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Nutrients and Antinutrients in Selected Brands of Malt Drinks Produced in Nigeria

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Abstract: Seven commercial brands of malt drinks were analyzed for reducing sugar, protein, minerals, vitamins A, vitamin C, oxalate, phytate and hydrogen cyanide. The malt drinks were found to contain substantial amounts of reducing sugar ranging from 603.66 to 943.45 mg/dl. Vitamins A and C were present in adequate amounts with respect to RDA requirements, whereas, low values were found for protein, iron, zinc, oxalate, phytate and hydrogen cyanide. The paper observes the need for standardization in the extent of fortification of malt drinks with vitamins and the possible inclusion of essential minerals as fortificants in these products to make them more wholesome.

Key words: Hydrogen cyanide, malt drinks, mashing, minerals, oxalate, protein, phytate, reducing sugar

Introduction

The non-alcoholic malt drinks are additional products to beer which are produced and marketed by several breweries in Nigeria. Malt drink production involves the use of similar raw materials, machinery and procedure as in beer brewing (Rooney, 1969). However, the malt drinks are reported to be wholesome and more nutritious than beer. Moreover, there are more potential customers for the malt drinks than beer in view of its non-alcoholic nature (Jepsen, 1993).

Traditionally, barley malt has been used in the production of extract for making malt drinks (Briggs, 1978). In recent times, there has been an increased utilization of sorghum and maize as adjunct of barley malt in Nigerian breweries for the production of brewing extract (Chukwurah, 1988). Also, at present, many brands of malt drinks in Nigeria are advertised and marketed as having been fortified with essential micronutrients (Akpanyung, 2002). This is a commendable development which is in line with the global effort at eradicating micronutrient deficiencies in human nutrition through the widespread fortification of foods (Blum, 1997).

This study was carried out to evaluate the nutrient and micronutrient content of locally produced brands of malt drinks. Parameters examined include protein, sugar, essential minerals and level of vitamin A and C. Antinutrient levels were also assessed because they may have adverse effects on nutrient availability. The potential health benefits of malt drinks are discussed.

Materials and Methods

Seven different commercial brands of locally produced malt drinks were analyzed. Three samples of each brand of malt drink were purchased from supermarkets at Uyo, Calabar and Aba. The samples were stored in a refrigerator at about 4°C. Prior to analyses, the malt drinks were opened, degassed, decolourised by

treatment with activated charcoal and filtered. The resulting clear filtrates were used for analyses.

Protein was analyzed by the biuret reaction (Plummer, 1978). Two millilitres of the malt drink was reacted with Biuret reagent to give a purple coloured complex whose absorbance was read at 540nm. The quantity of protein in the samples was extrapolated from a calibration curve prepared with bovine serum albumin (BSA).

The dinitro salicylic acid method of Miller (1959) was used to estimate reducing sugar. One milliliter of the malt drink was reacted with an alkaline solution of 3,5-dinitro salicylate reagent to give the brown coloured 3-amino-5-nitrosalicylic acid solution. Extinction was measured at 540nm. The quantity of reducing sugar was extrapolated from a calibration curve prepared with D-glucose.

Vitamin C (ascorbic acid) was determined by titration with 2,6-dichlorophenol indophenol (Plummer, 1978). Ten milliliters of each sample was treated with 0.4% oxalic acid and titrated with 2,6-dichlorophenol indophenol to a faint pink end point. A blank of a standard solution of ascorbic acid was treated similarly. The content of ascorbic acid in the malt drink was then obtained by calculation.

The Car-Price reaction (Jayaraman, 1992) was used to estimate vitamin A. Ten milliliters of the sample was extracted with chloroform. The extract was treated with a saturated solution of antimony trichloride. The absorbance of the resulting solution was read at 620nm against a reagent blank. The concentration of vitamin A in the sample was deduced from a calibration curve prepared with a standard solution of vitamin A.

