

## **Proximate and Mineral Elements Composition of Honey from Selected Hives in Jos Metropolis, Nigeria**

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**Abstract:** *The purpose of this study was to assess the proximate and mineral composition of honey obtained from selected hives in Jos metropolis, Nigeria which is important in estimating the quality of honey based on their concentration. Twenty seven (27) samples from nine apiaries with three replicates in each were analysed. Three Local Government areas with three apiaries in each were studied. The proximate and mineral composition analysis of the sample was determined by the Association of Official Analytical Chemists (AOAC, 2005). From the results obtained, moisture and ash content was highly significant, Jos North had the highest moisture and ash content (10.39% and 1.67% respectively) while Jos East had the least moisture content with the appropriate ash content which had no significant difference with Jos South. Other proximate and mineral elements compositions showed presence with no level of significance between all locations. The results shows that honey from all location possess low moisture content with the basic nutritive requirement, although honey obtained from Jos East should be highly recommended for its very low moisture content and high calcium and ash content, which was significant.*

**Keywords:** *Honey, Quality, Proximate Analysis, Minerals, Apiary*

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### **I. Introduction**

Honey is a sweet food made by bees using nectar from flowers. The variety produced by honey bees (the genus *Apis*) is the most commonly referred to as it is the type of honey collected by most beekeepers and consumed by human (1). Honey gets its sweetness from the monosaccharides fructose and glucose, and has approximately the same relative sweetness as that of granulated sugar (1). Honey has attractive chemical properties for baking and a distinctive flavour that leads some people to prefer it over sugar and other sweetness and most micro-organisms do not grow in honey because of its low water activity of 0.6% (2). It is a natural substance produced by bees, consisting basically of a complex mixture of carbohydrates, especially glucose and fructose, organic acids, amino acids, minerals, vitamins, enzymes, pollens, and pigments (3, 4). Its nutritional quality, medicinal and sensory properties have attracted thousands of consumers (5). Vitamin C and most of the Vitamin B complex are present in variable amounts (6).

Honey has a long history of human consumption, and is used in various foods and beverages as a sweetener and flavouring. Flavours of honey vary based on the nectar source and various types and grades of honey that are available (7). Vaughn (7) also reported that the study of pollens and spores in raw honey (melissopalynology) can determine floral sources of honey. High quality honey can be distinguished by fragrance, taste and consistency. Ripe, freshly collected, high quality honey at 20°C (68°F) should flow from a knife in a straight stream, without breaking into separate drops (8). Honey is classified by the floral source of the nectar from which it was made. The quality of honey is traceable to floral source and region of origin. Most commercially available honey is blended, that is mixture of two or more honeys differing in floral source, colour, flavour, density or geographic origin and its nutrition. The composition and quality of honey vary, depending on the climatic region, whether wet or dry, the environmental temperature, the type of botanical plant used to produce it, the honey bees species, the sugar composition, the treatment of honey during extraction, processing and subsequent storage conditions (9, 10). Honey comes in a range of colours including white, amber, red, brown and almost black (11). Its flavor and texture also vary with the flower nectar from which it was made. This study therefore, focuses on the assessment of the quality of honey produced in Jos metropolis.

### **II. Materials And Methods**

#### **2.1 Data Collection**

The study was conducted in Jos, Plateau state. Freshly harvested honey was collected from the nine (9) apiaries located in three Local Government Areas of Jos metropolis (Jos North, South and East). The experiment was laid out in a Completely Randomized design (CRD), with three treatments and three replicates in each Local Government Area (LGA). The samples were labelled, kept in a container at room temperature and thereafter taken to the Biochemical Laboratory of Ahmadu Bello University, Zaria, Nigeria for analysis.

## 2.2 Proximate and Mineral Content Analysis

The recommended method by the Association of Official Analytical Chemists (12) was adopted for the determination of the proximate composition such as moisture, Ash, crude fibre, crude fat and crude protein calculated as Nitrogen (N x 6.25) by the Kjeldahl method. The mineral contents of honey including Ca and vitamin C, were quantitatively determined using an atomic absorption spectrophotometer, after digestion by the wet ashing method (13).

