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ARTISANAL PRODUCTION OF "KURI" AN HONEY MADE ALCOHOLIC BEVERAGE FROM ADAMAOUA CAMEROON

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ABSTRACT

This paper aims at valorising an artisanal honey based alcoholic beverage from northern Cameroon (Africa). The studied process production involved most of stage required for production of mead with difference in starter preparation and handling which include a step of drying and smoking. The must preparation also present light difference with the one of wine production as there's no activator neither extra nutrients added. But a step of preparation of a so called "Mbii dong" is necessary. "Mbii dong" is a mixture of diluted honey with hot pepper or sometime spices. Some of the accessed physicochemical parameters which include pH, total titrable acidity, residual sugar and total polyphenols indicate similarities with that of mead. It also has to highlight the relatively high alcohol (around 15.4±0.6%) content of the beverage. The recorded values of physicochemical components as alcoholic, volatile acidity, polyphenols… may confirm the fact that a part of festivities, "kuri" can be used as medicines.

Keywords: *Honey, mead, Africa, wine, fermentation, drink.*

INTRODUCTION

Indigenous fermented products play important role in diet for populations in developing countries (Holzapfel, 2002; Dirar, 1993;). Fermentation processes are used to improve shelf life, nutritional quality and safety of foods (Motarjemi, 2002). In Cameroon a honey based alcoholic beverage locally called « kuri » is one of the top and popular drink for local indigenous population. Unfortunately this fermented beverage is still produced traditionally trough uncontrolled fermentation. There is therefore a need to investigate on artisanal production of this beverage in order to identify main key factor of production, and evaluate some of its nutritional and proximate composition. This can lead to a better understanding of biochemical changes which may occurred during this fermentation. Such study is a pre-requisite for "kuri" production at industrial level.

Material and Methods

Samples and Process design.

Rather than questionnaires, ethnographic methods as described by Schensul (1999) associated with focused group discussion method (Kumar, 1987) were used for data collection on the process.

Physicochemical analyses

pH was determined using a Kent EIL 7020 model pH meter. The pH of the fermented liquor was taken in triplicate in final product and during the fermentation process.

Residual sugar content was preceded by determination of glucose and fructose using the enzymatic method described by McCloskey (1978), both in final "kuri" beverage and during fermentation stage.

Titrable acidity (as percentage (w/w) tartaric acid) was determined according to the Association of Analytical Chemists (1990) method. Acidity was determined by titration with 0.1 N NaOH, solution and expressed as percentage tartaric acid; bromothymol blue was used as an indicator.

Total polyphenols were assayed colorimetrical using the Folin-Dennis Ciocalteau reagent as described by Juan Mangas, (1999) and the results were expressed as mg/l of gallic acid.

Total ethanol content was preceded by a Spectrophotometric micro-method for the determination of ethanol after distillation of wine that was made alkaline by a suspension of calcium hydroxide (Magri, 1997).

Total Soluble Solids (% Brix) Refractometric method was used to determine the soluble solids in honey as previously described by the International Honey Commission (IHC 2002). This was done by measuring the refractive index of honey using a refractometer thermostated at 20°C, and regularly calibrated with distilled water. Soluble solids were obtained from the refractive index of honey by making reference to a standard table.

Specific Gravity at 20 °C and Viscosity (poise) at 25°C: These two parameters were evaluated as describe by Nanda, (2003).

Specific Gravity Determination: This were done as follow, 20g of sample was poured into specific gravity bottle to overflow, then the stopper was inserted, later incubated in water-bath at 200 °C for 30 minutes. The bottle was removed from the water-bath wiped dry and weighed. Thereafter, boiled cool water was similarly treated the same way as that of sample then the specific gravity was calculated as the ratio of weight of ash over the weight of fresh sample time 100.

Volatile acidity (g/l): This was determined using Mathieu method by titration of the volatile acids separated from wine by steam distillation and titration of the distillate (Ribereau-Gayon and Peynaud 1962).

RESULTS AND DISCUSSION

Artisanal processing of honey into "Kuri" beverage

The artisanal preparation starts with must preparation. This is based on freshly harvested and filtrated honey.
Preparing must.

