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THE EFFECT OF CINNAMON POWDER ON SOME NUTRITIVE ATTRIBUTES OF ZOBO (*HIBISCUS SABDARIFFA*) DRINKS

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ABSTRACT

Zobo, an extract of Hibiscus sabdariffa, is a highly nutritive and refreshing beverage, but is limited in production and use as its nutrients are denatured within a short period due to low shelf life. Many natural preservatives have been used to inhibit spoilage and preserve its nutrients. Cinnamon is a potent anti-oxidant, additive and preservative. This study was designed to determine the effect of blending with cinnamon on the nutritive value of zobo drink during a seven days storage period. Six graded levels of cinnamon addition (0, 1, 1.5, 2, 2.5 and 3 g cinnamon per 200ml zobo) constituted the treatments in a Completely Randomized Design. The parameters studied include pH, Titratable Acidity, brix content, minerals, and Vitamin C. The results revealed that cinnamon contents decreased zobo drinks in pH and increased it in Titratable Acidity while in storage, the converse of which is true for the control. The brix content of all zobo treatments increased with storage, but the increase is marginal at higher cinnamon levels. Cinnamon content or storage did not give direct effect or trend to the mineral content of the treatments. Vitamin C content was significantly enhanced by increasing cinnamon content, but decreased with storage. The use of cinnamon (3g/200ml zobo) as an additive and preservative in zobo drink production is strongly recommended.

Keywords*: Additives, Preservatives, Acidity, Minerals, Vitamin, Treatments.*

1.0 INTRODUCTION

Zobo, a highly flavoured roselle drink, is a refreshing and non-alcoholic water extract of *Hibiscus sabdariffa* (Adesokan *et al*., 2013; Adelekan *et al.*,2014). This beverage is traditionally produced from dried petals (calyces) of the *H. sabdariffa* flower by boiling and filtration (Ogiehor *et al*., 2008; Kolawole and Okeniyi, 2007). It is traditionally blended with spices, additives and natural preservatives, including ginger, garlic, pineapple or alligator pepper. The beverage is consumed by several millions of people from different socio-economic classes and background in the West Africa sub-region, not only for the sweet-sour flavour, but for its richness in vitamins, natural carbohydrates, protein, antioxidants (Wong *et al*., 2002) and also minerals (Babalola *et al*., 2000). The short shelf life is however a great limitation to large scale production as Omemu et al. (2006) reported a short shelf life of 24 hours if not refrigerated. Natural preservatives that have been reportedly used effectively in increasing the shelf life include ginger, garlic, nutmeg and cinnamon (Adelekan *et al.*,2014; Ezearigo *et al*.,2014 and Adesokan *et al*. 2013). Cinnamon is an additive, natural preservative and spice with a strong inhibitory effect on spoilage (Zaika, 1988). This potent anti microbial additive and spice is obtainable from wild trees of the genus Cinnamomum *that is* native to the South America and Southeast Asia. This study sought to determine the effect of cinnamon blending on some nutritional qualities of stored (pineapple flavored) zobo drink.

2.0 MATERIALS AND METHODS

Materials: *Z*obo calyces (*Hibiscus sabdariffa)* and pineapples were purchased from Ipata market in Ilorin while cinnamon powder was obtained from Shoprite mall Ilorin, Nigeria. These materials were neatly packaged and conveyed to the laboratory.

Preparation of zobo drink: The zobo leaves were handpicked to remove dirt's and debris. Measure (400g) of the already cleaned calyces zobo leaves and the different concentrations of cinnamon powder (as in the Treatment Plan, below) were weighed using a weighing balance. The weighed zobo calyces was boiled with 2000mls of water for 15 minutes (Oghier and Nwafor, 2004) and was left to cool for 15 minutes before removing the calyces using a fine sieve and left to stand in a vessel. Two medium sized pineapples were properly washed, peeled and chopped into small bits with a clean stainless knife. The chopped pineapple was blended with a blender with stainless steel

blades until juice and pulp was 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 while 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 (below).

Chemical analyses: pH measurement, Titratable acidity (%), minerals (mg/100g) and the Vitamin C (mg/100g) content were determined according to standard methods (AOAC, 1990). The brix content (%) was determined with the hand refractometer, similar to the work of Bankole *et al.* (2013).

Statistical Analysis**:** Analysis of Variance (ANOVA) was carried out for the pH, brix, titratable acidity, and mineral content. The mean scores were computed and significant difference among the mean was determined (Duncan, 1955) using Statistical Package for Social Sciences, Version 16.0.

`Table 1: Treatment Plan.

