Burukutu: Healthy and Superior Indigenous African Traditional Opaque Beverage

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Abstract

This study was aimed at deepening knowledge on the social superiority based on the functionality and healthiness of burukutu opaque beverage, brewed with four cereals (sorghum, millet; maize and composite materials of the three cereals in equal ratio). Whereas sorghum-based burukutu beverage samples gave the highest levels of carbohydrate (24.04 ± 0.02%), ascorbic acid (0.15 ± 0.00 μg/100 g), magnesium (25.14 ± 0.03 mg/100 g), iron (4.17 ± 0.01 μg/100 g), and sodium (1.58 ± 0.02 mg/100 g); total fat (5.06 ± 0.02%), Ca²⁺ (3.96 ± 0.02 mg/100 g) and Mn²⁺ (4.71 ± 0.03 mg/100 g) varied the highest in millet-based burukutu beverage samples. Similarly, crude protein (15.14 ± 0.01%), total fibre (2.88 ± 0.31%) and ash (4.30 ± 0.02%) levels were highest in the maize-based burukutu samples while vitamin A precursors: β-carotene (1.89 ± 0.02 μg/100 g) and retinol (1.21 ± 0.01 μg/100 g) levels were highest in the composite material-based burukutu samples. However, variations in nutrient composition and caloric value amongst all samples were not significantly (p < 0.05) different. The study revealed that the indigenous African traditional burukutu opaque beverage is a healthy beverage which contains some functional phytochemical ingredients that can prevent the onset of certain chronic degenerative diseases including hypertension. On the basis of its nutrient composition, burukutu, therefore, is a superior traditional beverage that should be conferred some form of high social status.

Keywords: Beverage; Burukutu; Cereals; Functionality; Healthiness; Nutrients; Phytochemical

1. Introduction

The process of making beverages is known as brewing. Brewing involves the fermentation of flavoured extract (wort) derived from the mashing of malted cereals. Cereals had been malted for centuries for the production of weaning foods and brewing of traditional alcoholic and non-alcoholic opaque beverages in Africa long before the advent of western style malting and brewing technologies (Alemu, 2009; Beta et al., 1995). The African traditional opaque beverages are known

Traditionally, burukutu is brewed with red or white sorghum variety and/or maize malts (Lyumugabe et al., 2012). It has a sour taste resulting from the action of the lactic acid bacteria (Lactobacillus spp.) and opaque colour because of suspended solid and yeast materials (Adewara and Ogunbanwo, 2013; Ogunbanwo et al., 2013) with thin consistency. Burukutu is consumed among the indigenous people of the northern guinea savannah of Nigeria and other African countries including Ghana and Benin (Banigo et al., 1987). Its brewing process involves malting, mashing, boiling, fermentation and maturation (Lyumugabe et al., 2012). The microorganisms associated with the fermentation of burukutu include Sacchromyces cerevisiae, Sacchromyces chaveliera, Leuconostoc mensesnteroides and Candida acetobacter (Blandino et al., 2003; Van der Aa Kühle, et al., 2001). Several studies on burukutu and its raw materials have been reported (Uvere et al., 2000; Orji and Uvere, 2002; Kingsley and Victor, 2007; Yahaya, 2008; Lyumugabe et al., 2012; Adewara and Ogunbanwo, 2013). Unfortunately, burukutu is considered a low social status beverage culturally in traditional African societies. People who consume it are regarded as social misfits who cannot afford the cost of the European-style brewed beverage types.

Therefore, the objective of this study was to deepen knowledge on the social superiority based on the functionality and healthiness (nutrient composition and caloric value) of traditional opaque burukutu beverage indigenous to Africa brewed from four cereal sources: sorghum, millet, maize and composite material using equal ratio (1:1:1) of sorghum/millet/maize.

2. Materials and Methods

2.1 Source of Materials

Sorghum vulgare (red sorghum variety), Pennisetum glaucum (pearl millet), Zea mays (white maize variety) which were grown in different parts of Northern Nigeria and gari (a farinaceous starch powder processed from cassava: Manihot spp.) used in this study were purchased from Itam market in Uyo, Akwa Ibom State in Nigeria. The sorghum, millet and maize varieties were identified by the Department of Botany and Ecological Studies of the University of Uyo, Nigeria.