Several factors should be considered in choosing which method to use. Special attention must be given to the main ingredient which is honey. It has to be notice that the type of honey selected is as important to the flavour of "kuri" as grape varieties are to the flavour of wine. Strong flavoured honeys make strong flavoured "kuri", and lighter flavoured honeys yield lighter flavoured "kuri". In addition to flavour, colour must be considered when selecting honey, as this obviously impacts the appearance of the finished product. Standardized colour indexes are used to categorize honey under one of the following: water white, extra white, white, extra light amber, light amber, amber and dark amber. Honey colour is not indicative of quality, and it is not necessarily proportionate to the flavour intensity. Honey that has undergone minimal processing is the most desirable. Interviewed peoples also mentioned say when purchasing honey for "kuri" production, it's better to seek for the one which has not yet crystalized. If it has, it must be heated until all the crystals are dissolved. The amount of require honey depends upon the target finished alcohol, desired residual sugar and whether or not you are going to "stretch" the honey with less costly sugar. The must also locally called "Mbii Ndong" is the unfermented mixture made of honey, water and other ingredients as hot red pepper (Capsicum frutessens) extracts. Pure filtrated honey is diluted with warm water, then "hot" red pepper extract (Capsium frutescens) is added and the mixture passed through an artisanal filter made of woods and leafs. A clear dark filtrate with a "cola" like colour beverage is obtained. This beverage also called locally "Mbii Ndong" is a juice like hot pepper beverage wish can be also consume after cooling and jarring. This is also considered like "honey" juice and well appreciated by woman and children. "Mbii Ndong" is also use as "kuri" must. A part of the hot pepper, there are also many herbs and spices which are usually use for "special kuri" it's thus suitable to give special consideration to all possibilities for typical "kuri" production. Some are ground into a tea or infused during or after fermentation. Others may require heat to extract the desired flavours and aromas. One of the more interesting and creative aspects of "industrial kuri" production will be the selection and blending of different honeys to achieve a desired flavour and taste profile. Sugar is sometime added but this may only occurred after fermentation is completed.

Two major hurdles in honey wine production cited above are high microorganism loads and haze-causing proteins. Traditionally these problems are overcome by boiling the honey-water mixture for 15-20 minutes while skimming off the foam. Boiling sterilizes the mixture while denaturing and eliminating most of the haze-forming proteins. However, this solution comes at a cost. The first and most immediate problem with this approach is that most artisanal "kuri" winners lack the equipment to boil high volumes of liquid. Other drawbacks include the loss of some delicate and pleasing honey aromas as well as the development of bitter, harsh, resin-like tastes. Pasteurization is sometime used as a compromise. Holding the honey-water mixture at a temperature of 45°C for around 15 to 20 minutes has been reported to work well for eliminating biological load while not inflicting as severe a blow to the aromatic integrity of the honey thus final "kuri beverage". Unfortunately, this process still requires special equipment and does not eliminate the potential for haze formation. It is most likely that fining will be required to eliminate unstable proteins. Sulfiting, such as it is used in grape wine production, can be used to control microorganisms. If for industrial purpose we may go for a combination of pasteurisation with a tight DE filtration, this method should give the yeast a healthy head start on biological contaminants without the addition of heat.

Starter culture preparation

The fermentation step begins by the preparation of artisanal starter culture: This is obtained from the viscous trouble wine from the tanks bottom of previous fermentation. This viscous wine is collected in small jars and then store until decanted. The upper layer is removed and the remaining thick paste is pressed in and old cloth or wound bandage gaze. A solid soil coloured and pasty material is obtain. This dark "pasty" material is then sun dry or smoked until a fine dark powder is obtained. This latter rich wild yeast and mould powder considered as "kuri starter culture" can be store for years in dry conditions and use occasionally for a new "kuri" fermentation.

