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MICROSCOPICAL ANALYSIS AND QUALITY STATUS OF HONEY FROM SOUTHEASTERN NIGERIA

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ABSTRACT

Microscopical analysis and quality status of honey from Southeastern Nigeria were investigated. About 75 honey samples from the three zones each of the five states of the Southeastern zone of Nigeria were collected and tested upon for moisture status and pollen concentration and sedimentation. From the microscopical analysis of the samples, Croton species were found to be predominant accounting for 66.81 ± 5.4% followed by Helianthus species with 12.33 ± 10.80% while pawpaw was least with 1.52 ± 2.50%. The poor pollen spectra are suspected to be due to the influence of man on nature. Result of probe into pollen concentration value showed a total range of pollen grains per gramme of honey from Ebonyi as 737 from Croton species, 10 for Zea and 303 for Helianthus. 878 Croton species and 87 Zea for Enugu State while Anambra had 140 for Croton, 8 for Zea and 21 for Helianthus. Abia had 300 Croton, 10 Zea and 23 Helianthus while Imo had 320 Croton, 10 for each of Zea and Helianthus. Anambra presented the lowest while Enugu showed the highest values of pollen concentration. Sedimentation value showed a marked variation in the Southeastern zone which could be due to different methods of production and processing. Honeys from Enugu showed the highest sedimentation of 80 mm^3 in 10 grammes. With regard to quality by way of moisture content, result showed a range of 18 ± 1.15% from Anambra North zone to 22± 1.15 from Enugu North zone. Research showed that moisture content between 18.5 – 19% is ideal, though International standard allows up to 21% moisture content. It is recommended from this investigation that the Government and indeed bee-keepers from the zones should embark on aggressive propagation of Croton plant species most followed by Helianthus species in their apiaries to provide the needed pollen and nectar for bee farming.

Keywords: microscopical analysis, honey quality

INTRODUCTION

A survey of the world honey production shows that approximately 600,000 metric tons/year on the average, are obtained from 50 million hives of which, 64% belong to small producers, especially in developing countries. Worth mentioning also is the fact that the total value of honey exported by developing countries is half that of the developed countries, because, the honey quality is affected by the simple, sometimes primitive methods in handling bees and improper use of the bee pasture (Apimondia, 1976). In Nigeria and indeed Southeastern zone, rich nectar flow abound due to the prevalent thick forest nature of the zone. Bee keepers in these areas, keep their colonies in beehives of various shapes according to the material available to them viz: a hollow tree trunk, an earthen pot, basket or logs of woods (Linder, 1973). Bee culture is practiced uneconomically with traditional hives, the product being obtained by killing or severally disturbing the bee colonies, after which, they either die off or abscond.

Microscopical analysis of honey is a well developed method in Europe, however, as the importation of African honeys was never significant, there was no need for the specialists in Europe to concentrate their efforts on plant sources of African honeys. The prior condition of the microscopical analysis of honey is a sufficient knowledge of the pollen grains of the plants growing in the region studied.

Most of the honeys in the Southeastern Nigeria is produced by pressing and is in consequence enriched with pollen grains. From the point of view of nutrition, this really is enrichment. Only a very high pollen content affects the flavour. If the consumers are accustomed to pressed honey, it seems to me unnecessary to change the methods of production. But the world market rejects pressed honeys due to high content of small water-insoluble particles, pressed honey never becomes clear, and it crystallizes sooner than centrifuged honey. Storage or warming soon leads to browning reactions. In the Southeastern Nigeria, it seems difficult to connect a specific floral nectar with the turbidity of some of the honeys found. Some honeys showed more saccharase activity while some are bitter. This raises the question of whether extra floral nectars of honey dew may be the reason for the flocculent precipitation (Olagunji, 2000).

One of the basic quality characteristics of honey is water content, which should not exceed 19% (Krell, 1994). Honeys with more than 19% have a tendency to ferment. As a general rule, the aroma of a honey is better if the water content is low. This is because in the tropics, bees sometimes have difficulty in evaporating water from honey, especially if high temperatures during night and day are combined with a high relative humidity of the air.

