QUALITY ASSESSMENT OF LOCALLY PRODUCED HONEY FROM USMANU DANFODIYO UNIVERSITY, SOKOTO

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ABSTRACT
This study is conducted to analyze the physico-chemical properties and mineral compositions of locally produced honey samples in Usmanu Danfodiyo University Sokoto with the national and international standards. To achieve these, seven samples of locally produced honey was collected from the study area. the physicochemical properties was analysed using the Official Methods of Analysis established by Association of Official Analytical Chemists. The results showed that the colours ranged from extra light amber to light amber; pH from 3.67±0.21 to 4.53±0.12, electrical conductivity from 0.06±0.01mS/cm to 1.15±0.16mS/cm, density from 1.41±0.00g/cm3 to 1.36±0.00g/cm^3, ash content from 0.08±0.00% to 0.18±0.01%; moisture content from 3.94±0.29mg to 20.29±0.20% and total reducing sugars from 63.23±2.46% to 73.34±2.77%. The physico-chemical properties of the honeys were found to meet the established national standards. It was thus, concluded that honey from the area of study are of good quality.
Keywords: Quality assessment, Local Honey, Physical, Chemical, Minerals

1.0 INTRODUCTION

Honey is a sweet natural food made by bees using water, pollen and nectar from flowers (Cantarelli *et al.,* 2012). It is a semi liquid, yellow, sweet and flavoured food stuff, with a great biological and calorific value made by bees from nectar or sweet juice that can be found in different parts of the flowering plants (Bogdanov, 2014).

It is composed mainly of carbohydrates, lesser amounts of water and a wide range of minor components (White, 2015). Honey is a worldwide recognized natural food which has high nutritional value and many beneficial health promoting effects (Kaskoniene *et al.*,2015). Honey has been used as a traditional natural therapeutic agent to boost up the immune system and combat against diseases (Adetuyi *et al.,* 2019). Several authors reported that the healing capacity of honey is strongly influenced by the physical and chemical properties of honey (Maundoi *et al.,* 2011). The quality of honey is primarily determined by its physical, chemical and microbiological characteristics (Alvarez et al., 2010). Since the quality of honey varies according to geographical and seasonal conditions as well as floral sources, each honey exhibits various physico-chemical and Biological properties(Crane, 2009).

Development of codes of procedure and practice in production and handling of honey and legal requirements and policy have not been put in place by Nigerian Bureau of Standards (NEBS) due to lack of proper documentation on the palynological and physico-chemical parameters on Nigerian honey.

Nowadays, many people prepare using locally produced honey than commercial produced honey. This is because most commercial honeys lack the medicinal and nutritional properties due to the absence of the minor constituent and that it undergoes adulteration.Therefore, the aim of this research work is to analyze the physico-chemical properties of locally produced honey samples in Usmanu Danfodiyo University Sokoto.

2.0 MATERIAL AND METHODS

2.1 Study area

The study was carried out at Usmanu Danfodiyo University, Sokoto. The area is located at the western part of Sokoto metropolis on latitude 13º 01′N and longitude 5^0 15 ′E in the Sudan Savannas zone of Nigeria. The climate is semi arid, characterized by long dry (October to May) and short rainy (June to September) seasons and reaches maximum in August, with mean annual rainfall of 440 - 560mm minimum and maximum respectively. It has annual maximum and minimum temperatures of 40^0 C and 29^0 C, respectively. The natural vegetation of the area is Sudan savanna, characterized by few trees and grasses.

2.2 Samples collection

Seven honey samples was bought from Biological Garden at Usmanu Danfodiyo University, Sokoto and was labelled as (Sample A), (Sample B), (Sample C), (Sample D), (Sample E), (Sample F) and (Sample G). The honey samples was stored in a clean airtight bottles at an ambient temperature to avoid moisture absorption. The honey samples was later taken to the laboratory of the Department of Biochemistry, Usmanu Danfodiyo University, Sokoto State for analyses.

2.3 Determination of Physico-chemical properties

Physicochemical properties was analysed using the Official Methods of Analysis of Association of Official Analytical Chemists (AOAC,1990). Samples were analysed in triplicate to ensure uniform conditions and comparability.

2.3.1 Determination of colour

The color intensity of honey samples was measured according to the Pfund classifier (Mohammad, 2012). After briefly homogenizing each honey sample and by devoiding it of air bubbles, it was transferred into a cuvette with a 10mm light path until the cuvette was approximately half full. The cuvette was then insert into a spectrometer to measure absorbance at OD560 nm and color was expressed in millimeter (mm) (Mohammad, 2012).

2.3.2 Determination of ph and acidity

pH of honey samples was determined using a digital portable pH meter in accordance with AOAC (2000). The electrode was inserted into the honey samples to determined the pH. Occasionally, very thick honey samples were diluted two times with distilled water before inserting the electrode.