Fermentation

The fermentation process starts with heating clear "Mbii ndong" until temperature around 37°C to 40°C. The dry starter is then added step by step. First, around one to two grams of powder is mixed with 100ml of "Mbii ndong" and store for 12h to 18 h. The resulting sparkling liquid obtained is then mix with 1 litter of fresh "Mbii ndong" and again stored for 12h hours. The late 1 litre is use as starter for 10 to 15 litre of fresh "Mbii ndong" and again let age for 12 hours. The last 10 litre of wine like starter culture is then use as starter for 200 litre fresh "Mbii ndong". This final mixture is allowed to ferment in dark and warm for 48h to 72h according to the surrounding temperature. Generally as observed, the productions of "kuri" and grape wine have many similarities, with slight differences. While most grape juices provide yeast a healthy, balanced and nutritious environment, "Mbii ndong" (diluted honey) does not. In addition, honey has high bacterial loads, stubborn haze-forming proteins and low buffering capacity. To achieve consistent, high-quality results, "kuri" makers must address each of these issues. The oldest and simplest method for making "kuri" were said to just diluting the honey with water and leaving it in the hands of fate. This I think is a good way to make bad -tasting, cloudy "kuri".

Maturation

The obtained "young honey wine" is then filtered and the filtrate also called "strong honey wine" is put in jars closed and allow to maturate for 1 to 2 weeks. The obtained fresh honey/pepper wine is then serve immediately as it turn sour if keep longer in contact with air.

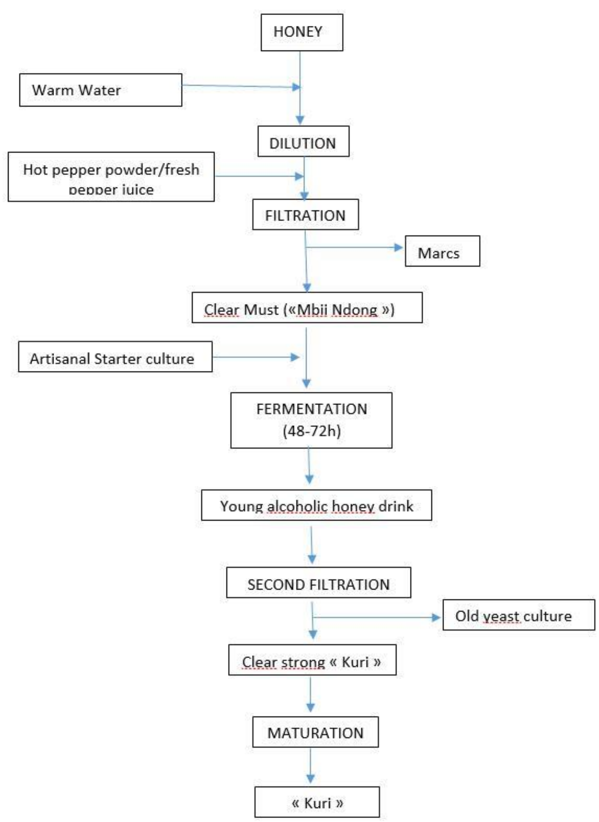

Figure 1. Process production of "kuri", a honey based alcoholic beverage from northern Cameroon

Physico-chemical composition of "kuri"

Table 1. Some Physicochemical parameters of fresh Honey compare to Honey Must designed for "kuri" production

	Brix (°Brix)	pH	Moisture (%)	Total residual sugar (%)	Specific Gravity at 20 °C	Viscosity at 25°C
Fresh honey	85.00±1.3	4.0±0.9	17.5±2.3	82.00±0.51	1.41±0.00	79.0±12.0
"Mbii Ndong"	25.00±1.2	3.9±0.5	42±5.1	27.00±0.34	1.10±0.00	16.3±1.7
"Kuri"	13.00±1.0	3.0±0.1	80±2.1	1.30±0.40	1.10±0.00	4.0±0.8

The pH values as mentioned in table 1 varies from 4±1 in honey, 3.9±0.5 in "Mbii ndong" and 3±1 for final maturated "kuri". If there's not a significant difference in pH values between fresh honey and diluted honey we notice a significant difference ($p<0.05$) between all anise "kuri" samples and both "Mbii ndong and fresh honey. Mean "kuri" samples had total titratable acidity values of 0.55±0.07 g/l00ml. Considering the pH and titratable acidity values, "kuri" may be considered sour beverage.

