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Nutrients in Non-Alcoholic Beverages in Nigeria

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ABSTRACT

Forty-one samples of carbonated soft drinks in Nigeria have been shown, on analysis, to contain high sugar contents (mean value, 14·0%) despite the high cost of this ingredient; the Food and Drug regulations allow 9%–14%. There is a considerable divergence in the mean values of sugar for the four brands examined; 14·9%, 15·3%, 12·4% and 13·7% for the Cola, Fanta, clear drinks and fruit juice, respectively. Similar large deviations in mean values were recorded for other chemical constituents of the drinks. Ascorbic acid, for example, has an overall mean value of 12·2 mg/100 ml whereas individual samples have mean values ranging from 36·3 to 7·25 mg/100 ml. The ascorbic acid values for the fruit juice drinks fall short of expectation in all cases.

INTRODUCTION

Non-alcoholic drinks comprise mainly Cola, orange, clear drinks, including Club Soda, Sparkling Water, Seven Up, fruit juices and squashes. All these, except the last two and other specialised soft drinks, are sugar-sweetened carbonated drinks containing water (83–93%), sugar (7–17%), CO_2 (0·1–5 gas volumes), colorants, e.g. Sunset Yellow, tartrazine; acids, e.g. phosphoric acid, particularly in Cola, tartaric, malic and citric acids, preservatives, e.g. benzoate, sulphur dioxide and sodium metabisulphite, vitamins, amino acids and electrolytes, and pH is adjusted to 2–5.

Non-alcoholic beverages may be classified on the basis of sweetener

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employed. Sugar is a very popular and widely accepted sweetener. Synthetic sweetener mixtures might include saccharin, which is 550 times as sweet as sucrose, cyclamates, which are 30 times as sweet as sucrose, sodium-5-ribonucleotide, chlorosucrose, amino malonic acid, etc. These sweeteners, when used to replace sucrose, may provide low caloric drinks.

The standard specification approved for carbonated drinks in Nigeria is as follows: water (90%); sugar (9–14%); ash (about 0·017%); carbon dioxide (3·5–4·0 gas volume); pH 2–5. This specification excludes synthetic sweeteners and enquiries conducted suggest that the use of synthetic sweeteners is prohibited in soft drinks in Nigeria.

The sugar content of soft drinks in Nigeria is rather high; these drinks therefore serve the purpose of increasing the caloric value of the diet. In this regard, therefore, soft drinks, when used as refreshment, also serve the function of supplementing and complicating the energy consumption of consumers.

The soft drink industry has experienced one of the highest growth rates, reaching about 250% within the last six years in Nigeria. There are over 60 brands of soft drinks in Nigeria today. The industry alone accounts for more than 30% of national sugar consumption. In view of the already unduly high carbohydrate intake in the Nigerian diet, the high rate of consumption of soft drinks and the possible human pathology associated with high sugar intake (e.g. cardiovascular disease, dental disorders, diabetes mellitus, obesity, enzymatic disorders, etc.) there is a need to monitor samples of soft drinks on shelves in the market for their principal constituents and particularly their sugar level.

This paper contains analyses of forty-one samples of soft drinks commonly consumed in Nigeria.

MATERIALS AND METHODS

At least ten bottles of each type of drink collected at random from shelves in the markets of at least two towns in twelve states of the country were analysed.

Each of the following analyses was conducted according to the official analytical methods (AOAC, 1975).

Sugar

Total soluble solids (as sucrose) was determined by measurement of the refractive index by the standard Brix method and the spectrophotometric-anthrone method was used for glucose.

Ascorbic acid (vitamin C)

The ascorbic acid content was determined by the spectrophotometric–Folic Phenol Reagent. (Reo & Keuther, 1943; Sood *et al.*, 1976).

Citric acid

The quantity of citric acid present was determined by the pentabromacetone gravimetric method (AOAC, 1975).

Malic acid and tartaric acid

Determination of these acids was carried out using the bitartrate method (AOAC, 1975).

Ash

The amount of ash content was determined by evaporating the sample to dryness and heating in a furnace at about 525°.

Soluble and insoluble ash

Percentages of H_2O-soluble and H_2O-insoluble ash were determined by dissolving the ash sample in hot water, filtering through ashless paper and washing with hot water (AOAC, 1975).

