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Short Note [Nota corta]

QUALITY EVALUATION OF MEADS PRODUCED WITH CASSAVA (*Manihot esculenta*) FLORAL HONEY UNDER FARM CONDITIONS IN NIGERIA

[EVALUACIÓN DE BEBIDAS PRODUCIDAS CON MIEL DE YUCA (*Manihot esculenta*) EN CONDICIONES DE FINCA DE NIGERIA]

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SUMMARY

Processed meads produced from cassava honey harvested in Nigeria were evaluated in order to promote the integral use of cassava at the farms. The domesticated honeybees that provided the monofloral experimental honey were kept in hives in a large cassava crop farm. Preheated and unheated dilute experimental honey (18 water: 10 honey v/v) samples were used to produce two types of mead. These samples were sulphited (0.08% SO_2) and then fermented with inoculated yeasts for 21 days at 25 - 26°C. Physicochemical, sensorial and microbiological analyses of the resultant mead samples were carried out with standard methods. The produced fresh mead samples had amber colour, 12.70 –15.01% alcohol w/v, pH of 3.64 - 3.67, and were generally acceptable to the sensory assessors. However, the mead made from the preheated diluted honey preserved better (microbiologically) than the unheated one after 2 months of storage at ambient temperatures (24 - 32°C). For extended product shelf life, experimental results indicated the need for subsequent secondary decantation or filtration and proper airtight (anaerobic) bottling of this alcoholic beverage from cassava honey.

Key words: mead, quality evaluation, honey, cassava, Nigeria.

RESUMEN

Se evaluó las características de bebidas producidas a partir de miel de yuca, la cual es producida como medio de promover el aprovechamiento integral de la misma en las fincas. Se obtuvo miel monofloral de abejas que fueron mantenidas en colmenas ubicadas en grandes plantaciones de yuca. Muestras diluidas (18 partes de agua:10 partes de miel v/v), precalentadas o no calentadas fueron empleadas para producir dos tipos de bebida. Las muestras fueron tratadas con 0.08% SO_2 y posteriormente fermentadas (inoculadas con levadura) por 21 días a 25 -26 °C. Análisis físico-químicos, sensoriales y microbiológicos fueron realizados. La bebida producida tenía color ámbar, 12.70 –15.01% alcohol w/v, pH de 3.64 - 3.67, y fue generalmente aceptable al panel de degustadores. Sin embargo, la bebida elaborada con miel precalentada se preservó mejor (microbiologicamente) después de dos meses de almacenamiento a temperatura ambiente (24 - 32°C). Para un mayor tiempo de vida en almacenamiento los resultados indican que debe realizarse una decantación secundaria o una filtración y almacenarla adecuadamente (anaeróbicamente).

Palabras clave: evaluación de calidad, miel, yuca, bebidas.

INTRODUCTION

Honey has been recognized by most cultures in the world as one of the sweetest wholesome food materials (Adjare, 1984). This sweetness is essentially due to its sugar contents. The average nutrient contents of fully ripened honey are 41.0% fructose, 35.0% glucose, 1.9% sucrose, 1.5% dextrin, 0.2% minerals, 17.0% water and 3.4% undetermined materials. The undetermined materials in honey (with average pH of 3.9) include organic acids, vitamins and proteins (Morse and Hooper, 1985).

The conversion of floral nectar to honey by the honey bee include chemical changes - such as enzymatic conversion of sucrose to fructose and glucose - and physical changes like the evaporation of some water contained in the nectar (Ojeleye, 1999). Honey can be monofloral or multifloral, depending on whether the nectar is obtained from one main floral source or from several floral sources. Over the years, the Apiculture Unit of National Root Crops Research Institute (NRCRI), Umudike, Nigeria, utilizing the large cassava (*Manihot esculenta*) hectrages of NRCRI, to keep domesticated honey-bees (*Apis mellifera*

andansonii) and to produce monofloral honey which is termed "cassava honey".

Mead, an alcoholic drink made by the fermentation of honey mixed with water, is one of the major secondary products of honey (Morse and Hooper, 1985). Unfortunately, there is not much literature about the use of monofloral honey from cassava nectar in the production of mead in the tropics with less information from tropical Africa. This study was aimed to provide some information on mead production with "cassava honey", using technology that is adaptable by local beekeepers, cassava farmers and food processors in the numerous farming homesteads of the tropical Third World countries. Since cassava grows well in many tropical countries, enhanced utilization of the cassava honey for mead production would not only make for better integral use of the crop, but could lead to increased domestication of the local honeybees.

