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Analysis of quality attributes of *Hibiscus sabdariffa* (*zobo*) drinks blended with aqueous extract of ginger and garlic

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Various types of highly valued food and medicinal products are produced from *Hibiscus sabdariffa* in different parts of the world. In Nigeria, the calyces of this plant are processed into a refreshing non-alcoholic beverage known as *zobo*. In this work, *zobo* drink was prepared using hot water extraction method and the juice obtained was blended separately with aqueous extracts of ginger and garlic. Physico-chemical, microbiological and sensory properties of the various blends of *zobo* were investigated. The results of this study showed that the *zobo* samples contained different concentrations of ascorbic acid which ranged between 22.5 and 35.8 mg/100 g. The pH ranged between 3.94 and 7.67, while the total sugar was between 2.5 and 3.56 mg/100 g. The samples also contained varying concentrations of Mg^{2+}, K^{+}, Ca^{2+}, Fe^{2+}, Na^{+} and Zn^{2+}. The total viable counts of the samples during storage showed that the microbial loads increased steadily and ranged between 1.2×10^{3} and 3.7×10^{7} (CFU/ml). The samples containing ginger and garlic had the lowest microbial count of 2.7×10^{4} CFU/ml on the seventh day of storage, while the sample containing no extract had the highest microbial load of 3.7×10^{7} CFU/ml within the same period of time. The sensory attributes of *zobo* beverage degenerate during the seven days of storage. However, the samples containing ginger and/or garlic were better rated in terms of the parameter tested. The results of this study indicate that incorporation of ginger and garlic extracts into *zobo* drink could be an effective means of improving quality attributes of this drink.

Key words: *Hibiscus sabdariffa*, sensory properties, zobo drink, microbial count.

INTRODUCTION

Hibiscus sabdarffa belongs to the super order Malvaceae and it is believed to originate from East Africa (Ilondu and Iloh, 2007). *H. sabdariffa* plants are cultivated and consumed as vegetable and tea, whereas other *Hibiscus* varieties are planted for the fibres they produce. It is called different names like Roselle and Sorrel in English and it is locally called *zobo* and *Isapa* in Nigeria (Adebayo-Taye and Samuel, 2000).

Many parts of Roselle including seeds, leaves, fruits and roots, are used in various foods. Among them, the fleshy red calyces are the most popular (Yadeng et al., 2005). Roselle is used in many folk medicines. In Nigeria, the dry red calyces are processed into a refreshing non-alcoholic beverage known as *zobo*. Despite the fact that the popularity of *zobo* juice is increasing, one of its greatest limitation for large scale production is that it has a very short shelf life of 24 h if not refrigerated (Omemu et al., 2006). Therefore, there is urgent need to explore various preservation methods that could be employed to extend the shelf life of this product.

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Dougheri et al. (2007) employed some chemical preservatives to improve the shelf life of *zobo* drink. They reported that only samples treated with benzoic acid remained organoleptically attractive after 14 days of storage. However, the problem with the use of chemical preservatives in food is that they tend to have adverse effects on the health of consumers (Adesokan et al., 2010). Therefore, naturally occurring plant extracts with proven antimicrobial properties will be preferred in food preservation (Kolapo et al., 2007). The use of natural preservatives has become more popular as compared to synthetic antimicrobials and antioxidants (Aliu et al., 2007).

Ginger (*Zingiber officinale*) and garlic (*Allium sativum*) are two plants traditionally used as spices in food preparation but have been demonstrated to have both antioxidant and antimicrobial activities (Kolapo et al., 2007). Therefore, the objective of this present study was to evaluate the physico-chemical and microbiological qualities of *zobo* drinks blended with ginger and garlic extracts.

MATERIALS AND METHODS

Collection of samples

Dry calyces of *H. sabdariffa* and fresh wet form of ginger rhizomes and garlic bulbs were obtained from local Bodija market in Ibadan, Nigeria. The samples were manually cleaned by handpicking stones and other unwanted debris. The samples were then thoroughly washed separately using sterile de-ionized water and allowed to air dry under the sun (40°C).

