THE EFFECT OF CINNAMON POWDER ON THE SHELF LIFE AND QUALITY ATTRIBUTES OF ZOBO DRINKS

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Abstract
Zobo is a highly acceptable beverage in West Africa with limited shelf life. This study determined the sensory and microbial attributes of Zobo drinks in storage when blended with cinnamon, a natural preservative. A Completely Randomized Design of six treatments (C0, C1, C1.5, C2, C2.5 and C3) was used, wherein the cinnamon content was varied, from 0 to 3g per 200 ml zobo drink. The pH, sensory properties, and Total Viable Count (cfu/ml) of the Zobo samples during a seven-day storage were monitored. The results revealed that pH of sample decreased with higher cinnamon content and days of storage, while the control sample increased in pH with storage. The taste scores of the zero cinnamon control was highest on the day of production, but decreased considerably with storage. The C3 (highest cinnamon level) sample was however highest in aroma, taste and general acceptability for the seven storage days. The C3 zobo sample inhibited microbial growth most throughout the days of zobo storage. It was concluded that cinnamon is a potent additive and preservative that improved the sensory properties and increased the shelf life by inhibiting microbial spoilage of zobo drink. The use of cinnamon additive at 3 g for every 200 ml of zobo drink is thus recommended.

Keywords: Sensory value, Total Viable Count, acidity, microbial spoilage.

Introduction
Zobo, a highly flavoured beaverage, is a water extract of *Hibiscus sabdariffa* (Adelekan, 2014). It is widely consumed in west Africa for its considered ability to quench thirst in humid tropical regions. Zobo is traditionally blended with spices, additives and natural preservatives, including ginger, garlic, pineapple or alligator pepper. Adesokan *et al*. (2013) reported the potency and effectiveness of ginger and garlic in improving quality of zobo drink. Ezearigo *et al*. (2014) reported the use of ginger, garlic, nutmeg and cinnamon to improve the shelf life of zobo and reported that the natural spices are more effective than refrigeration in delaying the microbial deterioration of zobo. Obi (2015) compared the shelf life and sensory acceptability of zobo with the use of ginger (*Zingiber officinale*), African nutmeg (*Monodora myristica*), cloves *(Syzygium aromaticum)*, *uziza* (*Piper guineense*), *udah* (*Xylopia aethiopica*), and *ehu* (*Piper guineense*) and reported that *Monodora myristica* had the highest preservative effect showing no visible growth after 48 hours while *Xylopia aethiopica* sample had the highest microbial count indicating the least preservative effect. There is dire need to improve the shelf life and preserve the essential nutrients present in the Zobo drink by use of an effective natural preservative. A very potent antimicrobial spice is Cinamon. Cinnamon is a spice obtained from wild trees of the genus *cinnamomum* which is native to the Caribbean, South America and Southeast Asia. Cinnamon is an affordable spice with a strong inhibitory effect and is used as an additive, flavouring and food preservative (Zaika, 1988). The flavour and preservative qualities of this spice makes it very useful in the kitchen (Shumaila and Mahpara 2009). Earlier studies reported the high energy and mineral contents of cinnamon. This study was designed to determine the physico

chemical, sensory and microbial properties of (pineapple flavoured) Zobo drink when blended with Cinnamon.

Table 1: Proximate and Mineral Composition of the Cinnamon

Nutrient	% Composition	Minerals	Amount in mg/g
Moisture	5.1	Iron	7.0
Ash	2.4	Zinc	2.6
Crude Protein	3.5	Calcium	83.8
Crude Fat	4.0	Phosphorus	42.4
Crude Fiber	33.0	Manganese	20.1
Nitrogen free extract	52.0	Magnesium	85.5
Energy	258 kcal/100g	Pottasium	134.7

Source: Shumaila and Mahpara (2009)

Materials and Methods

Materials: *Hibiscus sabdariffa* (zobo leaves), pineapples and clean bottles were purchased at Ipata market in Ilorin, cinnamon powder was obtained from Shoprite mall Ilorin, Kwara state, Nigeria and were packed and transported in a clean polythene bag to the laboratory.