`	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

3.0 RESULTS AND DISCUSSION

pH: The pH values of the various zobo samples stored for seven days at ambient temperature are shown in table 2. The pH values generally decreased with increasing levels of cinnamon content. The pH also decreased with the days of zobo drink storage, except for the no-cinnamon control. The lowest pH of 2.30 was recorded for the 7th day C3 zobo drink. The low pH value agrees with the observation of Olayemi *et al.* (2011) who reported similarly low pH of zobo drinks and is also in agreement with the works of Fasoyiro *et al*. (2005) who revealed that the pH of fruit flavoured zobo drinks had a low pH value which ranged between 2.19 and 3.62. The values were however at variance the works of Ajala *et al.* (2015) who reported a pH of 3.62. The differences might be due to processing methods, climate or temperature. Ajala *et al.* (2015) however observed a drop in the pH as storage days progressed, as similarly observed in this study. The pH values obtained implies that the zobo drink belongs to the class of foods referred to as high acid foods (Frazier and Westhoff, 1998) and thus has a good keeping quality.

Titratable Acidity: The percentage Titratable Acidity (TA) values of the samples (Table 3) increased with days of storage for all the treatments, with the C3 treatment increasing in TA from 0.39 to 0.61 between day 1 and day 7. TA conversely decreased with storage for the control. The higher cinnamon treatments had higher TA values. The increase in acidity of zobo is apparently due to an increase in the concentration of cinnamon powder present in the sample which indicates that there was an increase in titratable acidity of the samples during storage since it contains some organic acids like oxalic, malic tartaric and succinic (Wong *et al*., 2002). The high acidity shows that cinnamon will be able to increase the shelf-life of the drink. The increase observed is in agreement with the works of (Ashaye and Adeleke, 2009). This result also is in agreement with the work of Fasoyiro *et al.* (2005), where the presence of spices in zobo increased the TA values of the drink.

Brix Content: The initial brix value (at Day 1) was higher with increasing cinnamon content. The brix content of all the treatments decreased with the storage days, but the differences reduced with higher cinnamon content. The control sample decreased from 9.20

to 3.60 %, while the C3 treatment decreased from 9.33 to 8.85 %. The decrease in the brix content could be attributed to the increased titratable acidity in the drink. Bankole *et al.* (2013) reported brix content range of between 14.00 and 15.00 % for zobo drink fortified with kolanut extract under storage for 4 days. The zobo treatment without kolanut extract however reduced in brix content from 15.00 to 2.00 % during the 4 – day storage period. This corroborate the results of this study. Fasoyiro *et. al.* (2005) similarly reported that blank zobo drink had lower brix content (3.20%) than those fortified with apple juice, pineapple juice and orange juice (8.20, 9.22 and 11.21% respectively). This might explain the increase in brix content with higher cinnamon content in this study.

Mineral Content: The mineral content of the Zobo drink (mg/L) measured at beginning of the experiment (day 1) was not affected by the cinnamon content, as the variation in mineral content did not follow a particular trend. The results obtained for mineral composition of the zobo samples reported the presence of Calcium (Ca), Iron (Fe), Zinc (Zn), Pottasium (K) and sodium (Na) in all the samples, as also observed by Olayemi *et al*., (2011). The iron content of the treatments did not show significant variation. Earlier studies reported wide variations in zobo mineral content. The study of Adesokan *et al.* (2013) on zobo, blended with ginger and garlic reported that the range of values for potassium, sodium, zinc, iron and calcium were 2410 to 2673, 6.8 to 8.7, 7.7 to 12.5, 28.9 to 39.2, 1756 to 2100 mg/ 100ml zobo juice respectively. Olayemi *et al.* (2011) reported potassium, sodium, magnesium, iron and calcium value ranges in parts per million as: 219 to 235, 25.11 to 50.67, 5.75 to 7.88, 0.67 to 1.17, 2.0 to 4.0 ppm. The great variation between the values appears to be due to different fruit/spice blends used in zobo preparation as well as the units of measurement.

Vitamin C: The vitamin C content of zobo drink was higher on day 1 for the higher cinnamon content treatments. The range of Vitamin C of 39.11 and 20.44 mg/100g on day 1 is in agreement with the range of 34.32 and 21.33mg/100g reported by Bamisaye *et al.* (2011). The higher cinnamon content had appreciably supported higher vitamin C content of Zobo juice. Ezearigo et. al. (2014) recorded Vitamin C content of 38.4 mg/100g for zobo drink fortified with cinnamon and 42.02, 39.13, and 36.23 mg/100g for same drink fortified with garlic, nutmeg and ginger respectively. This agrees with the results of the present

study. Vitamin C content however decreased appreciably for all the treatments, as storage days progressed. The C3 treatment had 39.10mg of vitamin C in 100g zobo juice on day 1, but this decreased to 37.80 mg/100g on day 7 of storage. The trend is similar for all levels of cinnamon content. This is apparently due to progressive auto-oxidation of vitamin C and other nutrients of zobo as storage progressed.

