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QUALITY EVALUATION OF MARKET SAMPLES OF HONEY IN KANO, KANO STATE, NIGERIA

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Abstract
The study was conducted through field studies, laboratory and sensory evaluations to ascertain the quality of honey marketed in Kano. Questionnaires were administered to ten honey sellers, five each from the two major honey markets in Kano. Laboratory analyses included moisture, ash, total solids. pH, specific gravity, refractive index, total plate, coliform and total fungal counts. Sensory evaluation using seven-point Hedonic to evaluate appearance, flavour, colour, taste, sweetness, mouth-feel and acceptability was done. Results showed honey business is male dominated business. Honey quality is subjective through observations for colour and thickness as well as mouth-testing for thickness and there is no further processing prior to sales. Moisture content of the samples ranged from 15.24% (KM5) to 19.42% (KW2), ash from 0.2% (KM4 and KW4) to 0.70% (KW2); total solids 80.62% (KW2) to 84.82% (KM5). The specific gravity is the same (1.4) for all the ten samples. The refractive index ranged from 14.78 (KM4 and KW5) to 17.38 (KM1) while the pH ranged from 3.71 (KM3) to 4.08 (KM1). The matches-lighting and coliform tests were all negative for all the ten samples. Fungal counts were all negative except for samples KW3 and KW5 where mold growth was observed. There were growths in all the samples for total plate count. The sensory scores for appearance, flavour, colour, taste, sweetness, mouth-feel and overall acceptability were all above 4.0 on a 7-point Hedonic scale. Generally results of finding showed that all the honey samples were within acceptable standards of good quality honey.

Keywords: Honey, markets, physicochemical, quality and sensory.

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1. INTRODUCTION

Honey is the excretion of honey bees that suck the living part of plants, which they collect, transform and combine with specific substance of their own, store and leave in the honey comb to ripen and mature. Honey is also described as a sweet viscous liquid food which is of diverse color, produced in\ the honey sacks of honey bees from the nectar of flowers (Atkins *et al*., 1976). The nectar is ripened to honey by inversion of the major proportion of its sucrose sugar in to the sugar (laevulose) fructose and dextrose (glucose) and by removal of moisture (http://www.beesource.com, 2009).

The processing of honey consists of the removal of the thin wax layer of the honey cells. The wax cap can be sliced off with a sharp, long knife or special knives heated by steam or electricity (Bidemi, 1999). However, honey is sold in other forms and can be subjected to variety of processing methods giving different types of honey such as crystallized, pasteurized, strained, ultra-filtered, ultrasonicated, dried and chunk honey (Bidemi, 1999). But honey classification is based on the different sources of nectar that the bee collects, which determines the colour, flavour and aroma of a particular honey. Hence we have cotton honey, soybeans honey, black mangrove honey and fire wood honey. Others are citrus fruits and clover honey (Atkins *et al*; 1976). USDA (1970) reported that based on water content, flavour and aroma, presence or absence of defects and clarity, is graded into "A", "B", "C", or substandard grades.

The main constituents of honey are dextrose, fructose, sucrose, dextrin, mineral matter, proteins and wax. Pollen is invariably present in comb honey, but may be absent in products which have been finely strained. Honey also contains tiny amount of several compounds thought to function as anti-oxidants including chrysin, pinobanksin, vitamin c, catalase and pinocembrin (Gheldof *et al*; 2002). The specific composition of any batch of honey

depends on the flowers available to the bees that produced the honey. Typical honey percentage composition as reported by Rainer (1996) is fructose (38.25), glucose (31.3%) sucrose (1.3%), maltose (7.1%), and higher sugars (1.5%) and others (3.2%) (http://www.beesource.com, 2009). The physicochemical characteristics of honey include optical rotation used both to analyze the sugar of honey and to detect the presence of honey dew or other added sugar and colour which varies from visual colorless to deep red in color through shades of yellow, amber and brown with greenish or reddish tinges. Also included are honey brix, refractive index, specific gravity and viscosity (Root, 1975 and Atkins *et al*; 1976).

The marketing of honey is practiced mostly by villagers who farm the honey. They take the honey from the rural to urban areas, where large population and very high consumption is experienced (Atkins *et al;* 1976). These farmers, after collection from the beehive to urban areas sell the honey to major dealers in the urban areas. These major dealers transfer the honey to bottles (of different sizes if it is extracted honey), whereas the honey left in the honeycomb are normally sold in a calabash to consumers and other people involved in marketing of the honey. There are cases where natural honey is mixed with cane sugar syrup, glucose or less expensive sweeteners and is commonly referred to as adulterated honey (Root *et al,* 1975).