MATERIAL AND METHODS

Sources of honey and yeast

The experimental honey (cassava honey) was collected from the Apiculture Unit, National Root Crops Research Institute, Umudike, Nigeria. The Unit's hives were placed in the middle of the over 15 hectares sole cassava farm of Cassava Programme of NRCRI. The honey was harvested in the dry months of December and January; when other flowering crops in the farm's vicinity had been harvested. The pollen grains in the unprocessed honey were predominantly from cassava flowers. Packaged dried bakers' yeast (Saf instant yeast brand) purchased in Umuahia Main Market of Nigeria was used for fermentation.

Preparation of mead

Two mead types were prepared from preheated (100 ^{o}C, 20 min) and unheated honey –water mixtures (Type A and Type B respectively). In the preparation of type A mead, 10 parts of the experimental honey was added to 18 parts of water (v/v). The mixture, which was shaken and thoroughly blended, was put in a preheated heat-resistant plastic container before being dipped in boiling water for 20 minutes. Upon cooling, the mixture was made to have 1mg H_2S0_3 per litre or 0.08% SO_2 (to prevent unwanted microbial infestation) and transferred to a clean transparent glass bottle. 12 h before covering the bottle mouth with cotton wool, 1 part yeast (dry weight) was added to 100 parts of the mixture, and the mixture was then allowed to ferment at 25 – 26 ^{o}C (obtained by dipping in cold water stored inside a large trough in the laboratory block). After 21 days fermentation period, the resultant mead was filtered with muslin cloth to remove the sediments and some other insoluble materials and later transferred into a clean plastic (polythene) capped glass bottle. The type B mead preparation was as that of type A, except that the honey - water mixture was unheated prior to the acidification and subsequent fermentation. The preparations of type A and B meads were done in quadruplicate.

Physicochemical Analyses

The relevant physical properties of the meads were determined by the analytical methods of European Brewery Convention (EBC) (EBC, 1987). Hellige colorimeter, hazemeter, and specific gravity bottle were used to determine the colour (hue), turbidity, and the specific gravity of the drinks respectively. A colour chart was also used for the visual colour determination. Alcoholic content was determined with glass pycnometer and refractometer readings (with the aid of an alcohol chart), while a pH meter was used to obtain the pH of the drinks. Total titratable acidity was calculated with 0.1N sodium hydroxide and expressed as gluconic acid

Microbiological analyses

The two types of mead were subjected to microbiological (bacterial and fungal) analysis the day the yeasts were filtered off (i.e. after 21 days fermentation period), and after 2 months of storing the filtered drinks at ambient room temperatures (24 – 32 ^{o}C). Microbiological examination was by culture plate and spread plate methods (ICMSF, 1978; OXOID MANUAL, 1990). Incubation was at 37 ^{o}C for 48hrs for all the culture media used (MacConkey Agar, Yeast Extract Agar and Kligler Iron Agar).

Sensory Analysis

An expert test panel of nine food scientists was used to assess the relevant sensory characteristics (Jellinek, 1985, Bainbrigde *et al.*, 1996) of the fresh and stored mead samples. These sensory assessors were given the option to comment freely on the products.

RESULTS AND DISCUSSION

The results of the physicochemical analyses of the experimental meads are shown in Table 1. The alcoholic content (12.70 –15.01%) of these tropical meads was relatively comparable to the 8 –14% alcoholic content of the temperate Western meads as reported by Morse and Hooper (1985). However, the alcohol fermentation process in the pre-heated diluted honey system, seemed to have been more efficient

The total titratable acidity of the fresh mead samples was expressed as gluconate due to the fact that gluconic acid is by far the predominant organic acid in

honey (Ojeleye, 1999). Glucose oxidase oxidizes glucose to gluconic acid in the unripe honey. The acidic pH of the meads allows for absence of botulism (caused by *Clostridium botulinum*) in the bottled drinks. With the Hellige colorimeter, the amber colour of the fresh products was 15 and 13 EBC colour units for the type A and B meads respectively. Boiling of the mead's main raw-material (honey-water mixture) with the attendant denaturation and suspension of some macromolecules in the mixture is known to affect the hue of the product (Morse and Hooper, 1985).