Alkalinity of soluble ash

Alkalinity of soluble ash was determined by titrating the filtrate with 0·1M HCl.

Alkalinity of insoluble ash

Alkalinity of insoluble ash was determined by adding excess 0·1M HCl to the sample; this was then boiled; the excess HCl was later titrated with 0·1M NaOH solution.

Total acidity

The total acidity was determined using a titrimetric method.

Nitrogen

Nitrogen was determined by the Kjeldahl method. The crude protein content was determined by multiplying the N value by the factor 6·25 (AOAC, 1975).

RESULTS AND DISCUSSION

Table 1 shows that the sugar contents of the forty-one samples of four brands—Fanta, Cola, clear drinks and fruit juices—of non-alcoholic carbonated drinks are slightly higher, on average, than what the Food and Drug Administration (FDA) of the Federal Ministry of Health, Nigeria, approves for non-alcoholic drinks in Nigeria. Ketiku (1973) and Adeneye & Raji (1986) had earlier analysed seven and twenty-nine samples of drinks, respectively, and found higher sugar contents than approved by the FDA Department. Our analysis shows an overall mean value of 13·6% of total sugar, with a variation between 17·8% and 13·0% for the orange drinks, 19·3 and 12·5% for Cola, 16·0 and 4·00% for the clear drinks including Club Soda, and 14·0% and 8·0% for the fruit juice drinks. The FDA Department, however, approves 9%–10% sugar for the Cola drinks, a maximum of 14% for the orange and a maximum of 0·5% for Club Soda and Sparkling Water carbonated drinks. Table 2 summarises the analytical divergences.

Ketiku (1973), however, reported rather low sugar contents for some fruit juices (2·0 g/100 cl for lime; 6·0 g/100 cl for grapefruit; 9–2 g/100 cl for orange). Noronha da Silevia's (1982) analysis of canned fruit juices showed a much higher sugar content, varying between 14·0 and 21·8 Brix. Recent studies by Fang & Chang (1981) showed that the sugar content of juices depends on the fruit variety. It is no surprise, therefore, to find a wide divergence in the sugar content of drinks in the C and D brands. It is surprising, however, to find that Club Soda drinks, the C brand, contain as much as 16% sugar and on no occasion were any of these brands found to contain less than 5% sugar, whereas these brands of drink could be sugar-free altogether.

Random taste panels on the sweetness of the various drinks, particularly on the clear and fruit juice drinks, did not reflect the recorded differences in their sugar contents. The wide range in the sugar content may be rationalised on the grounds that some other sweeteners must have been included in these drinks. The probability of using synthetic sweeteners may be increasing in Nigeria especially with the 300%–500% increase in the newly-introduced foreign exchange rate through the Second Tier Foreign Exchange Market system. With this in view, it is now planned to monitor carbonated non-

alcoholic bottled soft drinks for some common synthetic sweeteners after one year of operation of the new foreign exchange rate.

Van Tornout *et al.* (1985) and Barnett & Yarger (1985) have shown the effects of synthetic sweeteners used in various proportions together with sucrose and glucose to obtain the desired level of sweetness. Fructose, aminobenzoic acid, chlorosucrose, cyclamates and saccharin are well established sweeteners that could have been used although only the first two sweeteners are allowed for inclusion in soft drinks in Nigeria.

Vitamin C contents range from 0·036% to 0·008%, 0·018% to 0·002%, 0·015% to 0·013% and 0·014% to 0·009% for orange, Cola, clear drinks and fruit juices, respectively. Fresh fruit pulp or juice extracts of *Chrysophyllum albidum*, sweet orange and mangoes, for example, contain, on average, about 0·90%, 0·45% and 0·10% ascorbic acid, respectively. The values for the drinks being investigated are rather low, particularly the bottled fruit juices. Fresh fruits are well known to be one of the natural sources of ascorbic acid. Vitamin C, however, is very sensitive to many conditions, including heat, storage and physical treatment. Soft drinks, even with low ascorbic acid contents, serve to supplement the body requirements of vitamin C.

Soft drinks today are supplemented with various agents to improve their nutritive value. For example, amino acids, such as proline, aspartic acid, glutamic acid and their salts have become common additives introduced in desired and controlled quantities under special dispensation for specific purposes, e.g. as health drinks.

