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Production technique and sensory evaluation of traditional alcoholic beverage based maize and banana

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ABSTRACT

Traditional alcoholic beverage has become common because of economic issue. This work was aimed to improve production process of alcoholic beverage based maize and banana extract and to evaluate sensory parameters of the obtained alcoholic beverage. Three formulations were tested with different quantity of banana pulp as adjunct (2v/3v, 2.5v/2.5v, and 3v/2v; wort/banana pulp labeled F1, F2 and F3 respectively). De-pectinized banana pulp was added to wort and the mixture was fermented in anaerobic condition, at ambient temperature of about 25 °C for 72 h in presence of *Saccharomyces cerevisiae*. Samples of alcoholic beverage obtained had light alcohol content from 4.63 ± 0.7% for F1, 4.05 ± 0.4% for F2, 3.32 ± 0.3% for F3. The alcohol content of samples was proportional to the quantity of banana added. The evaluation of banana extract performance in alcohol yield showed a perfect link between the quantity of alcohol produced and the brix degree of the mixture before fermentation, with the regression coefficient of 1. Sensory analysis showed that the 3 formulations had a dark color, a poor taste, an average odor for F1 and F2. Only F3 had a very good aroma. According to the sensory evaluation, F3 was the best formulation.

Background

Traditionally, the main raw material used in beer production has been mainly cereals (Nwabueze and Uchendu, 2011) (malted and unmalted) due to their high content in soluble (fermentable) sugar. The competition of cereals between the population and breweries, led the brewery industries to search for cheaper alternative sources of starch to substitute the cereals (Nwabueze and Uchendu, 2011). Several research on the traditional production of alcoholic beverages using banana as the raw material adjunct has been carried out (Bamforth 2006; Carvalho et al., 2009). Banana is rich in carbohydrates and minerals, and provides low acidity (Donohue and Denham, 2009). Prabir et al. (2013) used banana to produce beer and valorized the residues in the production of cookies. Carvalho et al. (2009) evaluated the performance of wort adjusted with banana juice at different concentrations and revealed an increase in ethanol production with approximately 0.4 g/g ethanol yield and 0.6 g/l volumetric productivity after 84 h of processing (Macgowan et al., 1983; Willaert and Nedovic, 2006). Shale et al. (2012) investigated on commercially produced banana beer using traditional methods. In that study, the authors concluded on a poor microbial quality of the traditional beer. The production of beer using banana as an adjunct was also realized by Pugazhenthi and Cholapandian (2011) and concluded that banana used as an adjunct could help in the development of new products as well as in the elaboration of concentrated worts.

Although the use of banana in traditional beer production is well known in some African countries: *urwagwa* in Kenya, Rwanda and Burundi, *Kasiksi* in DR Congo, and *lubisi* in Uganda (Parawira, 2012), no research of this kind has been conducted in Cameroon. In Cameroon, traditional beer are only maize based (*Haa'a* in Center region, *Chaa'a* in North - west, or sorghum based (*Bilibli* in Grand North)). The aim of this study was to improve the technique in alcoholic beverage production in Cameroon using the new ingredient (banana as an adjunct) and evaluate the alcohol yield performance while valorizing our local products.

Materials and method

Materials

– **Banana (*Musa acuminata colla*)**

The very ripe banana from the same lot was collected from a

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local market. Bananas were peeled. Water was added in a ratio of 1/3 (V/V) (water/banana pulp) dilution into the prepared pulp.

- **Maize** (Zea mays)

  Yellow maize of the same lot of Zea mays was collected from a local market. This maize was visually examined to be sure of its good quality which is essential for the quality of wort that will be produced.

- **Ferment agent**

The main ferment (yeast strain) used in this work was the commercial lager brewing strain (*Saccharomyces cerevisiae* brand Instant Yeast Nevada*)* collected from a super market.

Method

Production of malt

The maize collected to the local market was washed, steeped in fresh water for about 60 h at room temperature (about 25 °C). The steeped maize was put in bags for 72 h of germination at room temperature to obtain the malt.

Production of wort

The obtained malt was dried at 60 °C for 5 h, roasted at 80 °C for 50 min in the Owen brand BINDER. The roasted material was ground to obtain the grist. The grist was later boiled between 65 °C and 78 °C for 30–120 min (1.3 L of water for 500 g of grist) to extract wort. Filtration was done using a clean cloth.

Production of banana extract

Ripped banana was washed, peeled and mashed using the blinder. Potable water was added in a ratio of 1/2 (V/V) (water/banana pulp). The mixture was filtrated to obtain the extract.