Preparation of ginger and garlic extracts

One hundred grams of each of the spices were separately chopped into small pieces with a clean stainless steel knife. The chopped spices were then blended into 50 ml de-ionized water with a Kenwood blender having stainless steel blades until smooth pastes were obtained. The pastes were diluted further with 100 ml de-ionized water and filtered using a clean Muslin cloth. The resulting extracts were stored in clean bottles inside a refrigerator (5°C) until needed for use in *zobo* preparation.

Preparation of *zobo* drinks

For hot extraction, 175 g of already cleaned calyces of *H. sabdariffa* was added to 300 ml hot boiling water and was left to stand for 15 min. The hot, red-coloured aqueous extract was filtered with the white muslin cloth into a plastic bowl and tightly covered. The resulting *zobo* juice was separately blended with ginger, garlic, ginger/garlic mixtures at different concentration of 2.50 and 10%. The unblended *zobo* juice served as control.

Physico-chemical analysis

The pH of the *zobo* samples was measured by using a standardized pH meter (Micron pH meter). Appropriate procedure of A.O.A.C. (1990) was used to determine the metallic ion contents. Flame photometry was used to determined sodium, potassium and iron and Buck scientific atomic absorption spectrophotometer (model 200A) was used to determine calcium, magnesium and zinc. Crude protein and total sugar content was also estimated (A.O.A.C., 1990).

Microbiological analysis

The various *zobo* drink samples were serially diluted in sterile distilled water and appropriate dilutions were plated on nutrient agar, potato dextrose agar (PDA) and MacConkey agar for total viable, fungal and coliform counts, respectively. The nutrient and MacConkey agar plates were incubated at 35°C for 24 h, while the PDA were incubated at 28°C for 72 h and were supplemented with streptomycin to inhibit the growth of bacteria (Adesokan, 2005).

Sensory analysis

The blended *zobo* samples were analyzed by a 10 member panel that are familiar with the product which comprises of the students of the Polytechnic, Ibadan. The samples were scored based on a nine point hedonic scale where 1 equals extremely like and 9 equals extremely dislike. The data obtained were subjected to analysis of variance (ANOVA) and the means were separated by Duncan multiple range test (Kolapo et al., 2007).

RESULTS

The physico-chemical analyses of the various blends of *zobo* beverages are presented in Table 1. The result showed that the ascorbic acid content (mg/100 g) increased gradually and its values ranged between 22.5 in pure z*obo* juice (Sample A) and 35.8 in *zobo*/ginger/garlic mixture (Sample D). The pH values increased steadily and ranged between 3.94 in sample A and 7.67 in sample D. The total sugar also ranged between 2.5 and 3.56% in sample D. The result also indicated that the *zobo* samples blended with spices had higher crude protein contents than non-spiced *zobo* beverage and it values ranged between 9.1 (Sample A) and 62% (Sample D).

The various blends of *zobo* drink contained varying concentrations of Mg^{2+}, K^{+}, Ca^{2+}, Fe^{2+}, Na^{+} and Zn^{2+}. Another finding of this study is that the *zobo* beverages extracted with hot water had higher amount of nutrients than the sample extracted with cold water (result not shown).

The total viable counts (TVC) (cfu/ml) of the z*obo* samples are presented in Table 2. This result showed that there was a progressive increase in TVC with storage time. However, the *zobo* samples containing ginger or garlic had lower ($P \leq 0.05$) TVC than *zobo* samples containing no spice. Sample A had the highest count of 3.7×10^{7} cfu/ml, while sample D had the lowest count of 2.6×10^{4} cfu/ml by the seventh day of storage. The organoleptic properties of the beverages are presented in Table 3 and the result indicated that sample D had the highest overall acceptability of 2.3, while sample A had the lowest value of 1.9.

Table 1. Physico-chemical properties of different blends of *zobo* drink.