Being one of the most easily assimilated foods, honey has a wide variety of uses especially in industrial and home foods preparation and medicine (Atkins *et al*, 1976). The wide usage of honey coupled with the low quality of the marketers, demands that the quality of honey marketed in Nigeria be evaluated. This is the major objective of this paper, which focuses on honey marketed in Kano, one of the most populous cities in Nigeria.

2. MATERIALS AND METHODS

Kano the capital of Kano state is located in north-western Nigeria. The state made up of fourty-four local government areas was created May 27, 1967 and is the largest commercial centre in northern Nigerian with over 10 million people (Kano-ADP, 2007). In addition to the large and unique market, Kano is also blessed with various kinds of agricultural products which provide huge raw materials for agro-allied industries. (Kano-ADP, 2007).

The material of study was honey (Table 1) purchased from two markets Kofar Wambai and Kurmi markets in Kano metropolis. Reagents, microbial media and equipment were from Department of Food Science and Technology, Kano University of Science and Technology. Simple random sampling technique was used to select five honey sellers in each of the two main markets and. one litre of honey was purchased from each of these ten honey sellers.

Table 1: Symbols and their explanations for honey from two markets.

No.	Symbol	Explanation
1.	KM1	Honey sampled from first honey seller in Kofar Wambai market.
2.	KM2	Honey sampled from second honey seller in Kofar Wambai market.
3.	KM3	Honey sampled from third honey seller in Kofar Wambai market.
4.	KM4	Honey sampled from fourth honey seller in Kofar Wambai market.
5.	KM5	Honey sampled from fifth honey seller in Kofar Wambai market.
6.	KW1	Honey sampled from first honey seller in Kurmi market.
7.	KW2	Honey sampled from second honey seller in Kurmi market.
8.	KW3	Honey sampled from third honey seller in Kurmi market.
9.	KW4	Honey sampled from fourth honey seller in Kurmi market.
10.	KW5	Honey sampled from fifth honey seller in Kurmi market.

The samples was carried in aseptic bottles to the laboratory for analysis and stored at room temperature (25°C). The different ten honey samples were labeled as shown in table 1.

Questionnaire were administered to each of these five honey sellers in both Kofar Wambai and Kurmi markets. The questions were translated and explained in Hausa language to these honey sellers and their answers were filled for them. Questions asked included background honey sellers, shelf-life of honey, quality standards, and methods of honey marketing and handling techniques.

Percentage water of honey determined using the hot-air oven method as described by Kirk and Sawyer (1991) while AOAC (1984) method was used to determine the ash content. The total solids of honey were deduced by difference from the percentage contents of water. Refractive index and pH were determined by the AOAC (1984). Kirk and Sawyer (1991) method was adopted in determining the specific gravity. Total plate count, fungal and total coliform counts were as described by Diliello (1982).

A seven-point Hedonic sensory scale was used to evaluate these ten honey samples that were collected from the two markets in Kano metropolis. Sensory factors evaluated included appearance, flavour, colour, taste, sweetness, mouth-feel and overall acceptability. Fifteen taste-panelists consisting of final year students of Department of Food Science and Technology, Kano University of Science and Technology (KUST), Wudil were used for the evaluation. This was carried out in the Department's Sensory evaluation laboratory. The method used by Binga (2005) was used for the matches lighting test to determine honey quality especially adulteration. Here, 10ml of each of the ten samples of honey was placed in crucible and a lighted match was placed in to it. Depending on the response of the lit match in the honey to lighting, the results were recorded as follows: - = No lighting, + = Slight lighting, ++ = Moderate lighting and +++ = Appreciable lighting. Means, percentages, Analysis of variance (ANOVA) and mean separation were the statistical analyses conducted. The (SPSS) Statistical Package was used for data analyses.

3. RESULTS AND DISCUSSION

The results are presented in Tables 2-4 below:

Table 2: Percentage ash, total solids and moisture and pH, titrable acidity and refractive index of market samples of honey.