De-pectinization of banana pulp

Banana pulp contains complex sugars which are not useable by microorganism. In order to reduce those sugars, de-pectinization was done using pectinase enzyme SIGMA-Aldrich P2736. Pectinase enzyme was added to the banana pulp at a concentration of 0.0003% (w/v) and left for 5–6 h in incubation at 38 °C with occasional stirring.

Production of alcohol beverage

The fermentation process was carried out in a 5 L container in anaerobic condition, at 25 °C for 72 h. The fermentation process was initiated by the addition of 0.5–0.7 L of heavy yeast slurry (*Saccharomyces cerevisiae*) per hectoliter of wort. After fermentation the product were filtered using a clean cloth. Fig. 1 below represented the block diagram of the process.

For this study, three formulations were experimented:

F1: 2/3 (V/V) (wort/banana extract)
F2: 2.5/2.5 (V/V) (wort/banana extract)
F3: 3/2 (V/V) (wort/banana extract)

Analytical methodology

Before and after fermentations, samples were taken in triplicate and the pH and the degree brix of the filtered supernatant and wort were recorded respectively using a pH-meter OAKTON PN 54 × 541825 and a Refractometer 0–28% salinity (ATC).

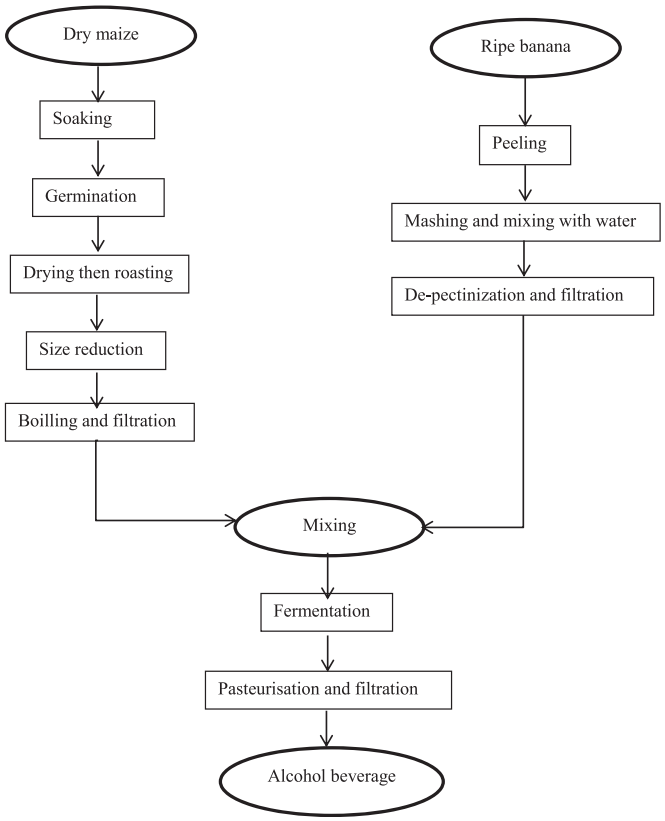

Fig. 1. Bloc diagram of the process

Test of Jones

The test of Jones is a characteristic test for alcohol. This test is to rapidly differentiate between primary, secondary and tertiary alcohol. The Jones reagent is a mix solution of CrO_3, sulfuric acid (H_2SO_4) and water (Dissolution of 26.72 g of CrO_3 in 23 ml of concentrated H_2SO_4).

- The test is positive with the primary and secondary alcohol: blue-green coloration before 5 min (chrome III ion color)
- The test is negative with tertiary alcohol: no color change

Determination of alcohol content

The alcohol content of samples was established by combining the results of two simple test measurements, that of a refractometer (to record sugar content) and a hydrometer (to determinate the specific gravity).

The alcohol content (%) was calculated according to the equation below:

Alcohol content = R − [(S.G.−l) × 1000] Were R= refractometer reading, SG = specific gravity

Statistical analyses

Descriptive statistic was done using scatter plots to illustrate the link between the quantity of alcohol and the brix degree before and after fermentation. A linear model of estimation of the quantity of alcohol from the brix degree before and after fermentation was put in place through the equation of line of estimation of the quantity of alcohol produced. Correlation test was realized to evaluate the relationship between the brix degrees and the quantity of alcohol. Finally, analysis of variance (ANOVA) was realized to analyze the effect of different formulations on the quantity of alcohol and the result was illustrated by a boxplot.