Original Research Article

Quality Changes During Storage of *Burkina* (a millet and milk-based) Drink

Abstract

Burkina, a drink prepared from millet and milk, is gaining economic attention in Ghana due to its perceived nutritious nature and high energy content. The drink which is produced on a small-scale is usually vended without proper control of storage conditions leading to rapid loss of quality. The objective of this study was to investigate the effect of storing *burkina* at different temperatures (4 and 30 °C) on the microbial and physicochemical (pH, titratable acidity, brix and phenolic content) quality of the drink. The pH, titratable acidity, brix and phenolic content of freshly prepared *burkina* were 3.65, 0.49 %, 2.05 and 0.26 mg GAE/100 g, respectively. Although, changes were observed, storage temperature did not have a significant effect on the physicochemical quality of *burkina*. The initial load of aerobic mesophiles, lactic acid bacteria, *Enterobacteriaceae*, and yeast and moulds in the freshly prepared *burkina* were 6.45, 5.49, 2.58 and 4.45 log cfu/mL, respectively. Storage at the higher temperature resulted in an increased microbial load within 48 h, leading to faster spoilage, with only marginal increases observed at the lower storage temperature.

Keywords: Storage temperature, Microbial quality, Phenolic content, Brix

1. Introduction

Burkina (also called *brukina*) is a ready-to-eat drink prepared from millet, fermented (or unfermented) milk and water, with sugar or salt added to taste (1). The consumption of *burkina* is gaining attention and it is competing favourably with other similar ready-to-eat drinks such as mashed-kenkey (2). *Burkina* is considered a nutritionally rich drink due to the presence of milk. The drink can be used as a weaning food and a source of nutrient deficiency intervention (3).

The production of the drink takes place throughout Ghana on a small-scale. Indeed, reconstituted powdered milk is used in the production of *burkina* due to the perceived expensive nature of fresh cow milk (2). The drink is mainly sold on the streets without proper temperature control. Considering the increasing popularity of *burkina*, it is important to study the quality of the drink and how this change with time. The objective of this work was to study the effect of storage temperature on the physicochemical, nutritional and microbial quality of *burkina*. Freshly prepared *burkina* was stored at 4 and 30 °C and the changes in pH, brix, titratable acidity and phenolic content were determined. Additionally, changes in aerobic mesophiles, lactic acid bacteria, *Enterobacteriaceae*, and yeast and moulds, as well as the proximate composition of fresh *burkina* were analysed.

2. Materials and Methods

2.1 Sample collection and preparation

Freshly prepared *burkina* were obtained from six producers in Cape Coast, Ghana. The samples were stored in incubators at 4 and 30 °C. The moisture, protein, fat, and ash content of the fresh samples were determined based on the AOAC (4) method of proximate composition analyses.

Sampling was carried out periodically for the determination of pH, titratable acidity, brix, phenolic content and microbial quality.

2.2 Determination of pH, titratable acidity, brix and total phenolic content

For the determination of pH, titratable acidity and brix, 100 g of the drink was homogenized in a kitchen blender and centrifuged at 4000 rpm for 15 min. A pH meter (B10P Benchtop) and digital refractometer (MA871, Milwaukee Instruments USA) were used to determine the pH and brix of the supernatant. The supernatant (5 mL) was titrated against NaOH (0.1 N) using phenolphthalein indicator in the determination of titratable acidity (5).

Phenolic content of the samples was determined by homogenising 10 g of the drink with 100 mL of 80 % methanol solution. After centrifugation, 100 μL of the supernatant was pipetted and Folin-Ciocalteu's (750 μL) reagent added. The mixture was incubated for 3 h at 35 °C and the absorbance measured at 725 nm. Gallic acid was used as the standard (6).