Source	Ph	SG	% Ash	RI	% Moisture	% TS
KM1	4.08 ± 0.02^{a}	1.4 ± 0.00	0.30 ± 0.01^{cd}	17.38 ± 0.15^{a}	16.42 ± 0.03^{g}	83.63 ± 0.03^{c}
KM2	3.85 ± 0.02^{b}	1.4 ± 0.00	0.30 ± 0.10^{cd}	$16.86 \pm 0\ 07^{b}$	17.85 ± 0.05^{d}	82.23 ± 0.03^{e}
KM3	3.71 ± 0.01^{f}	1.4 ± 0.00	0.40 ± 0.10^{cd}	15.58 ± 0.01^{c}	15.41 ± 0.01^{h}	84.62 ± 0.02^{b}
KM4	3.73 ± 0.01^{def}	1.4 ± 0.00	0.20 ± 0.10^{d}	14.78 ± 0.01^{e}	18.43 ± 0.03^{c}	81.62 ± 0.02^{g}
KM5	3.70 ± 0.01^{f}	1.4 ± 0.00	0.50 ± 0.10^{bc}	17.29 ± 0.01^{a}	15.24 ± 0.03^{i}	84.82 ± 0.02^{a}
KW1	3.77 ± 0.03^{cd}	1.4 ± 0.00	0.40 ± 0.10^{cd}	16.79 ± 0.01^{b}	19.21 ± 0.01^{b}	80.82 ± 0.02^{h}
KW2	3.79 ± 0.02^{c}	1.4 ± 0.00	0.70 ± 0.10^{a}	15.48 ± 0.02^{cd}	19.42 ± 0.02^{a}	80.62 ± 0.02^{i}
KW3	3.76 ± 0.02^{cde}	1.4 ± 0.00	0.50 ± 0.10^{bc}	15.48 ± 0.02^{cd}	18.01 ± 0.02^{d}	82.04 ± 0.03^{f}
KW4	3.74 ± 0.01def	1.4 ± 0.00	0.20 ± 0.10^{d}	15.38 ± 0.02^{d}	17.82 ± 0.02^{e}	82.24 ± 0.05^{e}
KW5	3.72 ± 0.01^{ef}	1.4 ± 0.00	0.30 ± 0.10^{cd}	14.78 ± 03^{e}	17.62 ± 0.02^{f}	82.57 ± 0.15^{d}

NB:

- Values are means of three determinations with standard deviations ($X \pm S.D^{a}$)
- Means in the same column with same superscript are statistically not different ($P \geq 0.05$).
- KM1 to KM5 = Honey from Kurmi market.
- KW1 to KW5 = Honey from Kofar Wambai market.

Table 3. Total plate, Fungal and Coliform counts (cfu/ml) of honey and Match-Lighting Test for quality of honey from Kurmi and Kofar Wambai markets in Kano.

Source	Total plate count	Total Fungal count	Total Coliform count	Match light test (Undiluted)	Match light test (50% dilution)
KM1	5.6×10^3	0.7×10^3	NIL	-ve	-ve
KM2	23.0×10^2	0.7×10^3	NIL	-ve	-ve
KM3	0.5×10^3	2.0×10^3	NIL	-ve	-ve
KM4	1.9×10^3	0.2×10^3	NIL	-ve	-ve
KM5	1.9×10^3	19.0×10^3	NIL	-ve	-ve
KW1	1.0×10^3	NIL	NIL	-ve	-ve
KW2	4.0×10^3	NIL	NIL	-ve	-ve
KW3	0.7×10^3	3.0×10^3	NIL	-ve	-ve
KW4	0.9×10^3	NIL	NIL	-ve	-ve
KW5	0.7×10^3	0.3×10^3	NIL	-ve	-ve

- KM1 to KM5 = Honey from Kurmi market.
- KW1 to KW5 = Honey from Kofar Wambai market.

Table 4: Sensory scores of the ten honey samples for different sensory factors. Generally, all the ten honey samples were rated above 4.0 on a seven-point Hedonic scale.

Source	Appearance	Flavour	Colour	Taste	Sweetness	Mouth-feel	Overall Acceptability
KM1	5.67 ± 1.50^{ab}	5.40 ± 1.18	5.60 ± 1.35	4.53 ± 1.60	4.47 ± 1.85	4.73 ± 1.62	5.33 ± 1.40^{a}
KM2	5.73 ± 1.30^{ab}	5.47 ± 1.25	5.20 ± 1.27	4.93 ± 1.62	5.20 ± 1.27	4.73 ± 1.83	5.27 ± 1.34^{ab}
KM3	5.33 ± 1.18^{ab}	5.13 ± 1.06	5.07 ± 1.67	5.60 ± 1.40	5.07 ± 1.53	5.13 ± 0.99	5.60 ± 0.99^{ab}
KM4	5.07 ± 1.44^{ab}	5.40 ± 1.35	5.47 ± 1.19	5.47 ± 1.30	5.33 ± 1.72	5.27 ± 1.71	5.13 ± 1.69^{ab}
KM5	6.00 ± 0.93^{ab}	5.47 ± 1.36	5.60 ± 1.18	5.73 ± 1.43	5.73 ± 1.63	5.20 ± 1.47	5.73 ± 1.03^{b}
KW1	5.80 ± 1.01^{ab}	5.13 ± 1.51	5.27 ± 1.28	5.47 ± 1.25	5.53 ± 1.19	5.07 ± 1.22	5.40 ± 1.77^{ab}
KW2	4.93 ± 1.28^{a}	4.73 ± 1.34	5.13 ± 1.30	4.47 ± 1.92	5.27 ± 1.16	4.60 ± 1.50	4.47 ± 1.51^{ab}
KW3	5.40 ± 1.55^{ab}	4.93 ± 1.71	6.07 ± 0.96	5.20 ± 1.27	4.93 ± 1.39	4.73 ± 1.28	5.20 ± 1.20^{ab}
KW4	6.07 ± 0.70^{b}	4.93 ± 1.75	5.40 ± 1.68	4.80 ± 1.94	5.00 ± 1.60	4.93 ± 1.39	5.47 ± 1.19^{ab}
KW5	5.80 ± 1.52^{ab}	4.80 ± 1.82	5.60 ± 0.99	5.07 ± 1.95	4.67 ± 1.92	4.60 ± 2.03	5.60 ± 1.24^{ab}

