

Full Length Research Paper

Stability studies and mineral concentration of some Nigerian packed fruit juices, concentrate and local beverages

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Time stability and mineral content of some Nigerian packet fruit juices, concentrate and local beverages (*sobo* drink, *kunnu* drink, *pito* and *burukutu*) were determined. The pH of the beverages was fairly stable throughout the 15 days the experiment lasted. The acid contents were within suitable range for human consumption and ranged from 0.041 M – 0.205 M. The concentrate has the highest titratable acidity ranging from 0.098 M on day 1 to 0.205 M on day 15. Elemental analysis of the minerals showed that the beverages were rich in macronutrients. Potassium was found to be the most abundant with content ranging from 4.35 – 5.85 mg/mL while manganese and copper were not detectable. Sodium content was between 1.300 – 1.335 mg/mL; calcium 0.560 – 0.925 mg/mL; magnesium 0.005 – 0.06 mg/mL; iron 0.005 – 0.025 mg/mL and zinc 0.005 – 0.010 mg/mL. The results showed that the drinks contain safe levels of mineral elements for human consumption and are sufficiently stable and safe.

Key words: Stability, fruit juices, beverages, concentrate, mineral content.

INTRODUCTION

If the importance of a nutrient is judged by how long we can do without it, water ranks as the most important. A person can survive only eight to ten days without water, whereas it takes weeks or even months to die from a lack of food. While water has no caloric value and therefore is not an energy source, without it in our diets we could not digest or absorb the foods we eat or eliminate the body's waste. Water is replenished by drinking liquids like fruit juices and beverages, preferably those without caffeine or alcohol, both of which increase the output of urine and thus dehydrate the body (Worthington-Roberts, 2007). Various types of drinks/beverages are often consumed as sources of fluids.

Fruit juices are directly extracted from fruits and consumed without further processing. Some of these are packed in bottles or laminated papers and sold. Fruit drink concentrates are a concentrated form of the juice extracted from natural fruits. Since it is expensive to package and store single strength juice, it is often desirable to remove a part or all of the water from the juice (Kim et al.,

1988). Such concentrates are diluted with water prior to consumption. Concentration reduces the storage volumes, thereby reducing the transport costs, and facilitates preservation which is achieved by improved shelf life with increased relative solid concentration. However during the process of concentration, a large part of the characteristics determining the quality of the fresh products undergoes remarkable modification which could reduce the nutritional value of the drink (Hur and Choi, 1993; Lee and Sohn, 2003; Choi et al., 1995).

Fruits have been a part of human diet and food supplement over the years. They are considered as healthy food supplements because they contain high quantity of water, carbohydrates, proteins, vitamins A, B₁, B₂, C, D and E; and minerals such as Ca, Mg, K, Zn and Fe (Wenkam, 1990; Okwu and Emenike, 2006). Besides their dietary importance, they are also useful as nutrient supplements and recommended internationally as superior to processed foods (Wenkam, 1990). Fruit consumption has been reported to be beneficial to health and to contribute to the prevention of degenerative processes, particularly lowering the incidence and mortality rate of cancer and cardio- and cerebro-vascular diseases (Rapisarda et al., 1999).

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Table 1. pH variation of Beverages over 15 days.

Beverage Samples	pH Values / Days														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FOJ	3.2	3.1	3.3	3.2	3.2	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.1
COJ	3.9	3.7	3.6	3.7	3.7	3.6	3.7	3.6	3.5	3.4	3.4	3.4	3.4	3.3	3.3
BOC	2.6	2.6	2.7	2.7	2.7	2.6	2.7	2.6	2.4	2.4	2.4	2.4	2.4	2.1	2.1
SD	2.8	2.8	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.5	2.6	2.6	2.6	2.3
KU	3.3	3.0	2.9	2.8	2.7	2.7	2.7	2.7	2.7	2.5	2.5	2.5	2.4	2.4	2.3
PT	3.7	3.7	3.6	3.6	3.5	3.4	3.0	3.0	2.9	3.0	2.9	3.0	2.9	2.8	2.8
BK	3.4	3.3	3.3	3.5	3.7	3.4	3.1	3.0	2.9	3.1	3.0	3.0	2.9	3.0	3.0

Apart from fruit juices and concentrates, other plant materials are often used in the preparation of alcoholic and non-alcoholic beverages. The simplicity of production, availability of raw plant materials and abject poverty in many rural communities, as well as the new economy-revamping policies of the government have resulted in increased production and consumption of many local beverages at cottage levels in Nigeria. Sobo drink and Kunnu drink are ready local alternatives to imported refreshing drinks. They are also reported to have various medicinal values (Onoja, 1996). Sobo drink is an aqueous extract of the dried reddish-brown petals (calyxes) of *Hibiscus sabdariffa* which is usually sweetened with sugar and sometimes flavoured with spices like ginger, hot pepper etc along with natural flavours like pineapple, orange or lime juice (Odebunmi and Dosumu, 2007). Other artificial flavourings like strawberry, vanilla, banana flavours etc, may also be added depending on individual taste (Bola and Aboaba, 2004). Kunnu is a drink made from ground millet or/and guinea corn and it is basically a refreshing, non-alcoholic drink. Pito and Burukutu are locally brewed alcoholic drinks from ground and fermented millet or/and guinea corn. Pito is the liquid part that floats while Burukutu is the part that settles in the bottom with some sediment in it.