Preparation of zobo drink: The zobo leaves were handpicked to remove debris. Quantity (400g) of the already cleaned calyces zobo leaves and the different concentrations of cinnamon powder (as in the Treatment Plan - Table1) were weighed using a weighing balance. The weighed zobo leaves was boiled with 2000 mls of water for 15 minutes (Oghiehor & Nwafor, 2004) and was left to cool for 15 minutes before removing the calyces using a fine sieve and left to stand. Two medium sized pineapples were properly washed, peeled and chopped into small bits with a clean stainless knife. The chopped pineapple was blended in a blender with stainless steel blades until juice and pulp were obtained. The juice was filtered using a clean sieve and the resulting extract was stored in a clean bottle (Adelekan *et al*., 2014).

Cinnamon Treatments: The weighed cinnamon powder (0,1, 1.5, 2, 2.5 and 3g) were poured into their respective labeled bottles, 200ml of the cooled Zobo juice and 50ml of pineapple extract was added to each bottle. The mixture was properly mixed to ensure a uniform juice and the blends were made into different treatments as described in the Treatment Plan.

Table 2: Treatment Plan

Treatment	**Samples**	**Zobo drink (ml)**	**Pineapple extract (ml)**	**Cinnamon powder (g)**
1	C 0	200	50	-
2	C 1	200	50	1.0
3	C 1.5	200	50	1.5
4	C 2	200	50	2.0
5	C 2.5	200	50	2.5
6	C 3	200	50	3.0

KEY

C0 = zobo sample with no cinnamon (control) C1 = zobo sample with 1 g cinnamon
C1.5 = zobo sample with 1.5 g cinnamon C2 = zobo sample with 2 g cinnamon
C2.5 = zobo sample with 2.5 g cinnamon C 3 = zobo sample with 3 g cinnamon

pH Determination: pH was measured using a pH meter (model HANNA:HI 9812-5), the electrodes of which was inserted directly into 10 ml beaker containing the sample. The reading on the meter was then recorded as the pH of the sample (Adelekan *et al*., 2014).

Microbial Analysis: Total viable counts of the samples were determined using pour plate technique (Aboki, 2004). Approximately 1ml of the dilution was placed on nutrient agar plates. The plates were incubated at 37^0C for 24 hrs and recorded as colony forming unit per ml of sample (cfu/ml)**.**

Preparation of Culture Media: Nutrient agar of 28 g was weighed and dissolved in 1 liter of distilled water. It was shaken in order to mix properly and heated to dissolve the powder completely. After heating, the tip of the flask was plugged with cotton wool and wrapped with Aluminum foil. The medium was then sterilized in the autoclave at 121^0C for 15 minutes and then allowed to cool to about 45^0C before pouring aseptically into petri-dishes.

Innoculation: 1ml of the zobo sample was pipetted aseptically into 9 ml of sterile distilled water in a test-tube and a serial dilution was used by pipetting 1ml of the dilution into 9 ml of sterile distilled water; dilution was prepared up to 10^{-3} dilutions. The 10^{-3} portion was plated by transferring 1 ml of the dilution into a separate petri-dish (in duplicate) and sterile molten nutrient agar was added and mixed by swirling the plate before allowing to solidify (Bridson, 1998). The plates were incubated at 37^0C for 24 hours and were examined for growth of colonies, counted and recorded.

Sensory Evaluation: The blended Zobo samples were evaluated for the sensory quality by using a 30 member panel that are familiar with the product. The panel comprises of students of the University of Ilorin. The samples were scored based on a 9-point Hedonic scale where 1 represents dislike extremely and 9 represents like extremely (Larmond, 1977; Badmos *et al*., 2014). The sensory quality was carried out on the appearance, aroma, taste, mouth feel and general acceptability. Analysis of Variance (ANOVA) was performed to the data gathered to determine the acceptability to the consumer. Panelist were served different bottles containing coded zobo juice, served at room temperature and the panelists were provided with water for mouth rinsing after each test.

Statistical Analysis: Analysis of Variance (ANOVA) was carried out for the pH and sensory quality attributes. The mean scores were computed and significant difference among the mean was determined (Duncan, $p \leq 0.05$) using Statistical Package for Social Sciences (SPSS) Version 16.0 (SPSS Inc., Chicago, IL USA). The microbial count was illustrated using the line chart.