2.3.3 Determination of electrical conductivity

Electrical conductivity was determined by measuring 20g dry matter of honey in 100ml of ultra pure water. The electrical conductivity cell was immersed at 20°C, while the reading was expressed in milliSiemens per centimeter (mS cm^{-1}) (AOAC, 1990).

2.3.4 Determination of density (g/cm^3)

Density was obtained by the mass to volume ratio relationship. By the use of a dropper, exactly 1ml of sample was introduced in a 5ml measuring cylinder. The mass was then measured using an electronic balance Adam.

2.3.5 Determination of ash content

10g of each sample was weighed in a silica crucible. The crucible was heated in a muffle furnace for about 3 to 5h at 500°C. It was then cool in desiccators and weigh. This was repeated consequently till the weight became constant (ash became white or grayish white).

2.3.6 Determination of moisture content

About 2.0g of the honey samples were put in pre- weighed dried crucibles, and transfer into a previously weigh crucible. The crucible was then placed into the drying oven at 105^0 C for 5 hours. After this, it was remove and place in a desiccator to cool. The cool crucible was re -weigh.

2.3.7 Determination of total reducing sugar

About 1g of honey sample in conical flask was dissolved using 100ml of hot water to dissolve all sugars. The solution was clarified by addition of 5 ml Carrez 1 solution followed by Carrez 2 solution then the content was filtered using whatman filter paper No. 1.

Then 10 ml of the filtrate was placed in duplicate in conical flask mixed with 10 ml of copper reagent (sodium carbonate solution, copper sulphate solution and citric acid) then boiled for 30 minutes and left to cool, after then 1 ml of saturated solution KI was added followed by 10 ml of 6N HCL. About three drops of 1%w/v starch was added as indicator, and the content was titrated against 0.1N (NaS_2O_3) up to the end point (blue black to cream) was used to convert titration volume to sugar content.

2.3.8 Determination of hydroxymethylfurfural

5g of honey samples was accurately weigh into a beaker and dissolved in 25ml distill water and quantitatively transfer into a 50ml volumetric flask. A solution of 0.5ml Carrez solution I was add to the solution and mixing followed by further addition of 0.5ml Carrez solution II. The prepare samples solution was filtered through Whatman No 1 filter paper. 5.0 ml of the filtrate was transferred into each of 2 test tubes; 5.0ml of water was added into one of the test tubes and mix well (the sample solution). 5 millilitres of 0.2% sodium bisulphite was add into the second test tube and mix properly (the reference solution).The absorbance of the sample solution was determined against the reference solution at 284 and 336nm. The determinations was carried out in triplicates. (White, 2009).

3.0 RESULTS

Table.1: Honeys colour expressed in absorbance (OD_{560} nm) and Pfund scale

Samples	Absorbances	Honey Colours	Pfund scales (mm)
A	0.93 ±0.05	Extra light amber	45.00
B	1.33 ±0.01	Light amber	74.00
C	2.71±0.22	Amber	109.00
D	2.97±0.06	Amber	114.00
E	1.14±0.03	Light amber	86.00
F	2.84±0.28	Amber	103.00
G	1.98±0.31	Extra light amber	56.00

Values are mean ± SD of triplicate determination

The colour of the honey samples was classified according to their absorbance (table 4.1) as extra light amber (Sample A and G),with a mean value of 0.93 ±0.05 and 1.98±0.31, light amber (Sample B and E) with a mean value of 1.33 ±0.01 and 1.14±0.03, amber colour (Sample C, D and F) with a mean value of 2.71±0.22, 2.97±0.06 and 2.84±0.28 respectively, significantly differences $p < 0.05$).

Table 2: Physico-chemical properties of honeys samples.

HONEY SAMPLES	PHYSICO-CHEMICAL PROPERTIES						
	Ph	E.C (mS/cm)	Density (g/cm$^{3)}$	Ash (%)	Moisture (%)	HMF (mg/kg)	TRS (%)
A	4.53±0.12	1.15±0.16	1.41±0.00	0.13±0.04	18.38±1.63	3.94±0.29	73.34±2.77
B	4.07±0.06	0.53±0.07	1.38±0.00	0.18±0.01	15.57±0.03	5.99±0.75	67.28±2.66
C	4.33±0.35	0.53±0.07	1.33±0.00	0.14±0.05	17.91±1.76	6.11±0.10	67.37±4.55
D	4.17±0.67	0.12±0.01	1.40±0.00	0.11±0.14	20.29±0.20	6.33±0.14	69.76±0.21
E	3.67±0.21	0.12±0.02	1.42±0.02	0.08±0.02	19.76±0.43	8.51±0.28	68.53±2.32
F	3.77±0.12	0.06±0.13	1.38±0.00	0.13±0.03	16.71±0.03	13.21±2.68	63.23±2.46
G	4.48±0.02	0.33±0.01	1.36±0.00	0.09±0.01	15.75±0.06	16.37±0.75	65.20±0.90

Values are mean ± SD of triplicate determination
EC: Electrical conductivity
TRS: Total reducing sugar(%).

