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PROXIMATE COMPOSITION AND MICROBIAL CHARACTERISTICS OF PROCESSED TIGER NUT MILK (*Cyperus esculentus*)

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Abstract
This study investigated the proximate and microbial characteristics of processed tiger nut milk. Tiger nut was purchased, processed under standard conditions and subjected to laboratory analysis in triplicates. The result showed that the sample contain 90.7% moisture content, 0.6% crude protein, 2.7% crude fat, 0.1% crude fibre, 0.2% ash and 5.7% carbohydrate. The microbial load was found to be higher than the FAO/WHO standard. The pH was found to decrease from 5.5 at preparation to 3.2 after 18 hours. It was concluded that tiger nut milk is a nutritious beverage with high moisture content but low crude fibre, crude protein, crude fat and ash content. The milk decrease in pH suggested increase in acidity which aids spoilage.

Keywords: Tiger nut milk, Proximate Composition, Microbial load.

Introduction

Tiger nut is an emerging grass-like perennial plant belonging to the family Cyperaceae and genus Paprus (Oguwike *et al.*, 2017). Tiger nut is also referred to as Zulu nut, Yellow nut grass, Ground almond, *Chafa* and Edible rush. In Nigeria, the Hausa's call it *Aya*, Yoruba call it *Imumu* and *Ofio* or *Aki Hausa* in Igbo (Omode *et al.*, 1995). Tiger nut can be eaten raw, dried, roasted or grated and used as flour or vegetable milk (Ogbonna *et al.*, 2013). The most common of its use is the processing into milk. In Spain, where it originated from, recognition and use seems to be highest globally. It is processed into local drink call *Horchata De Chata* (Allouh *et al.*, 2015). In Ghana, it is referred to as 'Atadwe' (Asante *et al.*, 2014) while it is called 'Kunnu Aya' in Nigeria (Ogbonna *et al.*, 2013), and produced in large quantity in the northern part of the country. There are three varieties of the nut which are brown and yellow, with the latter being the most preferred one because of its organoleptic characteristics, large size, attractive colour, freshness, and high milk yield during extraction (Oguwike *et al.*, 2017). Tiger nut beverages are whitish and considered by many to be very refreshing especially when chilled (Badau *et al.*, 2018).

Research efforts have been tailored towards the development of beverages from local raw materials globally and Nigeria is not left out (Said *et al.*, 2017). This can been argued from the perspectives of utilization of available materials to meet an enduring need such as the campaign against the excess consumption of carbonated drinks, increased awareness of the health benefits of natural products, and economic improvement of local farmers and rural economy. The sources of the beverages that have been relatively explored include millet, roselle plant extract (Zobo), sorghum and soybean. Despite the fact that tiger nut is one of the earliest domesticated crops in the world it is one of the underutilized crops in the world (Oguwike *et al.*, 2017). This also a cash crop that has not been given enough recognition and patronage. There has been increasing awareness on this and a campaign for heightened utilization given its nutritional and health benefits (Belewu and Belewu, 2007).

In light of this, the proximate composition of the tiger nut seed and products like flour and local snack 'donkwa' has been documented (Oladele and Aina, 2007). Temple (1989) further reported that tiger nut is rich in protein (7%) and carbohydrate. These carbohydrates include reducing sugar (7.4%), soluble polysaccharide (7.4%) and starch (86.4%). Its biological value is slightly higher as reported by Ojobe and Tempo (1993) than many other nutritious foods proposed by FAO/WHO (2002). The amino acid content of tiger nut is essentially found within the range needed by adult (Bosch *et al.*, 2005). A major issue associated with tiger nut milk is however the fast deterioration rate. Chemical and microbiological composition of tiger nut milk produced under hygienic conditions by a researcher has however not been largely explored. Most evaluations have been reliant upon samples gotten from sales outlet which may not be prepared under hygienic conditions.