Results and Discussion

pH of samples: The pH values of the various zobo samples stored for seven days at ambient temperature are shown in Table 2. The values ranged from 2.3 to 3.2 at the last day of storage. The pH values obtained was in agreement with the work of Fasoyiro *et al*. (2005) who revealed that the pH of fruit flavoured zobo drinks had a low pH value which ranged between pH 2.19 and 3.62. The low pH of zobo drink is apparently due to the content of organic acids (Wong *et al*., 2002) as well as the fermentation process. The pH of sample decreased with higher cinnamon content, and this trend was generally observed for all the days of storage. The cinnamon treated zobo samples decreased in pH throughout the days of storage while the control sample increased in pH. The low pH value agrees with the observation of Olayemi *et al.* (2011) who reported that the pH of Zobo drinks was low due

to the high acidity noticed in Zobo drink while the similar study by Ajala *et al.* (2015) reported a pH of 3.62. The pH value implies that the sample belongs to the class of foods referred to as high acid foods (Frazier and Westhoff, 1998) and thus has a better keeping quality. Wong *et al.* (2002) reported that the low pH of Zobo drinks is due to its originating from a naturally acidic fruit that is rich in organic acids including oxalic, malic, tartaric and succinic acids. Adelekan *et al.* (2014), in a similar study reported that the pH of the *Zobo* samples blended with ginger and garlic are higher than that of the *zobo* juice which contain no extract. This implies that Z*obo* juice is slightly acidic, as confirmed by the findings of this study.

Sensory Properties: The sensory properties of the samples during storage are as presented in Tables 3 and 4. Few hours after production, the taste (Table 3) of the control sample was most preferred, possibly because it carries the original taste of the drink, and panelists were apparently not familiar with the cinnamon flavour in zobo. Bitnes *et al.* (2007) earlier affirmed the importance of familiarity of panelists to product category in sensory analysis. The taste scores decreased considerably with storage, particularly for the control (zero cinnamon) sample. This might be due to breakdown of constituent protein, and denaturing of aromatic amino acids. In a related study by Paliyath *et al.* (2008), taste panels indicated that the taste score of untreated control drink gradually and significantly decreased in sensory scores during the storage period. This trend was equally observed in this study, and the poor taste of control zobo sample as storage progress makes cumulative taste (of seven days) scores to be low. This could also explain why sensory qualities were high for the high cinnamon containing samples. The addition of cinnamom minerals in the high cinnamon containing samples could also be responsible for the improved taste. Table 4 shows that the C1.5 and C2 samples were adjudged to have most acceptable appearance in this work. This apparently is due to moderate amount of pigments being contributed to zobo drink by the cinnamon additive. The average aroma, taste and general acceptability (for the seven storage days) were highest in this study for the C3 sample. This report is similar to that of Adelekan *et al*. (2014) where fruit additive and enrichment significantly increased sensory characteristics of the Zobo samples such as appearance, taste and overall acceptability.

Microbial count: The result of the treated zobo drink samples with different concentrations of cinnamon powder are shown in Fig. 1. The result revealed that the Total Viable Count of all the zobo samples were below 20 cfu/ml on day 1 (of zobo production) but microbial count increased appreciably on days 3, 5 and 7, with the low-level cinnamon samples having higher TVC. The Total Viable Count of control sample rose from 2 $x10^4$ cfu/ml and 1.83 x 10^5 cfu/ml at day1 and day 7 respectively while for the 3g cinnamon treatment (C3) no growth was observed between day 1 and day 5 while a minimal growth was observed at day 7 (4 x 10^3 cfu/ml). The observation of lack of microbial growth on days 3 and 5 (for C3) might be due to death rate of microbes being almost equal to the rate of multiplication. The highest cinnamon containing zobo sample inhibited microbial growth most and this is likely as a result of the antimicrobial properties (phytochemicals) of cinnamon. The antimicrobial properties of cinnamon has been severally documented. Mith *et al.* (2014) attributed the antimicrobial activity of cinnamon to the main bioactive constituents, particularly cinnamaldehyde. The active components of these essential oils are potential natural preservatives to effectively retard or inhibit the growth of pathogenic and spoilage bacteria and to enhance food shelf life. Nabavi *et al.* (2015) reported that the antibacterial properties of cinnamon is due to bioactive phytochemicals including eugenol and cinnamaldehyde.

The works of Adesokan *et al*. (2013) revealed that natural preservatives were able to extend the shelf life of zobo drink for seven day with a total viable count of 2.6 x 10^4 cfu/ml at day 7 of storage. This is confirmed by the findings of this study.