Acidity in carbonated beverages is most often provided by citric, tartaric, phosphoric and malic acids. Phosphoric acid is predominantly used in Cola drinks while tartaric acid is used in grape or fruit juices. The low mean pH values of 3·75, 3·39, 4·04 and 3·47 for the orange, Cola, clear drinks and fruit juice, respectively, provided supporting evidence for the inclusion of these acids within approved and tolerable limits. Of the four acids investigated, it is observed that malic and citric acids were of higher value than tartaric and phosphoric acids. The clear drinks record the lowest acidity while the fruit drinks have the highest, most probably to buffer the solution to give the drinks a taste closest to the taste of natural juices and also serving as preservatives.

The level of soluble ash follows no definite pattern even within the same brand of drinks. Ca^{2+} is highest in each drink; Na^{+}, K^{+}, Ca^{2+} have mean values of 3–83, 21–68 and 85–92 ppm, respectively. The insoluble ash is a reflection of the level of other cations including Pb^{2+}, Mg^{2+}, Mn^{2+}, Fe^{2+}, Cu^{2+} and Zn^{2+} present at 0·05, 10·1, 0·10, 2·24, 0·08 and 0·39 ppm, respectively. Cd^{2+} was not observed in any detectable quantity.

Soft drinks are known to derive their minerals from the concentrate, sugar and water. Kechciak and Maslowska (1984) reported that sugar alone could

TABLE 1
Major Nutrients in Some Nigerian Non-alcoholic Beverages

Brand of soft drink	*Glucose* (%)	*Sucrose* (%)	*Total sugar* (%)	*Protein* (%)	*Total acidity* (%)	*Ascorbic acid* (%) × 10^{-2}	*Citric acid* (%) × 10^{-2}	*Tartaric acid* (%) × 10^{-2}	*Malic acid* (%) × 10^{-2}	*Dry matter* (%)	*Ash* (%)	*Soluble ash* (%)	*Insoluble ash* (%)
A1	2·00	11·0	13·0	0·04	0·26	0·98	0·93	0·77	5·15	5·70	1·27	0·35	0·92
A2	2·10	13·0	15·1	0·06	0·23	0·88	0·69	1·03	5·03	3·89	0·69	0·34	0·35
A3	4·30	13·0	17·3	0·08	0·24	0·75	0·83	0·66	5·15	10·21	4·64	0·51	4·13
A4	2·30	13·0	15·3		0·15	0·98	1·11	0·68	9·81	3·22	0·04	0·02	0·03
A5	2·020	12·0	14·2	0·13	0·17	0·85	0·83	0·38	5·03	8·70	3·36	1·70	1·66
A6	4·30	11·0	15·3	0·08	0·12	0·85	1·79	0·47	6·63	10·47	4·81	1·12	3·69
A7	2·80	11·0	13·8	0·08	0·15	3·63	3·13	0·56	12·6	9·69	3·61	1·66	1·95
A8	2·20	11·0	13·2	0·11	0·14	1·00	0·22	0·61	8·38	10·03	4·56	2·28	2·08
A9	5·30	12·5	17·8		0·26	1·10	2·55	0·26	8·58	9·83	3·89	0·55	3·34
A10	5·40	9·0	14·4	—	0·19	1·08	0·58	0·92	7·54	5·79	3·04	0·48	2·57
A11	2·50	12·3	14·8	—	0·15	1·05	0·72	0·45	5·22	6·20	0·88	0·25	2·30
B1	3·00	11·0	14·0	—	0·21	1·23	0·22	0·94	3·44	7·47	2·76	0·60	2·16
B2	4·30	10·0	14·3	0·18	0·25	1·50	1·26	1·08	3·33	8·50	3·67	0·46	3·21
B3	3·50	9·0	12·5	0·19	0·30	1·84	0·20	0·40	4·02	8·47	3·43	0·48	2·95
B4	5·50	10·0	15·5	0·14	0·22	0·73	0·23	0·68	5·03	8·78	3·94	1·39	2·55
B5	6·50	11·0	17·5	0·04	0·12	1·08	0·18	0·82	5·88	8·77	3·76	0·76	2·99
B6	3·80	13·0	16·8	—	0·07	1·43	0·28	0·40	6·16	7·59	4·31	1·05	3·27
B7	4·30	12·0	16·3	0·13	0·24	1·83	0·20	0·96	12·56	6·44	3·58	0·52	3·06
B8	1·50	11·0	12·5	—	0·08	1·00	0·22	0·42	7·95	6·88	3·86	2·02	1·84
B9	8·80	11·0	19·3	0·18	0·22	0·83	0·23	0·68	7·96	5·24	2·45	0·48	1·92
B10	8·00	10·0	18·0	0·13	0·30	1·14	0·20	0·45	5·86	3·63	0·29	0·05	0·34
B11	2·50	9·5	12·0	0·19	0·20	1·02	0·21	0·34	5·03	2·82	0·90	0·30	2·28

