

## Studies on Optimal Conditions for the Preservation of 'Zobo' Drink

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### ABSTRACT

The study was carried out to determine the combination of preservation techniques (hurdles) that can best extend the shelf life of Zobo drink. Zobo drink was prepared from the calyx of *Hibiscus sabdariffa*. Two types of spices - *Zingiber officinale* (ginger) and *Caryophyllus* aromatics (cloves) were prepared and added in the following proportions 150g: 20g; 150g:10g; 100g:20g; and 100g:10g respectively, to 400ml of zobo drink. Samples of the drink were pasteurized at two different temperatures 167°C for 5min and 72°C for 6 min. All the samples were stored at ambient temperature ( $30 \pm 2^\circ\text{C}$ ) for 9 days. Microbial analysis was performed on the samples every 2 days. The various combinations of the spices alone could not preserve the drink beyond 2 days, but, when coupled with pasteurization, the shelf life was extended. A combination of ginger (150g) and cloves (20g) was found to be more effective, and when in conjunction with pasteurization, kept the drink in sterile condition for 3 days, and extended the shelf life to 5 days.

**Keywords---** Antimicrobial activity, hurdles, pasteurization, spices, volatile oils, shelf life.

### I. INTRODUCTION

Sorrel drink, popularly called 'Zobo', is a non-alcoholic beverage prepared by boiling the calyx of *Hibiscus sabdariffa*. The beverage has gained wide acceptance and popularity in Nigeria. There is increase in the demand for zobo drinks due to its low prices, nutritional and medicinal properties (Oboh and Elusiyon, 2004; Osueke and Ehirim, 2004). While some drinks contain artificial colouring and flavourings, zobo is unique, in the sense that it contains natural colouring, and may be taken with or without the addition of a flavouring agent. Zobo may have some antimicrobial quality (Obadina and Oyewale 2007; Ilondu: and Iloh, 2007, and hence its therapeutic action.

Zobo drink has natural anti-oxidant properties, rich in vitamins (wong *et al.*, 2002), sugar (Akanya *et al.*, 1998), and minerals (Babalola *et al.*, 2000). The calyces can be used to produce herbal tea and other food products (Akanya, 1997).

However, the drink is known to be easily susceptible to microbial spoilage. This constitutes a major drawback on its large scale production and marketability. The need thus arises to standardize its production to give quality product, compact package, and adequate shelf life (Olawale, 2009). The preservation of zobo drink has formed the subject of many researches (Ilondu and Iloh, 2007; Olawale, 2009; Ekwuru and Uzodinma, 2010; Nwachukwu *et al.*, 2007).

Heat sterilization, pasteurization, carbonation and chemical sterilization, such as the addition of sodium benzoate are commonly used to preserve or retard microbial spoilage of drinks, juices, and other food products. Apart from flavour and aroma, spices have been known for their antimicrobial qualities (Domans and Deans, 2000; Radhakrishnan and Velusamy, 2005; Ijeh *et al.*, 2005). The volatile oils are responsible for the aroma and taste of most spices, and by extension, their preservative effect. The preservative from garlic oil has been identified to inhibit the growth of both gram-positive and gram-negative bacteria. Cinamon and cloves contain 95% eugenol of the essential oil fraction, and is inhibitory to mould growth (Paster *et al.*, 1995).

The term 'Hurdle Technology' preservation has been derived from the use of combination of preservation techniques (hurdles) that any microorganism present will not be able to overcome. This method has become popular because the hurdles are used at low concentrations which do not have effect on taste, while maintaining the stability and safety of the food. Hurdle for preservation include temperature (low and high), pH (low and high), water activity, redox potentials addition of antimicrobials among others (Leistner, 1994). Hurdle technology approach has been used to preserve peach,

pineapple and banana puree using slight reduction in water activity, low pH and addition of antimicrobials (David and Shibamoto, 2006). Fresh Okra has been successfully stored using hurdles comprising two spices and mild heat. This present study investigated the effect of a combination of two spices and mild heat application on the shelf life of zobo drink

## II. MATERIALS AND METHOD

Dry calyces of *Hibiscus sabdariffa*, *Zingiber officinale* (ginger) and *Caryophyllus aromatics* (cloves) were purchased from a local market in Owerri, Imo State, Nigeria. After sorting to remove dirt and other extraneous materials, they were washed with cold water. The spices were ground using a local attrition mill.