4.0 CONCLUSION AND RECOMMENDATION

Stored zobo decreased in pH and increased in Titratable acidity with increasing levels of cinnamon addition, but the no-cinnamon control increased in pH and decreased in Titratable Acidity with storage. The brix content for all zobo treatments, with less differences at higher cinnamon levels. The differences in Mineral contents are wide, and does not follow an explainable pattern. Higher cinnamon levels of zobo had higher Vitamin C content, but Vitamin C content decreased with storage. This study strongly recommends the use of 3g cinnamon per 200ml zobo as an additive and preservative of zobo drink.

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Appendix:

Table 2: pH values of zobo drink treated with cinnamon powder

Sample	Day 1	Day 3	Day 5	Day 7
C0	2.63^{a}	2.84^{a}	3.14^{a}	3.20^{a}
C1	2.63^{a}	2.63^{b}	2.62^{b}	2.59^{b}
C1.5	2.62^{ab}	2.61^{bc}	2.59^{b}	2.54^{c}
C2	2.60^{ab}	2.59^{cd}	2.55^{c}	2.50^{c}
C2.5	2.60^{ab}	2.57^{d}	2.45^{d}	2.42^{e}
C3	2.59^{b}	2.40^{e}	2.34^{e}	2.30^{f}

Values with the same superscript on the same column are significantly different ($p \leq 0.05$)

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 C3 = zobo sample with 3 g cinnamon

Table 3: Titratable acidity (g/100ml) of the zobo drink treated with cinnamon powder

Samples	Day 1	Day 3	Day 5	Day 7
C0	0.28^{e}	0.24^{f}	0.16^{f}	0.11^{f}
C1	0.30^{d}	0.38^{e}	0.44^{e}	0.49^{e}
C1.5	0.35^{c}	0.40^{d}	0.49^{d}	0.50^{d}
C2	0.35^{c}	0.44^{c}	0.50^{c}	0.52^{c}
C2.5	0.37^{b}	0.48^{b}	0.54^{b}	0.56^{b}
C3	0.39^{a}	0.50^{a}	0.58^{a}	0.61^{a}

Values with the same superscript on the same column are significantly different ($p \leq 0.05$)

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 C3 = zobo sample with 3 g cinnamon

Table 4: Brix content (%) of the zobo drink treated with cinnamon powder

Sample	Day 1	Day 3	Day 5	Day 7
C0	9.20^{e}	8.47^{f}	6.50^{e}	3.60^{d}
C1	9.30^{d}	8.98^{e}	8.54^{d}	7.80^{c}
C1.5	9.32^{c}	9.19^{d}	8.93^{bc}	8.66^{b}
C2	9.33^{b}	9.23^{c}	8.89^{c}	8.84^{ab}
C2.5	9.33^{b}	9.26^{b}	9.10^{a}	8.85^{ab}
C3	9.34^{a}	9.27^{a}	9.15^{b}	8.92^{a}

Values with the same superscript on the same column are significantly different ($p \leq 0.05$)

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 C3 = zobo sample with 3 g cinnamon

TABLE 5: Mineral content of zobo drink treated with cinnamon powder (mg/100g)

Sample	K	Na	Zn	Fe	
C0	1.00^{a}	0.20^{b}	0.07^{c}	0.82	4.30^{a}
C1	1.10^{b}	0.10^{a}	0.03^{a}	0.80	4.80^{c}
C1.5	1.10^{b}	0.10^{a}	0.03^{a}	0.80	4.90d
C2	1.00^{a}	0.30c	0.08^{d}	0.81	4.50^{b}
C2.5	1.30^{c}	0.20^{b}	0.04^{b}	0.80	5.10^{e}
C3	1.00^{a}	0.10^{a}	0.04^{b}	0.80	4.30^{a}

Values with the same superscript on the same column are significantly different ($p \leq 0.05$)

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 C3 = zobo sample with 3 g cinnamon

Table 6: Vitamin C content (mg/100g) of zobo drink treated with cinnamon powder

Sample	Day 1	Day 3	Day 5	Day 7
C0	20.44^{f}	20.20^{f}	19.80^{f}	19.40^{f}
C1	25.30^{e}	25.12^{e}	24.80^{e}	24.50^{e}
C1.5	28.32^{d}	28.10^{d}	27.93^{d}	27.60^{d}
C2	30.30^{c}	30.30^{c}	30.10^{c}	30.00^{c}
C2.5	35.60^{b}	35.40^{b}	35.20^{b}	35.13^{b}
C3	39.10^{a}	39.00^{a}	38.00^{a}	37.80^{a}

Values with the same superscript on the same column are significantly different ($p \leq 0.05$)

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 C3 = zobo sample with 3 g cinnamon