Madau *et al.* (2018) evaluated the microbiological quality of tiger nut beverages sold within the University of Maiduguri, Borno State in order to ascertain its safety on the health of the consumers. In Abeokuta campuses, Ogun State, this was assessed by Taiwo *et al.* (2017). Likewise, Umar et al. (2014) in Umaru Musa Yar'adua University, Katsina State, Musa and Hamza (2013) in Kaduna State University and Elmahmood and Doughari (2007) surveyed this in Girei town of Adamawa State. This study methodologically prepared tiger nut milk under standard conditions and examined the proximate and microbial composition, with a view to compare with the findings of previous studies.

Methodology

Purchase and preparation of Tiger nut milk

Tiger nut (*Cyperus esculentus*), the yellow variety, was purchased from Ojoo Market Ibadan, Oyo State. The preparation was done in the Department of Wildlife and Ecotourism Management, University of Ibadan Hospitality Unit adapting the methods of Manga (2016) on Figure 1. The milk was package in a plastic bottle which was labelled to give brief information about the milk.

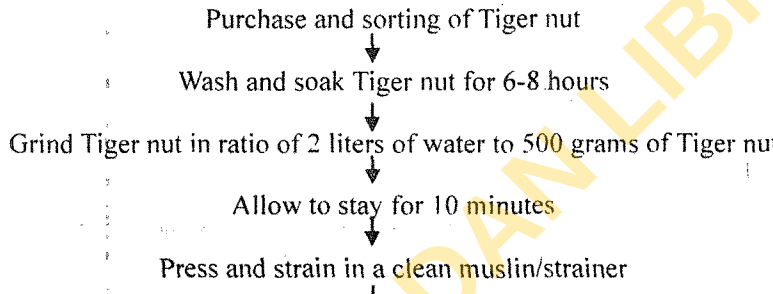

Fig. 1: Flow chart for the production of Tiger nut milk
Source: Adapted from Manga, (2016)

Proximate analysis: Three 10ml samples of the prepared Tiger nut milk was subjected to proximate composition analysis. Nutrient checked for were Carbohydrate, Crude fat, moisture, Crude protein, Crude fibre and Ash. This proximate analysis was carried out at Human Nutrition, College of Medicine, University of Ibadan, Oyo State.

Microbial analysis: The microbial analysis was carried out at the department of Microbiology, Faculty of Science, University of Ibadan, Oyo State. This was carried out to investigate the microbial load of 10ml of tiger nut milk with a view to determine the shelf life of the Tiger nut milk sample. The method use was adopted from Okorie *et al.* (2014). On each experiment, 10ml of sample content was dispersed in 90ml of sterile distilled water, homogenized by shaking vigorously and further diluted. An aliquot portion (0.1ml) of the 5th dilution was inoculated in duplicate on dried surface of Nutrient agar (for bacteria), Mac Conkey agar (without yeast for coliform), Sabouraud dextrose agar (for yeast) and potato dextrose agar (for moulds).

Data analysis: Using Statistical Package for Social Sciences version 21, data were subjected to descriptive statistics and the means and standard deviation were presented.

Results

Proximate composition

The sample was found to contain 90.7% moisture content, 0.6% crude protein, 2.7% crude fat, 0.1% crude fibre, 0.2% ash and 5.7% carbohydrate (Table 1).

Table 1: Proximate composition of tiger-nut milk

	N	Mean	Std. Deviation
Moisture content (%)	3	90.7267	0.01528
Crude protein (%)	3	0.5867	0.00577
Crude fat (%)	3	2.7033	0.00577
Crude fibre (%)	3	0.1033	0.00577
Ash (%)	3	0.2433	0.00577
Carbohydrate (%)	3	5.7400	0.01732

Microbial composition

This is presented on Table 2. The pH of the sample was found to decrease from 5.5 at preparation to 4.3 after six hours. This further decreased to 3.5 after 12 hours and 3.2 after 18 hours. The total bacterial count was 2.825 x 10^6CFU/ml at 0 hour. No growth was recorded for subsequent hours. Likewise, the total coliform count was 3.27x10^6CFU/ml and no growth was recorded for subsequent hours. The yeast composition was 1.275x10^6CFU/ml at 0 hour. This decreased to 2.95x10^5CFU/ml after six hours. After 12 and 18 hours, the yeast count has reduced to 7x10^4CFU/ml and 1x10^4CFU/ml respectively. The total mould count at 0 hour was 4x10^4CFU/ml and this remained the same after 6 hours. At 12 hours following preparation, the mould count has reduced to 2 x10^2CFU/ml. An increase was observed to 2.5 x10^4CFU/ml after 18 hours.

