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Comparative Analysis of the Proximate and Nutritional Compositions of Nigerian Bitter and Sweet Honey from *Apis mellifera.*

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Abstract- Honey, a natural product of the genus *Apis*, usually contains a variety of nutritional and mineral substances which varies depending on the plant species on which the bee forage. It had been noted that over the years, there have been a greater increase in the demand of bitter honey over the sweet honey; this has led to increase in price of this honey type and more gain for the apiculturists. This study was then undertaken to compared the nutritional and mineral compositions of Nigeria bitter and sweet honey. The honey samples used were collected from ADEKAM apicultural farm in Ala community, Akure, Ondo State and analysed following Standards Association of Official Analytical Chemists protocol for nutritional composition and mineral compositions using standard calibrated machines. Analysis of the results obtained showed that the two honey samples were significantly different ($p<0.05$), both in nutritional and mineral compositions. The bitter honey samples were richer in protein (0.74±0.04) and carbohydrate (77.86±0.84) composition required by human body for growth. However, significant ($p<0.05$) slight higher values of all the minerals composition (Na, K, Ca, Fe, P and Mg) was recorded in sweet honey samples, with Potassium (K) being the most abundant of all as earlier reported by previous authors. It can be concluded that although both types of honey are rich in nutritional and mineral elements. However, they are slightly different from each other, not only in taste, but also in some of the parameters studied. Therefore, further study is recommended to be undertaken to ascertain the types and quantities of amino acids and as well as the simple sugars in them.

Keywords: Honey, Nectar, Proximate composition, Minerals, Nutritional

I. INTRODUCTION

Honey is a sweet natural food made by bees using water, pollen and nectar from flowers (Cantarelli *et al.*, 2008). The variety produced by honey bees (the Genus *Apis*) is the one most commonly referred to, as it is the type of honey collected by most beekeepers and consumed by people (Famuyide *et al*., 2014). Folayan and Bifarin (2013), reported that honey is produced by honey bee workers mainly from nectar of flower or honey dew on leaves. Nectar is reduced to honey containing predominantly carbohydrates with a very little protein, vitamins, minerals, enzymes, amino acids and as well as other several compounds like phenolic compound thought to function as antioxidants (Surendra, 2008, Oyeleke *et al*., 2010, James *et al*., 2013).

These chemical components are of great importance as they influence the keeping quality, granulation, texture, as well as the nutritional and medicinal efficacy of honey (Surendra, 2008). The major constituents of honey are nearly the same in all honey samples, however, the biochemical composition and physical properties of natural honeys varies greatly according to the plant species on which the bees forage (Cantarelli *et al*., 2008; Ebenezer & Olubenga, 2010; James *et al*., 2013). Furthermore, the properties of natural honeys also vary depending on the differences in climatic conditions and vegetation of the areas. Buba *et al*. (2013), reported that natural honey is one of the most widely sought products due to its unique nutritional and medicinal properties, which are attributed to the influence of the different groups of substances it contains.

The production of quality honey to assure food safety and hygiene depend on the variation in the active components of the honey which is base on the plant species differences. However, despite the nutritional and health value of bee honey and its produce it has been reported that comparative relationship between the nutritional components and biochemical composition of honeys is very limited. For these reasons, this research was carried out to compare the biochemical active ingredient and nutritional composition of Nigerian bitter and sweet honey

II. MATERIALS AND METHODS

Sample collection

The honey samples (Bitter and Sweet) harvested during the late dry season 2013, were collected from ADEKAM apiculturist farm, Ala community, Akure, Ondo State, Nigeria. The honey was kept in air tight container to avoid moisture absorption. It was later transported to the laboratory of Department of

Biological Sciences, Federal University of Technology, Minna, for analysis.

Determination of Nutritional Compositions

Proximate analysis carried out on the honey samples to determined their composition were; protein, fat, dietary fiber, carbohydrate, water and ash. All the samples were analysed in triplicate using standard analytical methods described by Association of Official Analytical Chemists (AOAC).