In spite of the high consumption rate of these beverages, their stability and nutritional quality are not well documented. This work therefore aims to examine and provide information on the keeping qualities as well as the mineral composition of some of these drinks.

EXPERIMENTAL

Two popular brands of orange juices packed in laminated paper were used in this study and labelled FOJ and COJ. A fruit drink concentrate was also used (BOC) while the local beverages used are Sobo drink (SD), Kunnu (KU), Pito (PT) and Burukutu (BK). FOJ and COJ represent the ready-made fruit juices and were purchased from a store within Ilorin metropolis, BOC is a concentrate that is diluted before consumption and was also purchased from a store, SD and KU were locally-prepared non-alcoholic beverages while PT and BK are alcoholic local beverages and they were obtained from local brewers. All samples were kept in sample bottles with tight-fitting lids and kept at room temperature.

Stability studies

The stability of the samples was monitored by measuring the pH at 25°C for 15 days at 24 h intervals. The acidity was also determined by titrating 10 ml of samples with 0.1 M NaOH solution using 1% phenolphthalein as indicator. The titration was carried out on a daily basis for a period of 15 days.

Mineral content determination

Each drink sample was digested by the wet ashing method prior to mineral content determination as described by Abulude et al. (2007). 1 ml of sample was measured into a beaker and 10 ml of 1% HCl was added and the mixture heated on a hot plate until the content was reduced to about 1 ml. The solution was then made up to 50 ml with 1% HCl and stored in plastic containers until analyzed for K, Na, Ca, Mg, Mn, Fe, Cu and Zn using atomic absorption spectrophotometer.

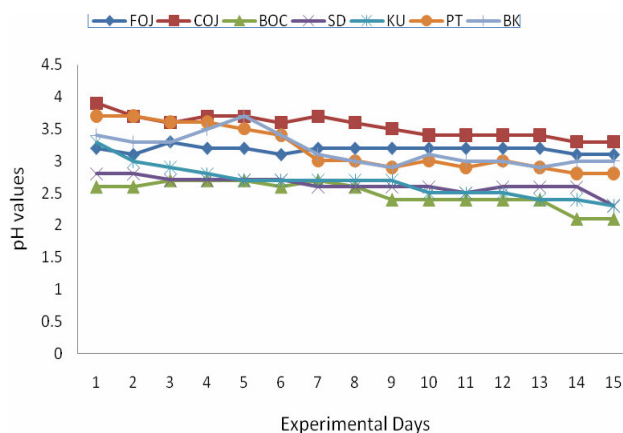
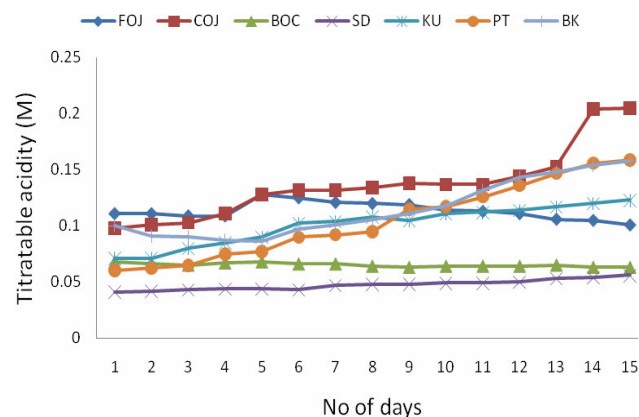
RESULTS AND DISCUSSION

The pH values obtained for all the drinks ranged between 2.1 and 3.7 (Table 1) and there was an observed gradual reduction in the pH values as the days progressed (Figure 1) except for BK which increased slightly until day 5 after which there was a steady decrease in the pH. This could imply that the samples were becoming more acidic and therefore less susceptible to bacterial action but more susceptible to the action of yeasts and moulds (Adeyeye and Agesin, 1999). The samples were also observed to develop characteristic 'fermented' smell as the days progressed. This may be as a result of the fermentation of the drinks to alcohol and then to vinegar due to the action of yeasts. FOJ had relatively constant pH values (3.1 – 3.3) compared with other samples and BOC had the lowest pH values (2.1 – 2.7).

The results of the titratable acidity of the beverages presented in Table 2 shows that the different beverages behaved differently as the days progressed. Generally, the highest titratable acid concentrations were obtained in the packed juices (FOJ and COJ) and burukutu. The acid content of FOJ was observed to gradually increase as the days progressed until after 5 days when the concentration started reducing gradually to a minimum concen-

Table 2. Titratable acidity (M) of the beverages.