In view of the foregoing, a microscopical analysis of samples of honeys from the Southeastern Nigeria was organized with the objective of providing a basis for a system of selection that can be used to harmonize:-

(i) High quality honeys with 18% water or less which allow long storage and which meets the demands of world market.
(ii) Honeys of normal quality with water contents between 19 and 21 percents for local use and short storage.
(iii) Honeys with more than 21 percent water, for brewing, baking and other industrial uses.
(iv) Provide a basis for producing pollen chart synonymous with the bee pasture common in the Southeastern Nigeria.

MATERIALS AND METHODS

This experiment was carried out in the laboratory of the Department of Apiculture, Federal College of Agriculture, Ishiagu, Ebonyi State,Nigeria.

Materials used in the experiment include Microscope, Glass slides, water, beaker, honey samples, filter papers, wooden tooth pick, refractometer, hygrometer, pollen diagram (Pollen Colour Chart).

Sample collection:- Honey samples were collected from five states of the South eastern Nigeria where honeys are produced. These include Ebonyi, Enugu, Abia, Anambra and Imo states respectively. To ensure equal representation five honey samples were collected from each zone in the three zones of each state making a total of 15 honey samples and 75 samples on the whole. The honey samples were directly picked from the producers to avoid adulteration and poorly stored honeys. These were carefully labeled and analyzed.

Method of analysis: The methods of microscopical analysis are quite simple, so far as laboratory techniques are concerned (Louveaux, 1970). A small amount of honey is diluted in water. After centrifugation of the solution, the sediment is enclosed in a glycerine jelly. The amount of sediment gives information about the kind of extraction, pressing or centrifugation. Ten grams (10g) of honey extracted by centrifugation usually show 2-5mm^3 sediment, pressed honeys much more, due to pollen stored in combs, which is loosened by the pressing process. More difficult is the identification of pollen grains. The species found are listed and counted. In any case, the pollen list is a documentation of plants visited by honey bees. In honeys extracted by centrifugation, the pollen spectrum reflects the contribution of the different nectar-producing plants to the honey.

Determination of moisture content was done using the method of Krell (1994). Each honey sample was collected and smeared on the tip of the calibrated refractometer which quickly reads the percentage moisture content of the honey sample. On the determination of pollen contents, Agwu and Akanbi (1985) recommended alcohol or water dilution technique and filteration processs. Water was preferred to alcohol because of cost and availability. 10 grammes of honey was diluted with 20 ml of water. After dilution, the sample of the diluted honey was filtered with filter paper to capture the pollen. The pollen grain on the filter paper is allowed for about 30 minutes to dry. While watching to be dried, the pollen grains on the filter paper are covered with larger beaker to prevent losses of the dried pollen grains through wind blows. Immediately the pollen grains were dried, they were placed into gas slide and the pollen was spread in all directions with a wooden tooth pick to ensure that all pollen taxa becomes eventually distributed on the glass slide. The pollen grains on the glass slide was mounted under light microscope and examined. The pollen was identified, counted and recorded each according to source of origin. Once the pollen grain have been identified, they are matched on a pollen colour chart which is used for interpretation. The pollen diagrams are useful in giving evidence of past human activities, vegetation and climatic history.

Statistical Analysis:- The results of the pollen counts and water contents were subjected to analysis of variance and percentages.

RESULTS AND DISCUSSION

The result of pollen analysis conducted in different parts of the world are never the same in the determination of floral origin. This is due to different environmental factors. Pollen analysis helps the bee farmers in the determination of moisture content, identifying the various floral sources and correct labeling of honeys for marketing. The flora of the South eastern Nigeria is known to be rich in species which are found only in the area. One would expect very special pollen spectra in the honeys of this country. In the 75 samples analyzed microscopically from the five states of South eastern Nigeria (Table 1) Croton spectes were predominant accounting for 66.81 ± 5.4% followed by Helianthus species with 12.33 ± 10.80% while the least were from paw-paw with 1.52 ± 2.50% respectively. The poor pollen spectra are due to the influence of man on nature. The quality standard of tropical African honeys is influenced by the fact that a great amount of the honey is used for brewing. Most of the quality characteristics necessary for table use are unimportant if the honey is used for beer production. For instance a high water content or over-heating. A high pollen content or impurities like crushed bees or broad, even improve the fermentation, because yeasts need substances containing nitrogen as well as sugars. Apart from floral origin, colour is also an important factor in the determination of its quality and marketing. Colour variation of honeys is also a product factor of the type of pollen collected by honey bees. Colour of honey varies due to age and storage condition. For instance while lighter honeys are marketed for direct consumption. Darker honeys have strong taste with higher market values. Even the flavour and aroma of honeys are governed by the floral sources.