Compared with other African and Asian honey wines (Bahiru, 2001, 2006; Rhim, 1997; Kim, 1999) analysed "kuri" sample were found to be similar. Again if considered other African wine (Djoulde, 2010, Akubor, 1996, Eze & Ogan, 1988) analysed "kuri" samples are just slightly higher than fruits wines. However most of analysed "kuri" samples seems presenting higher pH and TTA values than various commercial honey wines (Steinkraus & Morse, 1973). But this value was much lower than that for Tanzanian honey wine and pine apple wine (Tiisekwa, 2000).

The high titratable acidity obtained here with high amount of alcohol may lead to a sweet-sour alcoholic flavour which make 'kuri' preferable by consumers than other locally produce alcoholic beverage as sorghum beer (Djoulde, 2013, Blandino, 2003). This combination would also give 'kuri' the required microbiological stability, which may lead to extend the shelf life of the beverage without the use for highly specific techniques as observed in wine. Producers do not determine the end-point of the fermentation and 'kuri' is consumed while in the state of active fermentation. Aerobic conditions would result in the formation of acetic acid from alcohol making the product sourer, a condition termed as 'dryness' by consumers.

Viscosity

The viscosity of the fresh honey sample falls within the range of 59.0 – 83.0, mean 79.0±12.0 (Table1). This viscosity fall within the recommended values as mentioned by Abdel-Aal, (1993). Looking at the viscosity of "Mbii ndong" and "kuri" there's a drop down from 79.0 ±12.0 of fresh honey to 16.3±1.7 for "Mbii ndong" and 4.0±0.8 for "kuri". If the first drop can be easily attributed to the diluting effect of water the second seems to be linked to the breakdown of honey 'sugar into alcohol and other compound less viscous (Koch, 1997). Yeast convert sugars, through enzymatic actions, into CO_2 and alcohol (Amerine & Singleton, 1976). In the process of doing this, there may be a little bit left over that the yeast convert into energy for their own metabolic needs (Boulton & Quain, 2008). After fermentation is complete, this left over contribute to enhance sensorial properties of "kuri" and it's viscosity as well (Anupama, 2003).

Brix and Sugar content

The brix of original honey used by interviewed "kuri" maker varies from 76°Brix to 97°Brix with a mean of 85±3°Brix while all analysed "kuri" samples present a brix of 13±1°Brix. The same observation is made for total residual sugar which decrease from 82±5% of fresh honey to 1.3±0.4%. This can be interpreted as conversion of sugar during the process (Anupama, 2003). As the use starter culture is composed mostly of yeast and mould and the obtained final product seems to be majority alcohol (Table 2).

As present on table 2, the comparison of some chemical component of "kuri" with some commercial "mead" indicate a significant difference ($p<0.05$) in ethanol and total polyphenol contents with higher levels in "kuri" than commercial mead. The other measured parameter as total residual sugars, total titrable acidity, pH and volatile acidity seems not significantly different ($p<0.05$).

Table 2. Comparative study of the chemical compounds of "kuri" and "commercial Mead samples

Sample	Residual total sugars (g/l)	Ethanol (%)	Total titrable acidity (mg/l)	pH	Volatile acidity (g/l)	Total polyphenols (mg/l)
« Kuri »	1.3±0.4	15.4±0.6	7.2±0.6	3.0±0.6	0.3±0.00	1150±27
Commercial Mead	1.3±0.2	10.8±0.5	7.7±0.10	3.6±0.4	0.2±0.00	911±22

The mean alcohol content of the production units seems higher than the value reported for various traditional wines (Djoulde, 2010, 2011; Koh, 1995) but lower than that of Korean honey wine (Rhim, 1997). However the high rate of source of variances recorded here are indicative of the variability of "kuri" samples in their physico-chemical properties. In general it can be said that the range for alcohol content of "kuri" is very wide and values lower than 8% could be obtained in cases where the fermentation is far from complete.