## III. PREPARATION OF ZOBO DRINK

150g of the cleaned calyces were put in 400ml of water, and boiled with the spices (at different proportions) at 100°C for 20 minutes. The ginger and cloves were varied in the following proportions; 150g: 20g, 150g : 10g, 100g: 20g , 100g:10g respectively. 1500ml of pineapple juice was added to the extract and allowed to boil further for 10 minutes. Thereafter, the drink was filtered with the aid of a muslin cloth, 150g of granulated sugar added, and allowed to cool. Then, dispensed into sterile 20ml bottles and covered. The flow chart for the production of zobo drink is presented in Figure 1.

The drink samples were subjected to two different pasteurization treatments (67°C for 5 min, 72°C for 6 min), stored at ambient conditions (30°C ± 2°C) for 9 days. Samples were investigated every other day for microbial spoilage.

## IV. ANALYSIS

Microbial count was determined according to standard methods (Collins and Lyne, 1979). 1ml of sample was poured on plate count agar and incubated overnight at 37°C, the plates were examined for the presence of bacteria colonies.

## V. RESULTS AND DISCUSSION

The spices composition of the samples is presented in Table 1, while the results of the microbial analysis of the unpasteurized zobo drink samples (control) and the samples pasteurized at 67°C and 72°C are presented in Tables 2 - 4 respectively. Microbial growth was generally not observed for all the samples after production of the drink, and up to the first day of storage at ambient condition, except unpasteurized sample A. The taste of all the unpasteurized samples changed after the 2<sup>nd</sup>

day, and after the 3<sup>rd</sup> day, they were no longer fit for consumption. Visible spoilage was observed on the 8<sup>th</sup> day of storage.

All the samples pasteurized at 67°C (Table 3) recorded bacteria growth on the 3<sup>rd</sup> day of storage except sample A. This could be attributed to high spice concentration. There are evidences of increased antimicrobial activity associated with high spice concentration (Domans and Deans, 2000; Sangdic *et al.*, 2003; Ilondu and Iloh, 2009). However, sample A recorded bacteria growth on the 5<sup>th</sup> day, which increased progressively to the 9<sup>th</sup> day, with bacteria counts ranging from 170 – 300 cfu/mL. On the other hand, sample B had the highest bacteria count (50 cfu/mL) on the 3<sup>rd</sup> day. Thereafter, the count decreased gradually to 5 cfu/ml on the 9<sup>th</sup> day. This is a pointer to the fact that the preservative combination for sample B is more effective with length of storage.

Sample C recorded a bacteria count of 29 cfu/mL on the 3<sup>rd</sup> day, which is relatively lower than that recorded by sample B, but exhibited a gradual increase (like sample A) to 150 cfu/mL on the 9<sup>th</sup> day. This implies that the antimicrobial activity of the spices combination for samples A and C started dropping gradually after the 3<sup>rd</sup> day of storage. However, sample D generally exhibited lower bacteria load ranging from 10 – 25 cfu/mL relative to samples A and C. From the 3<sup>rd</sup> to the 5<sup>th</sup> day, bacteria count increased from 10 to 25 cfu/mL, thereafter, it decreased sharply to 10 cfu/mL on the 7<sup>th</sup> day, and rose again to 50 cfu/mL on the 9<sup>th</sup> day.

The samples pasteurized at 72°C replicated almost the same trend as those pasteurized at 67°C. All the samples had growth on the 3<sup>rd</sup> day except sample A, which later showed increase in colony count with length of storage, just like sample D. Samples B and C showed drastic reduction in colony counts beyond the 3<sup>rd</sup> day. Noteworthy, is the generally lower bacteria count of the samples pasteurized of 72°C for 6min relative to those pasteurized at 67°C for 5 min. This simply impresses the fact that the pasteurization temperature and duration could have an effect on the shelf life of zobo drink. This is in agreement with a related study by Ilondu and Iloh (2007).

## VI. CONCLUSION

The spices employed for this study namely *Zingiber officinale* (ginger) and *Caryophyllus aromaticus* (cloves) are good flavouring agents for zobo drink, and have varying levels of antimicrobial activity. The various combination of the spices in the zobo drink could not preserve the drink beyond 2 days at ambient storage. However, there was evidence of increased antimicrobial activity and extended shelf life when coupled with pasteurization. A combination of ginger (150g) and clove (20g) in zobo drink was found to be most effective, and coupled with pasteurization kept the drink in sterile

condition for up to 3 days, and could extend the shelf life to 5 days, under ambient storage condition. A pasteurization temperature of 72°C for 6min resulted in

reduced microbial load and is therefore recommended for pasteurizing zobo drink.