Vanderham et. al., (1999) collectively agreed that the taxa of pollen are used to indicate the floral nectar sources utilized by bees to produce honey. They noted that, the relative frequency of pollen is often used to verify and labell a honey sample as to the major or minor nectar sources. According to them, information generated from pollen analysis has important commercial values because, honey produced from a particular floral source command a premium price e.g. cereals and helianthus honeys. They also noted that identifying and verifying pollen in honey samples is one of the best ways to determine the region of nectar types used to produce honey, and therefore label it correctly, based on actual foraging resources.

Pollen analysis can also be used to identify the geographical source of origin. Herbet (1992) maintained that the combination of wind and insect-pollinated taxa found in honey samples would often produce a pollen spectrum that is unique for the specific geographical region where it was produced. As a result of trade agreements, import tariffs and legal trade restrictions, most of the leading honey producing nations of the world require accurate labeling of honey before it can be sold. In line with this accurate labeling of honey products, EEC has had strict labeling regulations for honey products since 1974.

Further to this, young (1908) had earlier on determined if pollen studies could be used to judge the adulteration of a honey sample. His hypothesis was that if honey was adulterated with sugar syrup, this could be detected by finding a reduction in the contents of pollen. However, the method he used to determine pollen concentration values of his sample is not considered accurate by today's standard. Based on his work, Young determined that the range of pollen concentration value varied from a low of 123 pollen grains per gramme to a high value of 5,410 grains per gramme of honey.

The result of this analysis (Table 2) showed a total range of pollen grains per gramme of honey from Ebonyi State as 737 from Crotton species, 10 from Zea species and 303 from Helianthus. In Enugu State, 878 of Croton Species, and 87 of Zea mays species. From Anambra, 140 of Croton species, 8 from Zea species and 21 pollen from Helianthus. Abia had 300 Croton. 10 Zea species and 23 Helianthus species while Imo had 320 Croton and 10 each of Zea Mays species and Helianthus species. Anambra presented the lowest while Enugu State showed the highest values of pollens.

Table 3 gives the sediment values of the honey samples from the Southeastern Nigeria. There is a huge variation due to the different methods of production. The highest values obtained was 80 mm^3 in 10 grammes of honey from Enugu Southzone. Such a value though high is not yet too high to give the honey a bitter, farinaceaus taste. Vorwohl (1976) gave a value of 600 mm^3 in 10 grammes of honey sample as a very high value that can cause distatefulness in honey. If the honey producer cuts away the pieces of comb containing pollen (bee bread) before processing, the sediment values of the honey will be much lower. This was shown by Evenius (1958) with heather honey of Northern Germany, where pressing is still practiced. He found out that, honeys pressed from "pollen-free" combs usually had less than 20 mm^3 sediment in 10 grammes. The values obtained in most of our samples showed that they were contaminated with pollen combs before pressing.

Almost all the sampled honeys when diluted showed a flocculent precipitation whose relative density seems to be only slightly higher than that of the honey solution. Under the microscope, it is seen that the precipitate forms a homogenous mass even though their chemical nature are unknown so far. One of the basic quality characteristics of honey is water content, which should not exceed 19% . As a general rule, the aroma of honey is better if the water content is low. The result of analysis in Table 3 shows a range of 18 ± 1.15 from Anambra North zone to 22 ± 1.15 from Enugu North zone.

Krell (1994) noted that good quality honey has moisture content between 18.5 – 19%; however, emphasized that international standard allows honeys up to 21% moisture content. Based on the above analysis, most of the honeys sampled from the Southeastern Nigeria are of international standards. Government and indeed bee-keepers can embark on aggressive propagation of Croton and Helianthus species to provide pollen pastures most frequently visited by bees in the zone.