Parameter	Sample A*	Sample B	Sample C	Sample D
Ascorbic acid (mg/100 g)	22.5**	25.0	23.5	35.8
pH	3.94	6.63	7.05	7.67
Total sugar (mg/100 ml)	2.5	3.2	2.95	3.56
Crude protein (%)	9.1	57	40	62
Mg^{2+} (mg/100 ml)	243	276	203	225
K^{+} (mg/10 0ml)	2410	2615	2673	2450
Ca^{2+} (mg/100 ml)	1756	2100	1905	1895
Fe^{2+} (mg/100 ml)	39.2	32.1	28.9	35.3
Na^{+} (mg/100 ml)	7.2	6.8	8.7	6.9
Zn^{2+} (mg/100 ml)	7.7	12.5	9.5	11.2

*Sample A, Unspiced *zobo* beverage; sample B, *zobo* with ginger; sample C, *zobo* with garlic; sample D, *zobo* with ginger and garlic. **Values are means of three determinations.

Table 2. Total viable counts (cfu/ml) of the different *zobo* blends during storage.

Samples	Day 1	Day 4	Day 7
Sample A*	$2.6x10^{4**}$	$3.5x10^{5}$	$3.7x10^{7}$
Sample B	$3.0x10^{3}$	$3.7x10^{3}$	$5.5x10^{6}$
Sample C	$1.5x10^{3}$	$1.9x10^{3}$	$2.5x10^{5}$
Sample D	$1.2x10^{3}$	$1.3x10^{3}$	$2.6x10^{4}$

*Sample codes are as stated in Table 1; **values are means of three replicates.

Table 3. Sensory evaluation of different blends of *zobo* drink.

Sample	Appearance		Taste		Texture		Colour		Aroma		Overall acceptability	
	D1	D7	D1	D7	D1	D7	D1	D7	D1	D7	D1	D7
Sample A	5.0*	2.3	4.5	2.5	4.5	1.0	5.2	2.2	5.3	1.5	4.9	1.9
Sample B	5.0	2.1	5.5	2.6	4.4	1.4	5.0	2.4	5.7	2.1	5.12	2.12
Sample C	5.0	2.4	3.3	1.3	4.3	2.3	4.9	2.6	3.1	1.9	4.1	2.1
Sample D	5.0	2.6	4.2	2.2	4.1	2.1	4.7	2.9	3.4	1.7	4.3	2.3

*Values are means of three replicates.

DISCUSSION

This work demonstrated that the ascorbic acid contents of z*obo* drinks supplemented with garlic and ginger are higher than that of ordinary z*obo* juice. This means that the vitamin C status of z*obo* beverages can thus be improved by blending with these spices. Babalola et al. (2001) reported the presence of ascorbic acid in various varieties of *H. sabdariffa*. 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 and should not be consumed without snack or on an empty stomach. A recent study revealed that the pH of the fruit flavoured *zobo* drinks had a low value which ranged between pH 2.19 and 3.62 (Fasoyiro et al., 2005).

The crude protein content of non-spiced *zobo* juice was 9.1% but higher values were obtained for the samples containing spices. This means that the spices are rich in protein. The crude protein value is similar to the one obtained by Olayemi et al. (2011). The *zobo* drinks evaluated in this work contained various metallic ions like Mg^{2+}, K^{+}, Ca^{2+}, Fe^{2+}, Na^{+} and Zn^{2+}. Olayemi et al. (2011) also reported various concentrations of these metallic ions in three different varieties of *zobo* subjected to the same preparation condition. In addition to this Builder et

al. (2010), reported the presence of certain phytochemicals like alkaloids, saponin, tannin, phenols, sterols, etc.

The spices used in this study were able to reduce the microbial loads of *zobo* samples during the seven days storage. However, Ogiehor et al. (2008) extended the shelf life of *zobo* for 42 days using 0.2% ginger extract and refrigeration. This method of storage under refrigeration is not practicable in present day Nigeria because of epileptic public power supply and the use of power generators is not economical. The sensory attributes of the *zobo* samples containing spices were also enhanced. The use of extracts of ginger and garlic in *zobo* preparation should therefore be encouraged as the sensory properties and shelf life of resulting product will be enhanced.

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