2.3 Microbial Analysis

Microbial analysis was carried out by vigorously shaking the drink and homogenizing 10 g in 90 mL peptone water. The mixture was serially diluted and plated on plate count agar and de Man-Rogosa-Sharpe for the enumeration of aerobic mesophiles and lactic acid bacteria, respectively. Plating on Sabouraud Dextrose Agar and Violet Red Bile Glucose agar was used to determine the levels of yeast and moulds, and *Enterobacteriaceae*, respectively (6). All microbial media were purchased from Oxoid Ltd. (UK).

2.4 Statistical Analysis

Statistical analysis was carried out using SPSS (IBM, SPSS Statistics 20). The student's *t*-test and analysis of variance was used to determine significant differences at a p of *0.05*.

3. Results and Discussion

3.1 Proximate composition and physicochemical properties

The proximate composition of fresh *burkina* is shown in Table 1. The samples had an average moisture, protein and ash content of 70.25, 9.67 and 1.24 g/100 g, respectively. The high protein and carbohydrate content could be due to the use of milk and millet, respectively, in preparing the drink (2). The proximate composition of the *burkina* drinks used in this study is comparable to that observed in other studies. In *burkina* drinks vended in several parts of Accra, Ghana, moisture, protein and ash ranges of 80.76-82.40, 2.96-4.83 and 0.41-0.47 g/100 g, respectively was observed (3). Nyarko-Mensah (2) also observed moisture, protein and ash ranges of 75.42 - 86.29, 4.61 -7.91 and 3.11-4.91 g/100 g, respectively, in samples of *burkina*. The fat and carbohydrate content of the drinks was also within the range of 1.31-3.44 and 5-13 g/100g, respectively, observed by Tawiah (3) and Nyarko-Mensah (2). The high variability in the proximate composition, characterized by the high standard deviations, could be due to the non-standardized process of preparing the drink. This is mainly due to different producers preparing their drinks to meet the taste and demands of their consumers.

The average pH, titratable acidity, brix and phenolic content of fresh *burkina* were 3.65, 0.49 %, 2.05 and 0.26 mg GAE/100 g respectively (Table 2). The low pH and the high titratable acidity could be due to fermentation of the milk, prior to its use in preparing the drink. Also, through fermentation, lactic acid bacteria could have utilised soluble sugars resulting in the low brix of the drink. Storage temperatures did not have a significant effect on the pH of the drinks, although the pH decreased to 3.37 and 3.47 after 2 and 4 days of storage at 30 and 4 °C, respectively. Similarly, storage temperature did not have a significant effect on titratable acidity, brix and phenolic content.

3.2 Changes in microbial quality during storage

The changes in the microbial composition of *burkina* during storage is shown Table 3. The initial load of aerobic mesophiles, lactic acid bacteria, *Enterobacteriaceae*, and yeast and moulds were 6.45, 5.49, 2.58 and 4.45 log cfu/mL, respectively. At 30 °C storage, the levels of aerobic mesophiles and lactic acid bacteria increased to 8.25 and 6.72 log cfu/mL within 48 h, however, at 4 °C, aerobic mesophiles and lactic acid bacteria increased to only 7.15 and 5.86 log cfu/mL after 12 days of storage. The load of *Enterobacteriaceae*, and yeast and moulds also increased to 3.38 and 6.40 during storage at 30 °C, while marginal increases to 2.85 and 4.90 were observed during storage at 4 °C, respectively (Table 3).

The insignificant increase in both aerobic mesophiles and lactic acid bacteria could be due to their initial high levels in the freshly prepared drink. This high initial microbial load could also have resulted in the short storage life of the drink. Indeed, signs of spoilage such as changes in flavour and emission of odours can be detected within 36 h in street vended *burkina* drinks. However, when kept refrigerated the drink can last for up to two weeks (7). The high initial load of lactic acid bacteria could have been due to the use of previous drinks as starter culture for the production of new drinks. The presence of *Enterobacteriaceae* in the vended drinks is a public health concern and shows that these drinks might have been prepared under unacceptable conditions.