CONCLUSION AND RECOMMENDATIONS

From the result of this analysis, it can be concluded that croton species were found to be predominantly accounting for 66.81+5.4% followed by helianthus species with 12.33+10.80%. Also research showed that moisture content between18.5-19% is ideal, though International standard allows up to 21% moisture content. Therefore, the southeastern honeys showing between 18+1.15% to 22+1.15% are of International standard. It is therefore recommended from this investigation that the Government and indeed beekeepers from the zone should embark on aggressive propagation of croton plant species, most followed by Helianthus species in their apiaries to provide the needed follow and nectar for bee farming.

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Table 1: Summary of important pollen species available in Honeys from Southeastern Nigeria found to be frequent in at least three of the fifteen samples collected from each state.

S/No.	Pollen Species	Frequencies			Total Freq.	Mean	%	± S.E.
		SP. 1	SP 11	SP 111*				
1	Croton	915	419	421	1755	19.5	66.81	5.4
2	Zea	70	15	20	105	11.67	4.00	2.9
3.	Helianthus	59	160	105	324	3.60	12.33	10.8
4	Palm tree	4	45	46	95	10.56	3.61	9.45
5	Guava	3	25	27	55	6.11	2.10	7.28
6	Cashew	4	42	44	90	10.00	3.23	2.8
7.	Cassava	4	47	47	98	10.89	3.73	3.8
8	Paw-paw	2	20	18	40	4.40	1.52	2.5
9	Mango	3	31	31	65	7.20	2.47	1.30
	Total				2627		100%	

* SP 1, 11, & 111:- Specimen 1 11 & 111 Honey samples from each State

Table 2:- Common Pollen sources and content used by honey bees in the sampled honeys from the Southeastern states of Nigeria.

States	Zones	Common species available and their percentages						
	Croton			Zea SPP		Helianthus		
Ebonyi	North	40	(5.4)	2	(20)	8	(2.6)	
	Central	300	(40.7)	8	(80)	285	(94.1)	
	South	397	(53.9)	-	-	10	(3.3)	
Total		737		10		30		
Enugu	North	300	(34.2)	5	(5.8)	-	-	
	Central	368	(30.5)	33	(37.9)	-	-	
	South	310	(35.5)	49	(56.3)		-	-
Total		878		87		-	-	
Anambra	North	40	(28.6)	3	(57.5)	6	(28.6)	
	Central	50	(35.7)	-	-	-	-	
	South	50	(35.7)	5	(62.5)	15	(71.4)	Total
		140		8		21		
Abia	North	60	(20)	5	(50)	4	(17.39)	
	Central	80	(26.67)	3	(30)	9	(39.13)	
	South	160	(53.33)	2	(20)	10	(43.48)	
Total		300		10		23		
Imo	North	30	(9.38)	-		4	(40)	
	Central	143	(44.69)	-		6	(60)	
	South	50	(15.63)	10	(100)	-		
Total		320		10		10		

Percentages are in parenthesis

Table 3. Quality tests result of honeys from Southeastern Nigeria.

States	Zone	Extraction method	Sediment	(mm^3/10g honey)	(%) water	±S.E.
Ebonyi	North	Pressed out	Flocky precipitation	60	20	±1.10
	Central	Pressed out	flocky precipitation	30	19	±1.16
	South	Pressed out	flocky precipitation	35	21	±1.16
Enugu	North	Pressed out	flocky precipitation	15	22	±1.0
	Central	Pressed out	flocky precipitation	27	21	±1.01
	South	Pressed out	not measurable	80	19	±1.1
Anambra	North	Pressed out	light flocky precipitation	30	18	±1.15
	Central	Pressed out	flocky precipitation	40	19	±1.16
	South	Pressed out	flocky precipitation	34	21	±1.17
Abia	North	Pressed out	light flocky precipitation	40	40	±1.50
	Central	Pressed out	light flocky precipitation	45	18	±1.20
	South	Pressed out	flocky precipitation	44	19	±1.16
Imo	North	Pressed, strained	light flocky precipitation	39	19	±1.2
	Central	Pressed out	flocky precipitation	38	21	±1.1
	South	Pressed out	flocky precipitation	35	20	±1.1

with 1 teaspoon of vanilla essence. Thereafter, they were packaged for sensory evaluation and proximate analysis.