The mean pH values of the honey samples varied from 3.67±0.21 to 4.53±0.12. EC values of the honey samples ranged from 0.06±0.01 (Sample F) to 1.15±0.16 (Sample E) mS/cm. The density(g/cm$^{3)}$ of the honey samples obtained ranged from 1.36±0.00 (Sample G) to 1.41±0.00 (Sample A). The ash content of the honey samples ranged from 0.08±0.00 (Sample E) to 0.18±0.01 (Sample B). The moisture content ranged from 15.75±0.06 (Sample G) to 20.29±0.20% (Sample D). The HMF of the honey samples analyzed ranged from 3.94±0.29 (sample A) to 13.21±0.28 (sample G) mg/kg. Total Reducing sugars ranged from 63.23±2.46 (sample F) to 73.34±2.77 (sample A).

DISCUSSIONS

The study is focused on the determination of physico-chemical properties such as:
In line with the standard given by the Biochrom Partners in Science and USDA (1985), the colour of the samples was classified according to their absorbance at OD_{560} (table 1). The honey samples ranges from extra light amber (Sample A and G), with a mean value of 0.93 ±0.05 and 1.98±0.31, light amber (Sample B and E) with a mean value of 1.33 ±0.01 and 1.14±0.03, amber colour (Sample C, D and F) with a mean value of (2.71±0.22), (2.97±0.06) and (2.84±0.28) respectively, which are all significantly different at $p < 0.05$). Similar results were reported for Slovak honeys (Kasperova *et al.,* 2012). The mean pH values of the honey samples varied from 3.67 to 4.53. This value is in accordance with the acceptable range for nectar honey (from 3.2 to 4.5) (White, 2015).

EC values of the honey samples ranged from 0.06±0.01 (Sample F) to 1.15±0.16 (Sample E) mS/cm. The results of electrical conductivity were consistent with the results reported by Escuredo *et al.,* (2012) in blossom and honeydew honeys. The density of the honey samples analyzed varied from 1.41±0.00 (Sample A) to 1.36±0.00g/cm^3 (Sample G). The average density of honey samples analyzed were within the permitted limits of 1.43 g/cm^3 as set by the International Honey Commission (2002) and Codex Alimenterius Standards (2001). Mean values of Ash content in honey varied from 0.09±0.01% to 0.30±0.04% (Table 4.2), which is within the acceptable range and it falls within the range reported for Nigerian honey samples from other locations Adebiyi *et al.* (2014). The moisture content of the honey samples ranged from 15.75±0.06 (Sample G) to 20.29±0.20% (Sample D), which was comparable to the values obtained from the USA honeys (Adebiyi *et al.* 2014), meaning that all the samples had moisture content within the limit allowed by the Codex, Council of the European Union (EU) and Kenya Bureau of Standards (KEBS) of ≤21%. The results were in agreement with previous studies (Duman *et al.* 2012). The Hydroxymethylfulfural from honeys analyzed ranged from 3.94±0.29 (sample A) to 13.21±0.28mg/kg (sample G) mg/kg with (Sample G) having the highest value of 13.21±0.28mg/kg and (Sample A) with the lowest 3.94±0.29mg/kg as shown in Table 4.2. There was a significant ($p<0.05$) different in HMF between honeys. These results were consistent with the result obtained by Malika *et al*., (2017). Total Reducing sugars (Table 2), ranged from 63.23±2.46 (sample F) to 73.34±2.77% (sample A) honeys and were below the acceptable minimum limit of 65%. These results were consistent with the results obtained by Muli *et al, (*2007). White and Doner reported free acidity, lactone acidity, and total acidity in the average of 22.03 meq/kg; 7.11 meq/kg and 29.12 meq/kg, respectively for 490 honey samples. In this study, the average values obtained for free acidity (23.00 meq/kg) are in line with the observation of White and Doner (2010) and Omafuvbe and Akanbi (2009). This study also revealed that the free acidity predominates over the lactone acidity in all the samples analyzed; similar observations were previously reported by other scientists Cantarelli *et al.,* (2008).

CONCLUSION

The present study revealed that the physico-chemical parameters can be used to characterize, classify, and set processing and storage conditions of Nigerian honey. The results obtained show that honey samples is characterized with high pH content, moisture content, TRS and free acidity. On the other hand, it has low ash content, electrical conductivity, and Hydroxymethylfulfural.

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