## 2.3 Statistical Analysis

Results obtained were subjected to Analysis of variance (ANOVA) using SPSS 16.0.

## III. Results And Discussion

### 3.1 Results

The result of the study revealed that the location of Airforce base, Wildlife Park and APLORI have the same floral composition of *Acacia nilotica* and *Eucalyptus camaldulensis*; PADP and Komo farms had Mango trees and other locations had varying floristic compositions.

Moisture content and Ash in the honey collected from the three location in Jos North was significant (P=0.03 and P= 0.001 respectively). FCF Jos had the highest while Wildlife park had the least moisture and ash content (Table 2).

The calcium in the honey collected from the three location in Jos South was significant (P=0.03). ECWA YC had the highest while Komo farms had the least Calcium content (Table 3). Moisture content in the honey collected from the three location in Jos North was highly significant (P= 0.001). Airforce had the highest value which was highly significant from Solomon Lar which had the second value and ECWA RD which had the least moisture content value (Table 4). Moisture and ash content of honey from the three LGA's (Jos North, East, South) shows significant difference, Jos north had the highest moisture and highest ash value of 10.39% and 1.67% respectively; while Jos East had the least moisture content and Jos South had the least ash content. Moisture content in honey from Jos North and South had no significant difference but Jos East had high significant difference. Ash content from Jos East and South had no significant difference but Jos North had high significant difference. (Table 5)

**Table 1: The Flora Composition of the Selected Locations in the Study Area**

S/N	Study area/Vegetation	<i>Bougainvillea Formosa</i>	Mango	<i>Acacia nilotica</i>	<i>Eucalyptus camaldulensis</i>	Teak	Orange
1	FCF.				+	+	
2	WILDLIFE PARK.			+	+		
3	PADP.		+				
4	ECWA Y.C		+		+		
5	APLORI.			+	+		
6	KOMO FARM.		+				
7	SOL. LAR.	+					
8	AIR FORCE BASE.			+	+		
9	ECWA RD.						+

+ Present

**FCF** : Federal College of Forestry, Jos. Jos North LGA; **Wild Life** : Wild Life Park, Jos. Jos North LGA; **PADP** : Plateau Agricultural Development Project, Jos. Jos North LGA; **ECWA Y. C.**: ECWA Youth Camp. Jos East; **APLORI** : AP Leventis Ornithological Research Institute, Laminga Jos East; **KOMO** : Komo Farm Laminga, Jos East.; **S. Lar.** : Solomon Lar Amusement park, Jos South; **Air Force** : Air Force Base, Jos South and **ECWA R.D** : ECWA Rural Development, Jos South.

**Table 2: Summary of Proximate Composition of Jos North**

Locations	MC	CP	CFat	CF	Ash	NFE	Ca	Vit C
<b>FCF, Jos</b>	13.43a	0.28a	10.93a	0.007a	0.96b	21.15a	6.59a	13.64a
<b>Wildlife</b>	6.93ab	0.26a	11.67a	0.003a	3.33a	20.74a	6.02a	12.89a
<b>PADP</b>	10.80b	0.27a	11.00a	0.013a	0.73b	20.32a	5.96a	12.93a
<b>SE±</b>	<b>1.30</b>	<b>0.05</b>	<b>1.05</b>	<b>0.006</b>	<b>0.21</b>	<b>1.56</b>	<b>0.62</b>	<b>0.67</b>
<b>Remark</b>	s	ns	ns	ns	s	ns	ns	ns

Means in the same column having the same letters are not significantly different ( $p \leq 0.05$ ) s-significant; ns-not significant

**Table 3: Summary of Proximate Composition Of Jos East**

Locations	MC	CP	CFat	CF	Ash	NFE	Ca	Vit C
ECWA YC	3.85a	0.28a	11.37a	0.010a	0.64a	21.04a	7.20a	13.93a
APLORI	4.23a	0.31a	11.22a	0.003a	0.70a	21.10a	6.07ab	14.05a
KOMO	4.31a	0.29a	11.63a	0.007a	0.79a	20.62a	3.67b	13.69a
SE±	<b>0.37</b>	<b>0.05</b>	<b>0.49</b>	<b>0.005</b>	<b>0.11</b>	<b>0.66</b>	<b>0.70</b>	<b>0.77</b>
Remarks	ns	ns	ns	ns	ns	ns	s	ns