Moisture content (M.C) was determined by drying 2.0g of each of honey samples at 70^{o}C to constant weight in hot air oven (AOAC, 1990).

$$\%\ M.C = \frac{fresh\ weight\ -\ dry\ weight}{fresh\ weight} \times 100$$

Ash content was determined by drying 5.0g of each sample in porcelain crucible at 105^{o}C for 3 hours in hot air oven to prevent loss by boiling. The dried samples were ignited in an ash in furnace at 600^{o}C to constant weight, cooled and weighed in milligram.

The determination of protein content was carried out using the Kjeldahl method. The total nitrogen content was first estimated from which the protein content was calculated using the 6.25 conversion factor for protein nitrogen using the AOAC Method, 2005. The fat content was determined by using acid hydrolysis method based on the AOAC Method.

The dietary fibers consisted of the total, soluble and insoluble fibers of honey samples were determined based on AOAC Method.

Carbohydrate value of the honey samples were estimated using the difference method of Charrondiere *et al*. (2004).
%Carbohydrate = 100% – (%Moisture + % Crude Fat + %Crude Protein + %Ash).

The energy values of the samples were determined by calculation as follows:
Energy (KJ/100g) = 4.186 [(%Crude Protein x 4) + (%Crude Fat x 9) + (%Carbohydrate x 4)]

Determination of Mineral Compositions

The mineral compositions presented in the honey samples evaluated include: Sodium and Potassium determined using flame photometer (Model: Corning 410), Magnesium, Calcium and Iron were determined using atomic absorption spectrophotometer (Model: Buck VGP 210) and Phosphorus was determined calorimetrically (Gallenkamp UK Model).

III. STATISTICAL ANALYSIS

Data collected from this study were represented in mean±standard error of mean. The data were thereafter subjected to paired sample T-test using statistical package for social science 20th version.

IV. RESULTS AND DISCUSSION

The results of the nutritional composition showed that with the exception of carbohydrate, there were significant differences ($P<0.05$) between all the compositions; moisture, ash, fat contents and crude fiber of the two honey samples. Higher values for fat, protein, crude fiber and carbohydrate content were recorded in bitter honey while the sweet honey had significantly higher content for moisture and ash table 1.

Mineral compositions

The mineral composition present in the honey samples Sodium, Potassium, Phosphorus, Calcium, Iron and Manganese. Statistical analysis showed that there were no significant differences ($P>0.05$) between Na, K, Ca, Fe and Mn determined for two honey samples. In addition, significant values ($P<0.05$) were recorded for phosphorus (3.00±0.02) and energy (333.64±0.35) contents. With the exception of Iron (0.01±0.00) and Manganese (0.01±0.00) the sweet honey had higher mineral constituent of all the element analysed. The variations in the mineral compositions might be due partly, to the different plant species and habitats from which the nectar are sought by the insects (Agunbiade *et al*., 2013)

Nutritional Compositions

Moisture content has been reported by Malika *et al*. (2005) to be the most important parameter that determines quality of honey, since it affects storage life and processing characteristic. The moisture content of both the sweet and bitter honey recorded in this study fall within the range as earlier reported by Nigerian authors. They reported that the moisture contents of honey ranged from 12.5 to 25.22%, (Badawy *et al*., 2004; Oyeleke *et al*., 2010, Buba *et al*., 2013). The low moisture content recorded in the bitter honey sample forms an important part of its qualities which protects honey from being degraded by microorganisms. The results of the ash content recorded in this study was similar to the result of Ayansola and Banjo (2011) who recorded range value of (0.140±0.158) to (0.708±0.754) from honey obtained in southwestern Nigeria. for ash content of sweet honey. However, this was contrary to the report of some Nigerian honey samples and other locations which showed that ash content of honey samples varied between 0.05 and 0.79% (Odeyemi *et al*. 2013), Agbagwa *et al.* (2010); Adeleke *et al*. (2006); Malika *et al*. (2005)].