2.2 Micro-malting of Cereal Samples

The grain samples (sorghum, millet and maize) were cleaned and sorted. They were mixed in equal ratio of 1:1:1 to create a composite material as fourth sample. The four samples were malted according to the method of Ogbonna (2011). Five hundred grams (500 g) of each sample was steeped overnight in tap water at a ratio of 1:2 at room temperature (28 – 30 °C). The soaked grains were washed, spread out on trays and covered with banana leaves to reduce dehydration during
2.3 Brewing of Burukutu Beverage Samples

The brewing of burukutu beverage samples followed modified processes as previously described (Achi, 2005; Ogbonna, 2011). The sun-dried sorghum, millet, maize and composite material malt samples were milled to consistent fine flour with a kitchen blender (Q-link Model QBL-20L40, Made in China). Two hundred grams (200 g) of each flour sample was weighed with a chemical balance (KERN.EG-300-3M, Kern and Sohn GMBH, Germany) and mixed with 50 g of garri as an adjunct and water at a ratio of 6:1:2 to form a thick mash. The mash was stirred and allowed to settle. The supernatant was decanted and the mash heated to and boiled at 100 °C for 25 min, cooled to 40 – 50 °C and the decanted supernatant added back. The cooled mash was rested for 1 h. More water (about 600 mL) was added and the paste lautered through a sieve cloth. The very cloudy wort was left to undergo spontaneous mixed culture fermentation at room temperature (28 – 30 °C) for 48 h. The fermented product was filtered through muslin cloth and left to mature for 48 h in covered pots. Thereafter, the resulting opaque beer was stabilized at 65 °C for 4 h with intermittent stirring and analysed.

2.4 Analyses of Nutrient Composition and Caloric Value of Burukutu Samples

Crude protein (Kjedahl method), moisture (oven drying method), carbohydrate (by difference), ash (furnace charring method), total fibre (oven incineration method), ascorbic acid, retinol and β-carotene (spectrophotometric method), mineral contents (atomic absorption spectrophotometric method) and calorie (by multiplying the values of crude protein, carbohydrate and total fat by the factors 4, 9 and 4, respectively) were determined according to the standard procedures of AOAC (2004). The total fat was determined through solvent extraction method. Two grams (2 g) of each sample was extracted with 150 mL of petroleum ether (boiling point 35 – 60 °C) in a reflux soxhlet extractor for about 8 h. The solvent was evaporated to dryness in a thermostated steam bath (GFL, Gasellschaft fur Labortechnik GmbH, Germany), cooled in a dessicator and weighed.

2.5 Experimental Design and Statistical Analysis

Each of the four samples used in this study was replicated three times and each replicate micro-malted and brewed to generate 12 analytical replicates. Each analytical replicate was subjected to triplicate analyses of nutrient composition and calorific value in a completely randomized design (CRD). Mean values of the triplicate determinations were subjected to a one-way analysis of variance (ANOVA) to determine significant differences using Statistical Package for Social Sciences (SPSS) version 17 for windows. Paired comparison of means for significant differences was separated by least significant differences (LSD). Differences at p < 0.05 were considered significant.

3. Results and Discussion

3.1 Macro-nutrient Composition

The results of the macro-nutrient composition of the burukutu beverage samples from sorghum,
millet, maize and a composite material are shown on Figure 1. The crude protein content of the burukutu beverage samples varied between 10.63 ± 0.02% (for the millet-based sample), 12.02 ± 0.03% (for the composite material-based sample), 13.08 ± 0.01% (for the sorghum-based sample) and 15.14 ± 0.01% (for the maize-based sample).

The crude protein composition of the four burukutu beverage samples were within the lower limit of the recommended dietary reference intake’s (DRI) acceptable macronutrient distribution range (AMDR) of 10 – 35% protein for adults (USDA, 2015). Hence, they are important dietary protein sources. Proteins play very essential roles in healthy diets and nutrition. The total fat content of the millet-based burukutu beer was the highest (5.06 ± 0.02%) of the four samples. Others were: 3.96 ± 0.03% (for the sorghum sample), 4.86 ± 0.02% (for the maize sample) and 4.97 ± 0.02% (for the composite material based sample). These values are lower than the DRI’s AMDR range of 25 – 35% total fats for adults (USDA, 2015) Fat serves as a source of energy and insulation for the body. In addition, it is needed for growth and development, as solvent for some vitamins including A, D, E and K, maintenance of cell membrane and providing taste and consistency to foods. However, caution should be exercised in order to avoid saturated and trans-fats in diets considering their deleterious health effects.