4. Conclusions

Burkina is high in carbohydrates and protein and can, therefore, be used an energy and protein source although the short storage life of the drink can limit its use and availability. Storage temperature did not affect the physicochemical properties (pH, titratable acidity, brix and phenolic content) of *burkina*, although, storage at a higher temperature accelerated microbial grow leading to faster spoilage.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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Tables

Table 1: Proximate composition of freshly prepared *burkina* samples.

Composition	Average content		
Moisture	78.68	±	7.28
Crude Protein	4.84	±	0.95
Ash	1.21	±	0.45
Crude Fat	3.01	±	0.70
Carbohydrate	12.27	±	7.17

Table 2: pH, titratable acidity (TTA), brix and phenolic content of *burkina* samples

Storage temperature	Incubation days	pH	TTA (%)	Brix	Phenolic Content (mg GAE/100 g)
30 °C	0	3.65 ± 0.18	0.49 ± 0.03	2.05 ± 0.26	0.26 ± 0.03
	0.5	3.51 ± 0.16	0.52 ± 0.04	2.05 ± 0.19	0.27 ± 0.01
	1	3.41 ± 0.18	0.54 ± 0.03	1.93 ± 0.34	0.31 ± 0.01
	1.5	3.37 ± 0.22	0.57 ± 0.03	1.95 ± 0.24	0.32 ± 0.01
	2	3.37 ± 0.21	0.58 ± 0.03	2.00 ± 0.28	0.33 ± 0.03
		±	±	±	±
4 °C	0	3.65 ± 0.18	0.49 ± 0.03	2.05 ± 0.26	0.26 ± 0.03
	2	3.64 ± 0.16	0.49 ± 0.04	2.03 ± 0.25	0.28 ± 0.04
	4	3.60 ± 0.16	0.51 ± 0.02	2.00 ± 0.26	0.29 ± 0.03
	6	3.54 ± 0.14	0.51 ± 0.02	1.90 ± 0.20	1.11 ± 1.60
	8	3.53 ± 0.10	0.52 ± 0.02	1.93 ± 0.26	0.32 ± 0.02
	10	3.49 ± 0.13	0.52 ± 0.03	1.93 ± 0.13	1.11 ± 1.53
	12	3.47 ± 0.13	0.52 ± 0.02	1.88 ± 0.28	0.35 ± 0.02

Table 3: Changes in the microbial load (log cfu/mL) of *burkina* during storage.

Storage temperature	Incubation days	Aerobic mesophiles	Lactic acid bacteria	*Enterobacteriaceae*	Yeast and moulds
30 °C	0	6.45 ± 0.79	5.50 ± 0.24	2.58 ± 0.59	4.45 ± 0.78
	0.5	7.33 ± 0.70	5.98 ± 0.36	2.80 ± 0.50	5.10 ± 1.12
	1	7.73 ± 0.67	6.52 ± 0.14	3.15 ± 0.45	5.83 ± 0.97
	1.5	7.68 ± 0.46	6.75 ± 0.12	3.40 ± 0.32	6.18 ± 0.69
	2	8.28 ± 0.30	6.73 ± 0.16	3.38 ± 0.26	6.40 ± 0.56
		±	±	±	±
4 °C	0	6.45 ± 0.79	5.50 ± 0.24	2.58 ± 0.59	4.45 ± 0.78
	2	6.75 ± 0.74	5.29 ± 0.51	2.58 ± 0.54	4.45 ± 0.73
	4	6.78 ± 0.72	5.69 ± 1.09	2.70 ± 0.50	4.53 ± 0.74
	6	6.83 ± 0.69	5.78 ± 1.03	2.80 ± 0.38	4.55 ± 0.72
	8	6.90 ± 0.84	5.79 ± 1.13	2.83 ± 0.46	4.75 ± 0.70
	10	6.90 ± 0.54	5.75 ± 0.92	2.85 ± 0.33	4.80 ± 0.68
	12	7.15 ± 0.91	5.88 ± 1.08	3.00 ± 0.48	4.90 ± 0.71