African consume fermented alcoholic beverages in special ceremonies such as circumcisions, wedding, naming and other mysterious ceremonies at festivals and social gatherings, at burial ceremonies and settling disputes (Steinkraus, 1983; Gadagas, 1999). Indigenous African fermented alcoholic beverages include Egyptian bouza, Tanzanian Wanzuki, gongo, tembo-mnazi and gara, Nigerian palm-wine, Kenyan muratina and uragua, and South African kaffir beer are mainly used as medicines for fever and other floods by adding barks or stems of Somme plants (Steinkraus 1983; Okafor, 1972). The recorded values of physicochemical components as alcoholic, volatile acidity, polyphenols… may confirm some of these said and they may be useful both for health or nutrition. Alcohol in traditional beverages may also serves as source of calories valuable to calorie-deficient villager. The primitive beverages provide not only calories but also B vitamins due to residues of substrates, fermenting yeasts and other microorganisms (Steinkraus, 1983).

Discussions

Regardless of the processing method choose for "kuri" or other honey based alcoholic beverage, the honey must be thoroughly mixed with water. Mostly for "kuri" production an open-top tank is used and fill to a given level with water, then honey is added. The main observe problem observe by doing this is that even with a continuous stirring, the honey is so dense that it tends to settle to the bottom (Bang, 2003). To overcome this bottleneck we propose the use wooden paddles to coax honey into solution. In addition using warm water may also help dissolving honey. However as mentioned earlier heating can decreased the floral character of the wines and enhanced characters such as oak, honey, and smoky (Francis, 1994).

Fermentation yeast health is paramount to a successful "kuri" fermentation, especially when dealing with wild yeast. Low nutrient levels and little buffering capacity in honey-water mixture can be also a bottleneck for a good "kuri" production (Ramalhosa, 2011). A full complement (highest allowable levels) of yeast nutrient (like Fermaid) and diammonium phosphate can be used to overcome this. In similar study, the continuous production of mead was achieved with yeast immobilized in calcium alginate gels. The alcohol production was stable in the pH range of 2.5–6.0 and a temperature range of 18–30°C with a sharp increase at 35°C. The process reduced the problems of contamination and secondary fermentation which are associated with traditional mead production (Qureshi, & Tamhane, 1985). Also, rehydration nutrients may help better prepare yeast for its difficult task. For reasons not fully understood, ultrafiltered meads tend to have faster, more dependable fermentations (Gupta, & Sharma, 2009). Another factor possibly contributing to poor yeast performance for "kuri" fermentation can come from the poor buffering capacity of the honey (Lučan, 2009). Because of this, pH can drops rapidly in the early stages of fermentation due primarily to the production of CO_2 and, subsequently, carbonic acid as well as the production of organic acids. The rapid drop in pH from usually above 4.0 to below 2.9 in the early stages of fermentation can cause a great deal of stress on the yeast and can severely hinder its performance (Pampulha, & Loureiro-Dias, 1989). For this reason, any acid additions used to balance "kuri" should take place after fermentation is complete to avoid adding to the problem. Some wine makers temper this drop in pH to no lower than 3.5 by additions of $CaCO_3$, $KHCO_3$, K_2CO_3 or some other base (Pilkington, 1998).

The last problem is the observed cloud appearance of "kuri" due to yeast. The flocculent appearance is caused by the yeast, and varies with the acidity and residual sugar contains (Noll, 2008). This can be overcome by a good handling of post fermentation clarification process: Depending on production methodology and the characteristics of mead, getting the yeast to settle out in a timely manner can be a problem. Some authors indicate the use with great success of silica gel followed by gelatin (Moio, 2004; Ferreira, 2001). However it's capital to prior determine the most effective fining rates. Honey also lacks the phenolic structure that fruits like grapes provide, consequently, even aromatic, flavourful, "kuri" can be quite thin on the palate. Sometimes a small tannin addition can help fill out the mouth feel—but be very careful, as it is easily overdone. An amount of residual sugar—whether added or resulting from an arrested fermentation—has a very positive impact on perceived body of final "kuri" and is therefore a very important component.

CONCLUSIONS

As demonstrated here "kuri" can provide a unique addition to artisanal African and Industrial winery's offerings. Unlike grape wine, "kuri" requires no cold stabilization. Turnaround time can be very short. Because it is so different from grape wines, it will be difficult to fit "kuri" among traditional wine line-up. For most people it may requires a lot of explanations, but there is a definite niche market—and within that context, it can be a pretty easy sell.

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