Fig. 1. Macro nutrient composition of burukutu opaque beer samples. [Data are expressed as mean values of triplicate determinations ± SD]
The moisture content for the sorghum, millet, maize and composite material based burukutu beverage samples was found to be 55.50 ± 0.02%, 55.69 ± 0.01%, 55.06 ± 0.02% and 55.64 ± 0.02%, respectively. The high moisture content of all the burukutu beverage samples may have been as a result of the fact that besides the inherent moisture content of each cereal material used all the processing steps were water based. Moisture is essential for good health and optimization of physiological processes including the digestion of food materials, absorption of nutrients, and supply of oxygen to the cells and aids the body to get rid of waste materials (Robertson, 2005). Carbohydrate content of the sorghum, millet, maize and composite material-based burukutu beer samples were lower than the DRI’s AMDR range (45 – 65%) of energy from carbohydrates for adults (USDA, 2015). Carbohydrate content of the sorghum, millet, maize and composite material-based burukutu beverage samples ranged between 24.04 ± 0.02% (for the sorghum based sample), 23.33 ± 0.02% (for the millet based sample), 17.76 ± 0.02% (for the maize based sample) and 20.73 ± 0.01% (for the composite material based sample). Carbohydrates are essential for energy required for all body activities including proper functioning of muscles, kidneys, brain and nervous systems. Ash content was found to be 2.08 ± 0.03%, 3.18 ± 0.01%, 3.75 ± 0.01% and 4.30 ± 0.02%, respectively for the sorghum, millet, maize and composite material-based burukutu beverage samples. The highest ash level was from the maize-based burukutu beverage sample. Ash content serves as an index of the mineral element composition of food samples being assayed.

3.2 Micro-nutrient Composition and Caloric Value

The results of the micro-nutrient composition of the burukutu beverage samples from sorghum, millet, maize and a composite material are shown in Table 1. Values for total fibre were 1.36 ± 0.03% (for sorghum-based sample), 2.11 ± 0.02% (for millet-based sample), 2.88 ± 0.31% (for maize-based sample), and 2.49 ± 0.02% (for composite material-based sample). These values are within the lower limits of values (2.2 – 7.8% and 2.5 – 11.3%) reported for oat and barley, respectively (Charalampopoulos et al., 2002; Havrlentova and Kraic 2006). Dietary fibres (DFs) which could be soluble or insoluble are non-nutritive bioactive and non-starchy polysaccharide components of food (Abuajah et al., 2015). They are the indigestible part of plant foods composed of linear and branched chains of carbohydrate molecules held together by bonds that cannot be hydrolysed by human digestive enzymes. Chemically, DFs are homo-polymers of glucose units in hetero-structural configuration of β(1,3;1,4) bonds in cereals or β(1,3;1,6) bonds in microorganisms. The water-soluble types are mainly β-glucans, gums, pectins, muclages and arabinoxylans while the water-insoluble types are lignin, cellulose, and hemicellulose (AACC 2001; Andlauer and Furst 2002; Charalampopoulos et al., 2002). DFs are very essential components of diets responsible for good health and wellbeing. The long fibrous structures of DFs enable them to trap harmful toxins and carcinogens in the digestive tract. Cereal soluble fibres have gained special attention for their many health benefits including lowering serum cholesterol, preventing cardiovascular diseases, type 2 diabetes, low glycaemia response, etc. In addition, it is attributed to having good water retention capacity, and hydrocolloidial gelling properties (Izrydorczyk and Dexter, 2008). Soluble DFs dissolve in and absorb water and are effective in binding toxins and cholesterol in the intestinal tract. In contrast, insoluble DFs do not dissolve in water and is effective in increasing faecal bulk and decreasing the speed of food passage (increasing food transient time) through the intestinal tract. Insoluble DFs also dilute out potential carcinogens and decreases the contact of toxins and carcinogens with the intestinal tract (Duss and Nyberg 2004; Ahmad et al., 2009; Havrlentova et al., 2011; Ahmad et al., 2012).
Table 1 Micro nutrient and fibre composition and caloric value of burukutu samples*