Conclusion and Recommendation

The use of cinnamon as an additive to Zobo drink appreciably reduced the pH of the drink, and also reduced microbial spoilage, thereby increasing its shelf life. The use of cinnamon also preserved the sensory attributes of the zobo drink in terms of aroma, taste and general acceptability. Three 3 g cinnamon additive per every 200 ml of Zobo is hereby recommended to increase the shelf life and quality attributes of the Zobo drink.

Appendix

Table 3: p3 values of Zobo treated drinks on storage days

Treatment	Day 1	Day 3	Day 5	Day 7
C 0	2.63^{a}	2.84^{a}	3.14^{a}	3.20^{a}
C 1	2.63^{a}	2.63^{b}	2.62^{b}	2.59^{b}
C 1.5	2.62^{ab}	2.61^{c}	2.59^{b}	2.54^{c}
C 2	2.60^{ab}	2.59^{d}	2.55^{c}	2.50^{d}
C 2.5	2.60^{ab}	2.57^{e}	2.45^{d}	2.42^{e}
C 3	2.59^{b}	2.40^{f}	2.34^{c}	2.30^{f}

NOTE. *Abc*: means followed by different superscripts along the column are significantly different

Table 4: Taste Scores of Sample in Selected Days during Storage

Treatment	Day 1	Day 3	Day 5	Day 7
C 0	6.40^{a}	5.90^{a}	1.50^{f}	1.70^{f}
C 1	6.10^{b}	4.80^{c}	2.90^{d}	2.90^{d}
C 1.5	6.00^{b}	5.40^{b}	2.20^{e}	2.20^{e}
C 2	5.30^{c}	5.50^{b}	3.00^{c}	3.30^{b}
C 2.5	5.50^{c}	6.10^{a}	4.10^{b}	3.10^{c}
C 3	5.50^{c}	6.00^{a}	5.00^{a}	4.00^{a}

Note: Abc: means followed by different superscripts along the column are significantly different

Table 5: Average Sensory values of Treated Zobo Drinks (7 Days abridged)

Treatment	Appearance	Aroma	Taste	Mouth-feel	General acceptability
C 0	6.13^{b}	4.20^{d}	3.88^{c}	4.88^{c}	4.61^{b}
C 1	6.00^{b}	4.33^{d}	4.18^{c}	5.98^{a}	4.43^{b}
C 1.5	6.80^{a}	3.78^{c}	3.95^{c}	5.15^{b}	4.10^{c}
C 2	6.63^{a}	5.23^{c}	4.28^{c}	5.30^{b}	4.50^{b}
C 2.5	5.98^{b}	6.80^{b}	4.70^{b}	5.88^{a}	6.35^{a}
C 3	6.20^{b}	7.48^{a}	5.13^{a}	5.20^{b}	6.40^{a}

Note: Abc: means followed by different superscripts along the column are significantly different

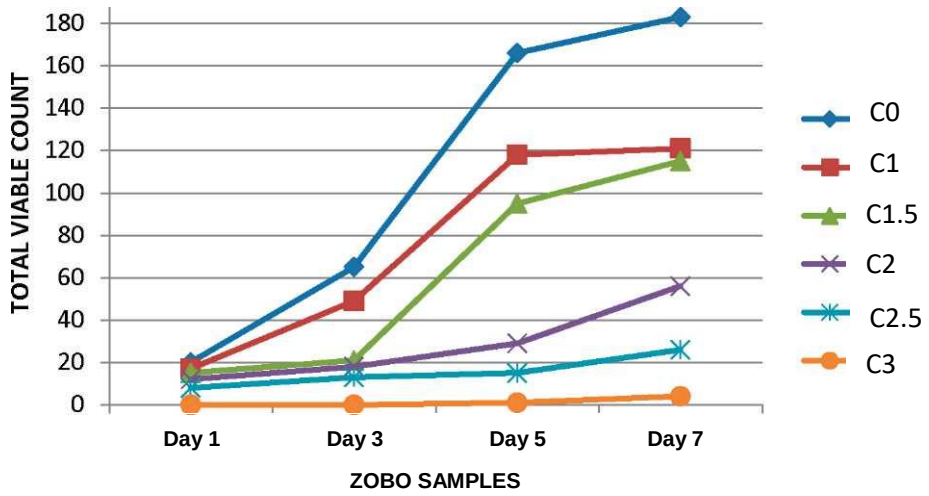

Figure1: Total Viable Count (TVC) of Zobo Samples in Storage (cfu/ml)

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