This present work is also in conformity with the results of buba *et al*. (2013) on honey samples collected from north-east which ranged from 0.10 – 0.50 with mean values of 0.29 ± 0.11, the fat content recorded in this study were within the range of 0.23 and 0.33.

The results of protein contents obtained in this research work were in agreements with the work of Buba *et al*. (2013) who reported that the protein content of honey in north-east of Nigeria ranged between 0.35 and 1.08. The results were also in conformity with an average amount of 0.70mg per 100g reported by National Honey Board. Contrary to the results obtained in this study Agunbiade *et al*. (2012), reported that the protein contents obtained from three state in Nigeria ranged from 1.43 -2.72%. This is an indication that honey is not an adequate sources of dietary protein.

The result of the carbohydrate contents (76.44 - 77.86) obtained were similar to work reported by earlier scientist

(Oyeleke *et al*., 2010; Buba *et al*., 2013) as well as National Honey Board (77.60 – 87.70). However, significant (P<0.05) higher carbohydrate content recorded in bitter honey could be attributed to forage plant difference of bees. This is in conformity with the report of (Doner, 1977) that Carbohydrates are the main constituents of honey comprising about 95% of honey dry weight.

The result obtained for Iron in both the sweet and bitter honeys (1.25 and 1.53 respectively) are in agreement with the work of Ankrah (1998) but in disagreement with that of Cantarelli *et al*. (2008). Similar to the results obtained in the study Agunbiade *et al*. (2012) reported that there is a wide variation in the mineral composition of honey obtained from three states in Nigeria. They reported that the wide disparity may be due to variation in the vegetations and soil composition of minerals at the different locations from which the honeys were produced. The results of Potassium (14.74±0.16 – 16.50±0.01) reported in this study were in conformity with the results of Adenekan *et al*. (2012) and Ajao *et al*. (2013) who recorded (0.97±0.01 – 1.38±0.01) and (0.93±0.05 – 1.40±0.01). The Conformity of this present result in terms of some mineral compositions by earlier scientists might be due to similar source of nectar and ecological zone. The results of the Phosphorus and Magnesium obtained with range values (2.62 -3.45) and (0.10 – 0.22) respectively, were in agreement with the works of Agunbiade *et al*. (2012).

V. CONCLUSION

It is concluded from this study that both sweet and bitter honey were slightly different in proximate and minerals composition. The differences observed in some of these parameters are attributed to their different flora sources.

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Table 1: Nutritional Composition of Nigeria Bitter and Sweet Honey Bee

SAMPLE	Moisture Content %	Ash Content %	Fat Content %	Protein Content %	Crude fiber Content %	Carbohydrate %
Bitter Honey	19.93±0.10^a	1.18±0.15^a	0.33±0.03^b	0.74±0.04^b	2.03±0.08^b	77.86±0.84^a
Sweet Honey	20.14±0.04^b	1.73±0.74^b	0.23±0.02^a	0.69±0.03^a	1.25±0.08^a	76.44±0.64^a

Values with different superscripts along a column are significantly different (P<0.05)
Values are mean ± SE of triplicate determinations.

Table 2: Mineral Composition of Nigeria Bitter and Sweet Honey Bee in mg/kg

SAMPLE	Na	K	Ca	Fe	Mg	P	Energy
Bitter Honey	2.80±0.00^a	7.50±0.00^a	3.90±0.21^a	1.53±0.00^b	0.22±0.00^b	2.62±0.07^a	329.12±1.82^a
Sweet Honey	3.10±0.00^a	9.50±0.01^b	4.30±0.15^a	1.25±0.00^a	0.10±0.00^a	3.45±0.02^b	333.64±0.35^b

Values with different superscripts along a column are significantly different (P<0.05)
Values are mean ± SE of triplicate determinations.

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