Table 2: Microbial composition of tiger nut milk

Time (hours)	pH	TBC (CFU/ml)		TCC(CFU/ml)		Yeast (CFU/ml)		Mould (CFU/ml)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
0	5.5	2.825 x 10^6	21213	3.27x10^6	466691	1.275x10^6	49498	4x10^4	1414
6	4.3	NG	NG	NG	NG	2.95x10^5	106066	4x10^4	28284
12	3.5	NG	NG	NG	NG	7x10^4	0.00	2 x10^4	0.00
18	3.2	NG	NG	NG	NG	1x10^4	0.00	2.5 x10^4	21213

(**Note** = TBC – Total bacterial count, TCC – Total coliform count, SD – Standard deviation, NG – No growth)

Discussion

One of the essential components of any beverage is its water content (Ojebo and Tempo, 1993). The tiger nut milk was found to comprise of 90.7% moisture content. This when compared to the moisture content in dried tiger nut (3.5%) as reported by Oladele and Aina (2007) is high, mainly because the principal constituent in the production is water. High moisture content has however been noted to typically allow microbial growth (Udeozor and Awonorin, 2014). The sample was found to contain 0.6% crude protein, 2.7% crude fat, 0.1% crude fibre, 0.2% ash and 5.7% carbohydrate. Bamishaiye and Bamishaiye (2011) reported that tiger nut drink is a rich source of unsaturated fats and some enzymes which help in digestion. Also, the milk is thought to be beneficial to diabetic patients if it is sugar-free (Anderson *et al.*, 2009) and those seeking to reduce cholesterol or lose weight (Borges *et al.*, 2008), due to its content of carbohydrate (Alegría-Torán and Farré- Rovira, 2003). This is evident in this study as the sample was prepared without sugar. However, the crude protein, crude fibre and ash content of the milk were found to be low when compared with the composition of tiger nut seeds documented by Oladele and Aina (2007). From the results of this study, it was observed that the microbial counts were above the limit of acceptance, which shows that the beverage was not suitable for consumption after the first few days of storage. And this goes in line with the findings of Abaejoh *et al.* (2006) who indicated that the deterioration effect of microorganisms on tiger nut beverage drink hampered its production in Nigeria. The reduction in the pH from 5.5 at zero hour to 3.2 at 18 hours depicts an elevated level of acidity. This is similar to the findings of Ibrahim *et al.* (2016) of pH 3.05 to 4.36). Also, Efiuvwevwere and Akoma (1995) reported pH of 3.2 for tiger nut milk; Akoma *et al.* (2006) reported a pH range of 3.32 to 4.15 also for tiger nut milk. Musa and Hamza (2013) reported pH range of 3.5 to 4.5 for tiger nut milk consumed by students of Kaduna state University. This type of acidity is called biological acidity and may be as a result of the growth of microorganisms as pH reduces (James, 2000). In contrast, the only bacterial count reported was at zero hour, and no growth was observed for the 18 hours following preparation. Increase in acidity has however been associated with increased fermentation which invariably leads to spoilage.

Conclusion

Tiger nut milk is a nutritious beverage with high moisture content but low crude fibre, crude protein, crude fat and ash content. The milk had high microbial load and its acidity which facilitates spoilage as the storage hours' increases. It is recommended that, good hygiene must be ensured while preparing the beverage so as to avoid cross-contamination that can increase the beverage microbial load.

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