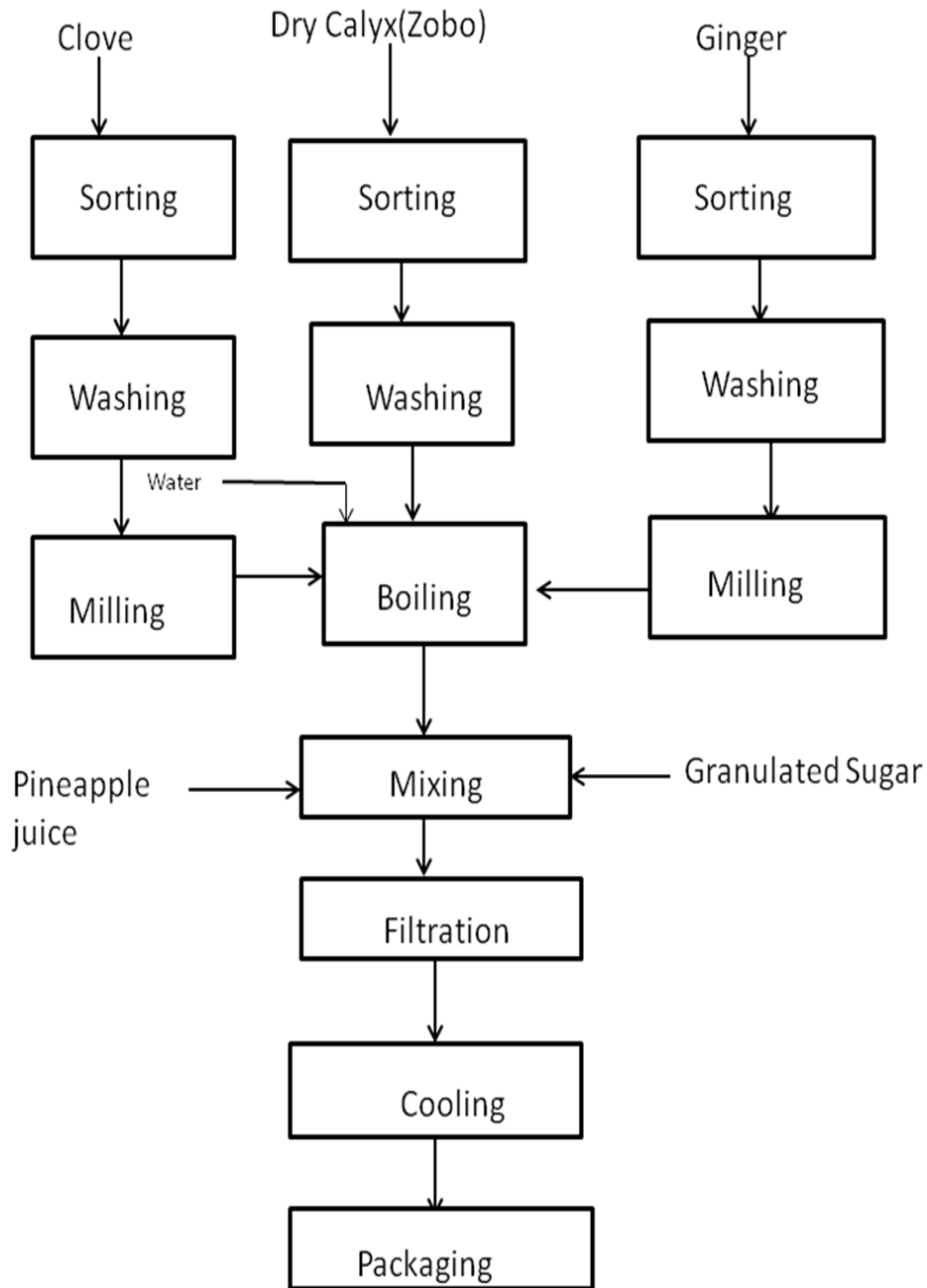


Fig1 Flow chart for the production of zobo drink

**Table1: Spices composition of samples**

Sample	Ginger (g)	Clove (g)
A	150	20
B	150	10
C	100	20
D	100	10

**Table 2: Microbial analysis of unpasteurized samples**

Sample	Bacteria Count (cfu/mL)	
	Storage time (day)	
	1	8
A	32	X
B	-	X
C	-	X
D	-	X

X - Visible spoilage

**Table 3. Results of microbial analysis of samples pasteurized at 67°C**

Sample	Bacteria Count (cfu/mL)				
	Storage time (day)				
	1	3	5	7	9
A	-	-	170	223	300
B	-	50	12	7	5
C	-	29	65	89	150
D	-	16	25	10	50

**Table 4: Results of microbial analysis of zobo samples pasteurized at 72° C**

Sample	Bacteria Count (cfu/mL)				
	Storage time (day)				
	1	3	5	7	9
A	-	-	59	87	120
B	-	185	131	83	41
C	-	254	10	-	101
D	-	5	90	130	160

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