C1	4·00	0·0	4·0	0·19	0·02	1·25	4·27	0·82	2·84	2·71	0·30	0·05	0·25
C2	3·50	8·00	11·5	1·69	0·11	1·43	0·23	0·35	3·38	5·58	2·53	0·69	1·84
C3	1·50	8·00	9·5	—	0·31	1·80	1·03	0·40	4·24	5·87	3·27	0·95	2·32
C4	5·00	11·0	16·0	1·06	0·02	1·29	0·16	0·40	4·50	5·94	2·19	1·00	2·26
C5	5·50	0·0	5·5	0·19	0·13	1·25	0·10	0·94	5·03	4·89	2·58	0·05	0·10
C6	5·75	10·0	15·8	—	0·16	1·34	0·43	0·63	5·29	6·31	3·35	0·93	2·60
C7	1·75	10·0	11·8	—	0·12	1·43	0·40	0·31	7·85	5·78	0·15	0·72	1·86
C8	2·90	11·0	13·9	0·63	0·57	1·10	0·48	0·45	5·60	4·07	3·25	1·21	2·09
C9	5·00	9·0	14·0	0·25	0·12	1·33	0·38	0·49	12·14	5·90	2·64	0·85	1·79
D1	4·75	9·0	14·0	—	0·17	1·23	0·51	0·63	7·22	6·24	3·10	1·26	1·84
D2	1·50	12·0	13·5		0·33	0·88	0·53	0·61	7·66	6·68	3·79	1·42	2·37
D3	2·50	9·0	11·5	0·31	0·13	1·00	0·57	0·38	4·74	1·98	1·22	0·23	1·00
D4	8·25	12·0	20·3	0·75	0·14	1·38	0·76	0·73	6·54	6·52	5·31	1·77	3·54
D5	1·00	7·0	8·0	—	0·13	1·34	0·40	0·47	11·5	5·31	2·19	0·70	1·49
D6	2·75	12·0	14·8	0·13	0·45	1·13	1·19	0·87	6·07	4·29	3·41	0·91	2·50
D7	3·85	10·0	13·8	0·13	0·22	0·95	0·46	0·39	5·88	2·88	1·05	0·35	1·12
Mean	3·85	10·1	13·6	0·59	0·19	1·22	0·74	0·60	6·50	6·30	2·77	0·80	2·07
SE ±	0·22	0·34	0·28	0·05	0·01	0·15	0·11	0·02	0·26	0·22	0·14	0·06	0·11
A													
Mean	3·22	12·7	14·1	0·005	0·19	1·20	1·22	0·62	0·007	7·61	2·78	0·84	2·09
SE ±	0·22	0·36	1·24	0·001	0·01	0·25	0·27	0·07	0·001	0·66	0·43	0·20	0·37
B													
Mean	4·66	10·7	15·3	0·015	0·20	1·17	0·31	0·65	0·006	6·78	3·01	0·74	2·42
SE +	0·62	0·36	2·47	0·002	0·02	0·10	0·10	0·07	0·001	0·54	0·39	0·18	0·27
C													
Mean	3·88	7·44	11·3	0·005	0·12	1·33	0·83	0·53	0·006	5·23	2·27	0·72	1·68
SE ±	0·47	1·00	4·38	0·002	0·06	0·04	0·37	0·07	0·001	0·40	0·38	0·13	0·25
D													
Mean	3·51	10·1	13·7	0·002	0·22	1·13	0·63	0·58	0·007	4·84	2·88	0·95	1·98
SE ±	1·04	0·71	4·14	0·001	0·05	0·06	0·11	0·07	0·001	0·67	0·61	0·22	0·36

TABLE 2(a)