Days	Titratable Acidity (M)						
	FOJ	COJ	BOC	SD	KU	PT	BK
1	0.111	0.098	0.068	0.041	0.071	0.060	0.100
2	0.111	0.101	0.066	0.042	0.071	0.062	0.091
3	0.109	0.103	0.065	0.043	0.080	0.065	0.090
4	0.109	0.111	0.067	0.044	0.085	0.075	0.087
5	0.128	0.128	0.068	0.044	0.090	0.077	0.086
6	0.125	0.132	0.066	0.043	0.102	0.090	0.097
7	0.121	0.132	0.066	0.047	0.104	0.092	0.101
8	0.120	0.134	0.064	0.048	0.108	0.095	0.105
9	0.119	0.138	0.063	0.048	0.105	0.115	0.111
10	0.114	0.137	0.064	0.049	0.111	0.117	0.118
11	0.113	0.137	0.064	0.049	0.112	0.126	0.132
12	0.111	0.144	0.064	0.050	0.114	0.136	0.143
13	0.106	0.153	0.065	0.053	0.117	0.147	0.148
14	0.105	0.204	0.063	0.054	0.120	0.156	0.154
15	0.101	0.205	0.063	0.056	0.123	0.159	0.158

**Figure 1.** pH Values of Beverages over a period of 15 days.**Figure 2.** Variation in titratable acidity of beverages over 15 days.

tration of 0.101 M. The other packed juice exhibited different characteristics with the concentration increasing gradually from the 0.098 M on day 1 to 0.205 M on day 15. BOC which is a concentrate showed a fairly constant titratable acidity (0.063 – 0.068 M). This is expected since the concentrate contains some preservatives which are expected to inactivate the enzymes in the drink and therefore prevent the deterioration or any chemical reaction in the drink (Fellers et al., 1986).

Sobo drink has the least titratable acid concentrations (0.041 – 0.056 M) and these increased gradually as the number of days increased. KU and PT also showed increasing acidity as the experimental days increase while BK recorded a slight decrease in the acidity during the

first 5 days and then a continual increase during the rest of the days which was attributed to the breakdown of the natural antioxidants and antimicrobial agents.

The mineral compositions of the beverages are shown in Table 3. Potassium is the most abundant element in all the beverage samples followed by sodium and then calcium. Copper and manganese were not detectable in the beverages while magnesium, iron and zinc are present in trace amounts. This result is in agreement with the result reported by Onibon et al. (2007) who worked on some Nigerian fruits and also reported that potassium was the most abundant mineral in the fruits while magnesium, iron and zinc were present in minute quantities the Potassium and sodium are macroelements required

Table 3. Mineral Composition (mg mL⁻¹) of the beverage samples.

Beverage Samples	Mineral Composition (mg mL ⁻¹)							
	K	Na	Ca	Mg	Fe	Zn	Mn	Cu
FOJ	5.100	1.305	0.730	0.010	0.010	0.010	ND	ND
COJ	5.850	1.320	0.925	0.005	0.025	0.005	ND	ND
BOC	5.215	1.300	0.805	0.005	0.010	0.010	ND	ND
SD	4.750	1.305	0.875	0.010	0.015	0.005	ND	ND
KU	4.850	1.320	0.595	0.010	0.010	0.005	ND	ND
PT	4.350	1.300	0.640	0.005	0.010	0.010	ND	ND
BK	5.550	1.335	0.560	0.060	0.005	0.005	ND	ND

ND = Not detectable.

for the maintenance of cellular water balance, acid-base balance and nerve transmission and are required in large amounts in the body (Wardlaw, 1999; Worthington-Roberts, 2007). Deficiencies of these macronutrients lead to muscle cramps, mental confusion, loss of appetite and irregular cardiac rhythm (Worthington-Roberts, 2007). However, there is a direct relationship between sodium intake and hypertension in humans (Dahl, 1972) therefore it is desirable that the concentration of sodium in foods is not as high as that of potassium. These results therefore indicate a desirability of the consumption of these beverages because they contain a high concentration of sodium and potassium but the concentration of sodium is lower than that of potassium. Calcium is essential in bone and teeth formation (Wardlaw, 1999) and a deficiency of it causes rickets and osteoporosis (Hunt et al., 1980). Consumption of these beverages is therefore desirable as they serve as good sources of this macronutrient.

Conclusion

This work has shown that except for COJ (a packed fruit juice) and BK (a local alcoholic beverage), the beverages have fairly stable titratable acidity throughout the days of the experiment and the acid contents are suitable for consumption even without refrigeration. The shortcoming is the 'alcoholic smell' emanating from the drinks due to fermentation as the days of the experiment progressed. This was because the drinks were kept at room temperature.

The mineral ion contents of these drinks are not too high as to call for caution in the consumption of the drinks but the concentrations make these drinks good natural sources of these metal ions.

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