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Burukutu samples</th>
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<tbody>
<tr>
<td></td>
<td>Sorghum based</td>
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<tr>
<td>Ascorbic acid (μg/100 g)</td>
<td>0.15 ± 0.00</td>
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<tr>
<td>β-Carotene² (μg/100 g)</td>
<td>0.62 ± 0.02</td>
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<tr>
<td>Retinol (μg/100 g)</td>
<td>0.66 ± 0.02</td>
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<tr>
<td>Ca²⁺ (mg/100 g)</td>
<td>2.86 ± 0.01</td>
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<tr>
<td>Mg²⁺ (mg/100 g)</td>
<td>25.14 ± 0.03</td>
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<tr>
<td>Mn²⁺ (mg/100 g)</td>
<td>3.31 ± 0.03</td>
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<tr>
<td>Fe²⁺ (mg/100 g)</td>
<td>4.17 ± 0.01</td>
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<tr>
<td>K⁺ (mg/100 g)</td>
<td>84.81 ± 0.02</td>
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<tr>
<td>Na⁺ (mg/100 g)</td>
<td>1.58 ± 0.02</td>
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<tr>
<td>Total fibre (%)</td>
<td>1.36 ± 0.03</td>
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<tr>
<td>Calorie (kcal)</td>
<td>64.04 ± 0.01</td>
</tr>
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</table>

*Values are means of triplicate determinations ± SD
aComposite material
²β, beta; Ca, calcium; Mg, magnesium; Mn, manganese; Fe, iron; K, potassium; Na, sodium

The caloric value profile showed that the sorghum-based burukutu beverage sample had the highest caloric value (64.04 ± 0.01 kcal) followed by the millet and composite material-based samples (61.38 ± 0.01 kcal and 56.53 ± 0.02 kcal, respectively) whereas the maize-based burukutu beverage sample had the lowest caloric value (55.34 ± 0.00 kcal). Caloric value is a measure of the energy content of food materials which is absolutely essential for all human activities, physiological processes and maintenance of body equilibrium. The vitamins and mineral composition of all the burukutu beverage samples were generally low. Sorghum-based burukutu beverages showed the highest ascorbic acid content (0.15 ± 0.00 μg/100 g) and the composite material-based burukutu beverages had the highest β-carotene and retinol levels of 1.89 ± 0.02 μg/100 g and 1.21 ± 0.01 μg/100 g, respectively. Ascorbic acid is vitamin C, β-carotene is vitamin A precursor while retinol is vitamin A. Similarly, sorghum-based burukutu beverage samples were found to have the highest mineral content in terms of magnesium, iron and sodium (25.14 ± 0.03 mg/100 g, 4.17 ± 0.01 mg/100 g and 1.58 ± 0.02 mg/100 g, respectively) whereas millet-based burukutu samples had the highest calcium and manganese levels (3.96 ± 0.02 mg/100 g and 4.71 ± 0.03 mg/100 g, respectively). Potassium content varied with highest in the maize-based burukutu opaque beverage samples (97.62 ± 0.02 mg/100 g). According to the DRI, vitamins are essential for metabolic processes in the body, keeping cells strong, building tissues, fighting infections, promoting normal growth and ensuring good health. All minerals are essential. The body is not capable of manufacturing them. Therefore, they must be included in the diet. They are directly and indirectly involved in every bodily process. Most of the physiological processes of the body cannot occur without the presence of these minerals. Adequate amounts of vitamins diminish without the presence of the specific minerals required for their effectiveness. Similarly, minerals serve as prosthetic groups or cofactors to vitamins functioning as coenzymes in enzyme catalysed bioreactins. Minerals are equally required for the right composition and proportion of body fluids, formation of blood and bones and the creation and maintenance of healthy nerve functions (McCauley, 2000). Above all, the higher potassium than sodium levels makes them ideal diuretic
diet for the prevention of the onset of certain health conditions including hypertension. Generally, vitamins and minerals are functional ingredients of food which impact positively on human health and wellbeing beyond mere nutrition.

The variations in nutrient compositions and caloric values amongst the different burukutu beer samples were not significantly (p < 0.05) different. However, these variations may have arisen as a result of climatic differences and access to water, use of fertilizer in the cultivation of the cereal grains and nutrient composition of the soil, ecological, seasonal and geographical variations of the respective growing regions which make up the physiological compositions of the cereal materials used and the processing methods applied in this study.

4. Conclusions

This study revealed that all the burukutu beverage samples studied composed of varying levels of macro (protein, moisture, carbohydrate, and total fats) and functional micro (total fibre, ascorbic acid, β-carotene, retinol, and minerals: potassium, calcium, magnesium, iron, sodium, and manganese) nutrients. In addition, they have caloric values. Hence, the indigenous African traditional burukutu opaque beverage is a healthy beverage which contains some functional phytochemical ingredients that can prevent the onset of certain chronic degenerative diseases including hypertension. On the basis of its nutrient composition, burukutu beverage, therefore, is a superior beverage that should be conferred some form of high social status.

Conflict of Interest

The authors declare no actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations that could inappropriately influence, or be perceived to influence, this work.

References


http://www.watershed.net/Importance-of-Minerals/