Summary Showing Divergence in Nutrients in Each Brand of Drink

Brand of drink	*Glucose (%)*			*Total sugar (%)*			*Ascorbic acid (%) × 10^{-2}*			*Citric acid (%) × 10^{-2}*			*Tartaric acid (%) × 10^{-2}*		
	Mean value	*Highest value*	*Lowest value*	*Mean value*	*Highest value*	*Lowest value*	*Mean value*	*Highest value*	*Lowest value*	*Mean value*	*Highest value*	*Lowest value*	*Mean value*	*Highest value*	*Lowest value*
A		A10	A1		A9	A1		A9	A3		A7	A10		A2	A9
Series	3·22	5·40	2·00	14·9	17·8	13·0	1·22	1·10	0·88	1·21	3·13	0·58	0·63	1·03	0·38
B		B9	B8		B6	B3		B7	B4		B2	B5		B2	B11
Series	4·66	8·80	1·50	15·3	19·3	12·0	1·17	1·83	0·73	0·43	1·26	0·18	0·73	1·08	0·34
C		C6	C3		C4	C1		C3, 7	C8		C1	C5		C5	C7
Series	3·88	5·75	1·50	12·4	16·0	4·00	1·33	1·43	1·30	0·83	4·27	0·10	0·53	0·94	0·31
D		D4	D5		D4	D5		D4	D2		D6	D5		D6	D3
Series	3·51	8·25	1·00	13·7	20·0	8·00	1·13	1·38	0·88	0·64	1·19	0·40	0·63	0·87	0·38
Overall mean	3·83			14·0			1·22			0·74			0·60		

TABLE 2(b)

Summary Showing Divergence in Nutrients in Each Brand of Drink

Brand of soft drink	*Malic acid* (%) × 10^{-2}			*Dry matter* (%)			*Ash (soluble)* (%)			*Ash (insoluble)* (%)			*pH*		
	Mean value	*Highest value*	*Lowest value*	*Mean value*	*Highest value*	*Lowest value*	*Mean value*	*Highest value*	*Lowest value*	*Mean value*	*Highest value*	*Lowest value*	*Mean value*	*Highest value*	*Lowest value*
A		A6	A5		A3	A4		A8	A4		A3	A4		A8, 9	A2
Series	7·21	12·0	5·03	7·61	10·2	3·22	0·84	2·28	0·02	2·09	4·13	0·03	3·75	4·20	3·00
B		B7	B2		B4	B11		B8	B10		B6	B10		B1	B9
Series	6·13	12·6	3·33	6·78	8·78	2·82	0·74	2·02	0·05	2·42	3·27	0·34	3·39	4·00	3·00
C		C9	C1		C6	C8		C8	C5		C6	C5		C5	C4
Series	5·74	12·1	2·84	5·23	6·31	4·07	0·72	1·21	0·05	1·28	2·60	0·10	4·04	5·30	3·60
D		D5	D3		D2	D3		D4	D3		D4	D3		D4	D5
Series	7·13	11·5	4·74	4·84	6·68	1·98	0·95	1·77	0·23	1·98	3·54	1·00	3·47	3·85	2·80
Overall mean	6·50			6·30			0·80			2·07			3·66		

account for as much as 3·0 mg/dm^3 of Fe^{2+} and 9·84% and 0·98% of the total Zn^{2+} and Cu^{2+}, respectively. Orange concentrate contains as much as 2·9% Fe^{2+} and 0·80% Cu^{2+}. Kechciak (1984), in another report, showed that the levels of Fe^{2+}, Mn^{2+}, Pb^{2+}, Cu^{2+}, Ni^{2+} and Co^{2+} were higher in carbonated beverages than in tap water used for their production. Electrolytes in soft drinks may not necessarily be expected to maintain a particular value but efforts should be made to guarantee the content of these within accepted safe levels.

Considering the high rate of consumption of soft drinks, and already high caloric local diet, it is important that the sugar content of soft drinks in Nigeria, or any tropical countries where the diet is of high calorific value, should be reduced. We wish, therefore, to recommend that there should be three types of soft drink in the tropical underdeveloped countries. One type, *health drinks*, should contain about 4% sugar but this should be fortified with amino acids, vitamins and electrolytes, and should be used especially by convalescents; a second type intended for athletes should contain up to 8% sugar and be fortified with electrolytes, amino acids and vitamins. The third type, to serve as refreshment and for entertainment, should contain less than 4·0% sugar with only a minimum quantity of amino acids.

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