Proximate Analysis

The proximate composition of the ginger-blended mango drink samples was determined according to the AOAC, (1990) methods.

Sensory Evaluation

A trained ten (10) man panel, drawn from the members of staff of National Root Crops Research Institute, Umudike and Michael Okpara University of Agriculture, Umudike was used to determine the acceptability of the drinks. The attributes evaluated for were colour, taste, pungency, mouth-feel and over all acceptability. Each of the attributes was evaluated on a 7-point hedonic scale of '7' representing 'like extremely, '6' representing 'like moderately', '5' representing 'like' and '4' representing 'undecided'. Others were '3' representing 'dislike moderately', '2' representing 'dislike' and '1' representing 'dislike extremely'.

Statistical Analysis of Data

The data were statistically assessed by analysis of variance (ANOVA) procedure and least significant difference (LSD) was used to separate means as described by Arkin and Colton (1971).

RESULTS AND DISCUSSION

The proximate composition of the samples in Table 1 showed that samples DD, CC and BB showed no significant (P=0.05) difference in their dry matter content although DD had the highest dry matter content followed by CC. The sample FF (control) was lowest in dry matter content. In ash, sample EE was shown to be highest, followed by sample BB, CC, AA and CC respectively. The control also had the least ash content among the samples. The protein composition was from highest to lowest in samples CC, BB, AA, DD, EE and FF respectively with a significant (P=0.05) difference among the samples. The samples with high carbohydrate composition were DD, CC, BB, AA, EE and FF respectively. However, sample FF had the highest moisture content among the samples. The result showed that the food composition of sample FF (control) was the least among the samples.

Table 1: Proximate Composition of Ginger-blended Mango Drinks

Sample	Dry Matter	Ash	Fat	Protein	Carbohydrate	Moisture Content
AA	11.17	0.57	0.31	0.54	9.76	88.83
BB	11.92	0.85	0.47	0.57	10.03	88.08
CC	11.94	0.47	0.37	0.65	10.45	88.06
DD	12.16	0.66	0.41	0.51	10.58	87.84
EE	10.69	0.89	0.33	0.43	9.18	89.31
FF(Control)	7.91	0.25	0.36	0.17	7.13	92.09
LSD (0.005)	**0.72**	**0.06**	**0.03**	**0.05**	**0.76**	**0.72**

The result of sensory evaluation as shown in Table 2 showed that the colour of sample FF was most preferred followed by AA and BB, although there was no significant (P=0.05) difference

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PRODUCTION OF GINGER-BLENDED MANGO DRINK; IMPLICATION FOR SUSTAINABLE DEVELOPMENT

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ABSRACT

The production and acceptability of ginger-blended mango drink samples were carried out in this study. These samples of ginger-blended mango drink were evaluated using the Fanta drink produced by Nigerian Bottling Company as a control. The samples were labeled AA, BB, CC, DD, EE and FF representing mango and ginger blends 90g/10g, 87.5g/12.5g, 83.5g/16.5, 75g/25g, 50g/50g and control respectively. A trained ten (10) man panel of judges drawn from members of staff of National Root Crops Research Institute (NRCRI), Umudike was used to evaluate the acceptability of the samples. The attributes evaluated for were colour, taste, pungency, mouth-feel and over-all acceptability. Also the proximate analysis of the samples was carried out to determine the food value of the samples. The result showed that the various samples of ginger-blended mango drinks were higher in nutrient content than the control while samples with mango ginger blend of 90g/10g and the control were acceptable on equal basis. Another sample that was acceptable was mango ginger blend of 87g/12.5g respectively.