The colour (hue) and taste of the meads were found generally acceptable by the expert sensory panelists and theirs comments are as shown in Table 2. Therefore, meads produced with cassava floral honey, could be considered a value added product of the crop.

Table 1: Physicochemical characteristics of the produced experimental meads.

	Mead*	
Characteristics	Type A	Type B
Colour	Amber	Amber
Specific gravity ($x10^{-2}$)	106.70 ±0.004	102.23 ± 0.003
Turbidity (EBC units**)	>12 (turbid)	>12 (turbid)
pH	3.67 ± 0.012	3.65±0.017
Alcohol (% w/v)	15.01 ± 0.040	12.70 ±0.025
Acidity (%)	0.14 ± 0.020	0.14 ± 0.01

* Type A = produced from preheated diluted honey
Type B = produced from unheated diluted honey
** EBC formazin base units = 40 Helm units

Table 2: Sensory assessors' comments on the meads produced with cassava honey.

For	Against
1. Taste like sweet wine	1. Had an after taste bitterness (negative).
2. Taste like honey	2. Slightly turbid (slightly cloudy), especially Type A mead
3. I recommend the drinks for marketing	
4. Had a characteristic (unique) after-taste bitterness	
5. A nice beverage from cassava (honey)	
6. Good value added products	

The turbidity observed in the experimental meads (Tables 1 and 2) is probably due to non-ageing of the alcoholic beverages. In United States of America and Europe, a second decanting in 4-6 months and bottling a year later had been reported to give clearer meads (Morse and Hooper, 1985). There is the need for further research into a possible relationship between the bitterness principles observed in Table 2 and those of root tubers of some cassava phenotypes (mistakenly ascribed to HCN content) (Onwueme, 1978; Bradbury and Holloway, 1988).

The results of the post-fermentation microbiological assays of the bottled mead samples are shown in Table 3. Though ripening honey can contain some bacteria (eg *Gluconabacter* and *Lactobacillus viridescence)* and osmophilic yeasts (*Sacharomyces* and *Zygosacharomyces)* (Ruiz and Rodriguez, 1975; FAO, 1982), preheating the diluted honey seemed to account for the observed lower microbial load in the fresh Type A mead (Table 3). The A mead samples also seemed to preserve better (microbiologically) during the study period at the ambient room temperatures (24 - 34^{o}C).

To avoid bottle breakages due to possible high internal pressure (from fermentation gases) sturdy bottles should be used in the production of tropical meads. There is also the need to use cork or a good local equivalent for capping the bottles of mead during storage. The locally available polythene material used for the capping of the bottled experimental meads had been shown to be a relatively poor barrier of air (Fellow and Axtell, 1993). Furthermore, the results in Table 3 indicated possible presence of aerophilic microorganisms that might lead to early deterioration of inappropriately sealed bottles of the farm processed meads.

Table 3: Post-fermentation microbial assessment of the bottled mead samples.

		Culture** (colonies/ml)					
		YEA (37^0C/48hrs)		MCA (37^0C/48hrs)		KIA (37^0C/48hrs)	
Time (months)	Mead sample*	Ppm	Spm	Ppm	Spm	Ppm	Spm
0 (fresh)	Type A	NG	NG	NG	NG	NG	NG
	Type B	5	7	3	4	NG	5
2	Type A	NG	2	NG	1	NG	3
	Type B	48	50	NG	-	NG	49

* Type A = Produced from the preheated water-honey mixture
Type B = Produced from the unheated water-honey mixture
** MCA = MacConkey Agar
YEA = Yeast Extract Agar
KIA = Kligler Iron Agar
Ppm = Pour plate method
Spm = Spread plate method
NG = No Growth

CONCLUSION AND RECOMMENDATION

The results from this study show the potential use of simple technology to produce mead in Nigeria and other developing tropical countries with honey derived from cassava nectars. Currently, cassava flowers are not being utilized as food. To get meads of enhanced quality and shelf-life, extra efforts should be made to age the alcoholic beverage, and appropriately bottle it after about one year of maturity.

Finally, it is recommended that the honey-water mixture for farm production (of meads) in the tropics should be preferably preheated before fermentation, in order to obtain lower load of undesirable microbes in the product.

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