 20%. Somehow, the lower moisture content of UI and OO contributed to the higher glucose, protein, fructose and maltose values found in their samples. The average moisture content of UI and OO were below <21% which is regarded good according to Codex Alimentrius specifications. The moisture content of honey is one of the criteria that determines it shelf

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stability. Thus, the higher the moisture, the higher the probability that the honey will ferment upon storage by osmo-tolerant yeast (Viuda-Martos et al., 2010). A high content of moisture in honey is also an indicator of adulteration (Nyau et al., 2013). Protein value recorded least in samples from OJ. Ash content in honey is a reflection of the total inorganic minerals that are present in the sample after incineration (Vanhanen et al., 2011). Low ash content was recorded fell with the range of typical natural honey and not of honeydew honeys, which have been reported to have high ash content (Viuda-Martos et al., 2010). Although OJ had the highest ash content followed by OO and making that of UI the least. It is opined that sugars in all honey samples belong to available sugar because unavailable sugars are considered as dietary fibre (Charrondiere et al., 2004). Therefore, the energy value is mainly attributed by the high sugar content of hone sample. Nitrogen free extract by difference of honey samples were in the range of international standard of honey specifications. Glucose and fructose are the major component of carbohydrate found in honey and the ratio of preponderance is a factor in determining adulteration levels. Low values of ether extract were recorded from the content of honeys samples across locations and this is in agreement with Azenedo et al., 2010. Crude fibre of the honey samples were also within range with OJ having the least. Hydroxymethylfurfural (HMF) also follow the same trend. Fresh honey contains less than 15% of hydroxymethylfurfural (HMF) depending on the pH value and temperature and age of the honey.

CONCLUSION

The study observed a significant variation in the characteristics of honey across various sampled location. Most of the samples were within the range when compared with international standard for honey specification (Codex Alimentarius 2001) except for the moisture content of OJ that exceeded the expected value. Honey sample from UI has best overall rating from the sensory survey. Result further revealed that variability of some qualities were as a result of location and harvest procedure. Colour, taste, flavor, texture are some of the parameters that can be used determine quality honey but quality honey cannot be based on the aforementioned as this is greatly influenced by nectar source, temperature, geographical range amongst other factors.

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