Means in the same column having the same letters are not significantly different ( $p \leq 0.05$ ) s-significant; ns-not significant

**Table 4: Summary of Proximate Composition f Jos South**

Locations	MC	CP	CFat	CF	Ash	NFE	Ca	Vit C
S LAR	7.11b	0.32a	11.18a	0.007a	0.73a	21.10a	6.77a	13.01a
AIRFORCE	16.31a	0.32a	11.18a	0.103a	0.68a	21.96a	6.67a	14.05a
ECWA RD	6.94b	0.29a	11.56a	0.000a	0.68a	20.75a	6.19a	12.99a
SE±	<b>0.81</b>	<b>0.05</b>	<b>0.49</b>	<b>0.057</b>	<b>0.08</b>	<b>0.92</b>	<b>0.54</b>	<b>0.87</b>
Remark	s	ns	ns	ns	ns	ns	ns	ns

Means in the same column having the same letters are not significantly different ( $p \leq 0.05$ ) s-significant; ns-not significant

**Table 5: Proximate Composition of Jos Metropolis (North, East And South)**

Locations	MC	CP	CFat	CF	Ash	NFE	Ca	Vit C
Jos North	10.39a	0.27a	11.20a	0.008a	1.67a	20.74a	6.19a	13.15a
Jos East	4.13b	0.29a	11.41a	0.007a	0.71b	20.92a	5.65a	13.89a
Jos South	10.12a	0.31a	11.31a	0.037a	0.70b	21.27a	6.54a	13.35a
SE±	1.14	0.02	0.37	0.019	0.25	0.57	0.44	0.41
Remark	s	ns	ns	ns	s	ns	ns	ns

Means in the same column having the same letters are not significantly different ( $p \leq 0.05$ ) s-significant; ns-not significant

### 3.2 Discussion of results

Honey produced by honey bees (*Apis mellifera*) is one of the oldest traditional medicines known to man for therapeutic and prophylactic uses (14, 15). Proximate analysis is usually carried out to determine the nutritional values of foods and food based products. The nutrient content is essential not only for health promotion, but also for metabolic energy. The proximate properties of different samples of honey used for evaluation in this study are depicted in Table 2 to 5 above. Samples from Jos North had the highest moisture content of 10.39% (with this value being highest in FCF Jos) while Jos East had the lowest average value of moisture content (4.13%). The moisture content obtained in all the nine locations range from 13.43% to 4.13% which conforms to the range reported for floral honeys by Badawy et al., (16). It also indicates that all the samples comply with USDA, (17) standard of honey grading. Moisture content is practically the most important parameter that determines quality of honey, since it affects storage life and processing characteristic. The variations in the moisture content of honey have been attributed to the composition and floral origin of honey (18). The strong interaction of sugar in honey with water molecules may decrease the water available for microorganisms. The low moisture content of honey also forms an important part of the system which protects honey from being degraded by microorganisms as observed in samples from Jos East. Moisture content was observed to be highest in Jos North and South with no significant difference (10.39% and 10.12% respectively), variations also exists in each of this L.G.A; FCF Jos (Jos North) and Airforce (Jos South) shows high percentage of moisture content (13.43% and 16.31% respectively), the least moisture content and was observed in wildlife park (Jos North) and ECWA RD (Jos South) as 6.93% and 6.94% respectively. It was found that the honey samples would be prone to granulation because of high moisture content ( $> 20\%$ ) 919 (19). Honey Regulation 197651 No 180 Council Directive 74/4009/EEC stipulated honey moisture content should not be more than 21%. It is apparent that the water content varies greatly and may range widely. The amount of moisture

is a function of factors involved in ripening, including, among others, the original moisture of the nectar. According to the United States Standards, extracted honey may not contain more than 18.6% moisture. Moisture level of about 17% has been found to be optimum. When honey is nothermatically sealed, because of its hygroscopic nature, it absorbs moisture. Honey with less than 17.1% water will not ferment in a year, irrespective of the yeast count. Between 17.1 and 18% moisture, honey with 1000 yeast spores or less per gram will be safe for a year. However when the moisture is above 19% honey can ferment even with only one spore pergram, which shows that honey from all locations of the three Local Government Area have the required moisture content that will inhibit deterioration. The moisture content of honey is one of the criteria that determine the shelf stability of honey (20, 21). Thus the higher the moisture, the higher the probability that honey will ferment upon storage by osmotolerant yeasts (22). A high moisture content of honey is also an indicator of adulteration (23).