Key words: ginger-blended mango drink, sustainable development

INTRODUCTION

Onyegbado *et al*, (2000) observed that fruit drinks form important part of menu during ceremonies in Nigeria but regrettably, most of the drinks were imported. This report contended that a situation like this calls for production of cheaper local brands to reduce the foreign exchange requirement for their importation. Also, Nigeria being a developing country has little or no facilities for storage of fruits during harvest seasons. This results in huge wastage of fruits. In an attempt to guard against wastages and contribute towards sustainable utilization of tropical fruits, the production of ginger-blended mango drink became possible. However, the use of ginger in this drink was necessary in order to exploit the medicinal qualities of ginger (Fagbogun, 1987), and to utilize its spicy nature to produce mildly spiced drinks suitable for all classes of people.

MATERIALS AND METHODS

The mango fruits were bought from Umuahia main market in Abia State, Nigeria while ginger of the variety UG 1 (Njoku, *et al*, 1995) was obtained from Ginger Programme of National Root Crops Research Institute (NRCRI), Umudike, Abia State Nigeria.

Preparation of ginger-blended mango drink samples

The ginger-blended mango drink samples were produced using UNIFEM (1988) method. The procedure was by weighing peeled and de-stoned mango pulp and peeled ginger in the proportion of 90g/10g, 87.5g/12.5g, 83.5g/16.5g, 75g/25g and 50g/50g (in grams of fresh weight) of mango and ginger samples. These samples were labeled AA, BB, CC, DD, EE and FF respectively. Using 500ml of water out of which a little quantity was used in grinding the ginger and mango into a fine pulp with kitchen blender. Also, a little quantity of the water was used in making syrup from 15g of sugar. Thereafter, the ginger and mango pulp was added to the remaining water in the pot and boiled for 8 minutes for sterilization. The boiled material was allowed to cool and the syrup was added and the whole mixture sieved using muslin cloth to get the ginger-blended mango drink. Each of the samples was allowed to cool before being flavoured among the samples. The result also showed that the colour of all the samples was acceptable by the panelists. The taste of samples AA, BB and FF was acceptable with that of AA and FF being accepted by the panelists on equal basis. The pungency of samples AA and BB was acceptable by the panelists and there was no significant (P=0.05) difference among the samples. The result of the mouth-feel showed that only samples AA and BB were acceptable by the panelists. The over all acceptability of the samples showed that AA, BB and FF were acceptable by the panelists. Samples AA and FF were most acceptable and on an equal basis followed by sample BB. However, there was no significant (P=0.05) difference among the acceptable samples in over all acceptability.

Table 2: Sensory Qualities of Ginger-blended Mango Drinks

Sample	Mango/ginger ratio (g)	Colour	Taste	Pungency	Mouth-feel	Over all Acceptability
AA	90/10	6.6	5.9	5.8	6.0	5.9
BB	87.5/12.5	6.5	5.3	5.7	5.6	5.5
CC	83.5/16.5	6.0	4.3	3.9	4.4	4.3
DD	75/25	5.9	3.6	3.3	2.9	3.5
EE	50/50	5.9	3.7	2.8	2.8	2.9
FF	Control(Fanta)	6.7	5.9	4.4	4.6	5.9
LSD (0.005)		**0.57**	**0.70**	**0.86**	**0.87**	**0.49**

IMPLICATIONS FOR SUSTAINABLE DEVELOPMENT

The experiment showed that mild spicing of mango drink with ginger enhanced its acceptability. This implied that those who would not have used mango drink might be attracted to use it due to its spicy taste. Also, the demand for this drink among enlightened people who would be attracted by its high content of nutrients, availability of its raw materials and simplicity of preparation methods would be high. The fact that the production of ginger-blended mango drink is not capital intensive, it can provide a good source of employment for low income earners and rural farmers. However, due to the fact that ginger and mango are locally available, commercial production of ginger-blended mango drink will encourage the government to ban the importation of related counterparts in order to save foreign exchange and also reduce huge wastages of mango during its season.

CONCLUSION

The result of this experiment revealed that the ginger-blended mango drinks from 90g/10g and 87.5g/12.5g mango and ginger respectively and the control were generally acceptable by the panelists. The result showed that ginger-blended mango drinks from the above combination can compete favourably with 'fanta' and other imported fruit drinks in the market.

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