- Values $X \pm S.D^{a}$ are means of sensory values of 15 taste-panelists.
- Means in the same column with same superscript are statistically not different ($P \geq 0.05$).

Results of survey studies about honey sellers showed the followings:

- Honey marketing in Kano State is a male dominated business in these two markets.
- Purchase of honey by traders is through middlemen and not directly from bee farmers.
- They buy the honey in liquid form
- No further processing before sales i.e. it is sold as it is bought.
- Sales price of good quality honey is from five thousand to six thousand naira for 20 litres container of honey
- Methods of detecting good quality honey include: Mere observation for thickness, oral tasting, and visual observation of colour. There is also "simple arithmetic" i.e. combination of visual observation and oral tasting.
- Honey storage does not require any special care
- Length of stay i.e. shelf-life is quite long i.e. several months
- General belief is that honey has medicinal value

Table 2 gives the pH, specific gravity, refractive index and percentage moisture, ash and total solids of ten market samples of honey from Kurmi and Kofar Wambai markets of Kano, Kano State. Significant differences were observed for pH, refractive index and percentage moisture, ash and total solids of ten market samples of honey ($P \leq 0.05$). But no significant difference ($P \geq 0.05$) was observed between the specific gravity of the ten honey market samples.

The 0.2% ash contents of honey samples KM4 and KW4 are as reported by http://www.beesource.com (2009). The variations in other honey samples could have arisen as a result of sources differences for the honey samples.

The moisture content values of the honey ranged between 15.24 to 19.42% were all acceptable based upon United States of America standards that reported moisture content of good quality honey to be between 18.0 to 20.0% (USDA, 1970). Similarly, the pH of the honey was within acceptable range as the pH range was 3.70 to 4.08. This falls within 3.2 to 4.5 as is commonly reported (http://en.wikipedia.org/wiki/Honey, 2010).

Table 3 gives the results of microbiological analysis and that of match-lighting test of the ten honey samples. The absence of coliform bacteria in all the ten honey samples is good because it portends that these market samples of honey do not pose a health hazard to the unsuspecting consumer public. On the other hand the presence of fungi / mold is no cheering news as it suggests health hazard even though specific mold / fungi present is not ascertained. But the high values obtained for total plate counts cannot confirm danger or otherwise as the microorganisms may or may not be benign.

The match-lighting tests were all negative even at fifty-percent (50%) dilution. This is indicative of lack of dilution with caramel even though dilution with water cannot be ruled out (Binga, 2005).

Furthermore, except for second honey sample from the Kofar wambai market (KW2) that has a sensory score for acceptability as 4.47, others have sensory ratings above 5.0 on a seven-point Hedonic scale. Based on the results of sensory evaluation, the first three best honey samples in increasing order of acceptability rating by taste-panelists were KM5 (5.73), KM3 (5.60) and KW5 (5.60).

4. CONCLUSION

Honey marketing is a male dominated business while procurement of honey by sellers is through middlemen and not directly from bee farmers. The honey is bought and sold in liquid form as there is no further processing before sales i.e. it is sold as it is bought and sales price of good quality honey is from five thousand to six thousand naira for 20 litres of honey.

Methods of detecting good quality honey include mere observation for thickness and colour, testing with mouth and "simple arithmetic" i.e. observation and testing. Honey storage does not require any special processing, shelf-life is quite long i.e. several months and there is the general belief that honey has medicinal value.

Moisture contents of 15.4 to 19.42 and pH of 3.70 to 4.08 of the ten samples of honey were within acceptable limits. The sensory scores were all above 4.0 on 7-point Hedonic scale.

This study has unraveled a lot of grey areas about honey that need to be studied. This includes determining the actual proximate compositions of all these honey to the minutest details. Added to develop simple and rapid response methods for determining honey quality and to ascertain the potency of medicinal claims of the healing powers of honey.

There is also need to ascertain the actual source(s) of these honeys with a view to determining their original grades, level of processing and / or adulteration. Also Comparing the results of chemical and physical evaluation with that of organoleptic evaluation is important.

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