Samples from Jos North had high Ash value (1.67%) which was significant, while ash value of Jos East and South was not significantly different (0.70% and 0.71% respectively). The flora origin of honey has been reported responsible for the variability in ash content by Molan, (24). Ash content is a reflection of the total inorganic minerals that are present in a sample after incineration (25). The low ash values recorded fell within the range typical of natural nectar honeys (23) and not of honeydew honeys, which are have been reported to have high ash content (22). The Codex AlimentariusCommision (26) standard specified an ash content of not more than 0.6% for normal honey.

Among the three Local government area (LGA) used as study sites; moisture and ash content was highly significant in Jos North ( $P=0.03$  and  $P= 0.001$ ); Calcium contents was significant ( $P=0.03$ ) in Jos East while moisture content was significant in Jos South ( $P=0.001$ ).Calcium is very essential for strong bones, therefore honey obtained from Jos East especially from ECWA Youth Camp (ECWA YC.) which showed a high value for calcium composition(7.20%) is recommended for its quality, perhaps this difference may be attributed to the floral composition around the apiary (Mango and Eucalyptus).Wildlife Park also had a highly significant ash content of 3.33%. Jos East is recommended for its very low moisture content, high calcium content and the standard requirement of ash content as studied by Molan (27). This result obtained may be attributed to the flora compositions found in the locations, which was mainly, *Acacia nilotica*, *Eucalyptus camaldulensis*and Mango.

Other proximate and mineral elements such as crude protein, crude fat, crude fibre, Nitrogen free extract (NFE) and Vitamin C showed no level of significance between all locations, but they were present in right quantity, presence of VitaminC helps to protect the body against immune system deficiencies, Skin wrinkling, eye diseases, etc.

Therefore honey obtained from all locations have the required moisture content and nutritive compositions but honey from Jos East region is highly recommended for its very low moisture content, high calcium content and the standard requirement of ash content.The determined proximate composition of the honey employed for this study agrees with most similar studies that have evaluated the composition of honey (24,28). Very low values were recorded for the protein and fat contents of the different honey samples. The results obtained were in agreement with that reported by other authors (20,9). High fat content makes foods to be susceptible to rancid spoilage during storage (29). The results show that these honey samples are quite rich in minerals. The percentage mineral content is considered as a quality criterion indicating the possible botanical origin of honey (25). The differences in mineral content majorly depend on the type of soil in which the original nectar bearing plant was located (9,10). Soluble dietary fibres have health-promoting properties as they have been implicated in lowering plasma and liver cholesterol concentration (30), diarrhoea treatment and detoxification of poisonous metals (31)

The results obtained from the study shows that honey possesses somenutritive contents which include protein, carbohydrate,crude fibre, fat, vitamin C, glucose and fructose invarious compositions. This is in agreement with thestudy of Habonimana et al., (32), Molan et al., (27) andAbuharfeil et al., (33) who had independently reported thathoney can be used as a nutritive supplement of human need.

#### **IV. Conclusion**

This study reveals that honey possesses some nutritional quality that can be used assupplement for the need of human, As a result of the vegetation type in Jos metropolis,Plateau state which supports various plant species that is beneficial to beekeeping and quality honey production. There abounds a large variation in honey quality produce in the study areaas a result of the effectin its vegetation. Due to this, certain type of monofloral and polyfloral honey can be produced in Jos metropolis and globally for its outlook, as well as theirantioxidant and medicinal benefits.

The results of this study show the variability of some quality characteristics of honey samples from the different regions of Nigeria. The honeys were mostly of good quality when compared with Codex Alimentarius (26) honey specifications. The honey samples from the Jos East had the best overall acceptability ratings.

However, the difference in composition or quality of the honey samples may also 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, which could serve as basis for further research.

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