Total oxalate was determined by the method of Dye (1956). 100ml of the sample was digested with dilute hydrochloric acid for 4 hours at 50°C. Oxalate was precipitated from solution as calcium oxalate by treatment with dilute calcium chloride solution at 90°C. The precipitate was solubilized with hot dilute H₂SO₄ and

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titrated against dilute KMnO_4 . The oxalate content was calculated by taking 1ml of 0.05M KMnO_4 as equivalent to 2.2 mg oxalate.

The alkaline titration method of AOAC (1984) was used to detect hydrogen cyanide. 100ml of the malt sample was steam-distilled into a solution of NaOH. The distillate was treated with dilute KI solution and titrated against AgNO_3 solution to a faint but permanently turbid end point. Hydrogen cyanide was estimated by taking 1 ml of 0.02M AgNO_3 as equivalent to 1.08 mg HCN.

Phytic acid was determined by the method of Wheeler and Ferrel (1971). 100ml of the malt drink was extracted with 3% trichloroacetic acid. The extract was treated with FeCl_3 solution and the iron content of the precipitated ferric phytate was determined by atomic absorption spectrophotometry. A 4:6 Fe/P atomic ratio was used to calculate the phytic acid content.

The mineral element composition of the malt drinks was obtained by diluting 1 ml of sample 10^2 times with distilled water and analyzing for the relevant mineral nutrient by atomic absorption spectrophotometry.

Results and Discussion

The nutrients and anti-nutrients in the various brands of malt drinks are shown in Table 1.

Reducing sugar was found to abound in the malt drinks ranging in value between 603.66 and 943.52 mg/dl. The major sources of sugar in malt drinks is through the enzymic hydrolysis of the starchy raw materials during mashing.

By estimation, a standard bottle of each brand of the malt drinks (30cl) supplies more than one gram of reducing sugar. Thus, these drinks serve a veritable source of quick energy especially valuable to athletes and other persons involved in heavy physical activity. Conversely, diabetic patients should exercise restraint since the high level of sugar in malt drinks could lead to complications in this disease condition.

The protein content ranged between 27.54 and 35.28 mg/dl. Storage proteins are known to be enclosed in the endosperm cells of the barley and sorghum raw materials. These proteins are classified into albumin (4%), globulin (31%), hordein (36%) and glutein (29%). Hordein and glutein are the major proteins broken down during malting whereas albumin and globulin are mainly enzyme proteins (Palmer, 1989).

In adults, the FAO/WHO/UNU safe intake of proteins has been reported to be 0.80 g/kg for females and 0.85 g/kg for males (Latham, 1997). For a 70kg man, this translates into a protein requirement of 59.5g/day. Thus, the contribution of malt drinks to the daily requirement of protein appears to be minimal.

Vitamin A is essential for normal growth, vision, immune response and cell differentiation (Sommer and West, 1996). The intake of vitamin A recommended by FAO is 750 μg retinol per day for adults, with lactating mothers

requiring 50% more whereas children and infants require less (FAO, 1988; Latham, 1997). The deficiency of this vitamin is of public health concern in many developing countries. Available data (UNICEF, 1994) indicates that in Nigeria, vitamin A deficiency affects 9.2% of children and 7.2% of mothers. Vitamin A deficiency has been associated with increased respiratory infections, risk of diarrhea and decreased immune response (Sommer and West, 1996).

In the present study, the level of vitamin A in malt drinks has been found to range between 40.55 $\mu\text{g}/\text{dl}$ and 51.70 $\mu\text{g}/\text{dl}$. The consumption of a standard bottle of malt drink (30cl) provides the body with 120.45 – 155.610 μg of vitamin A. Therefore, the malt drinks contribute substantially to the RDA of vitamin A. Interestingly, malt drink is one of the products currently enjoying voluntary fortification in Nigeria (Akpanyung, 2002).

Vitamin C is an important antioxidant in the human body fluid (Halliwell and Gutteridge, 1990). This vitamin is also required for the proper formation and maintenance of intracellular material, especially collagen (Latham, 1997). It has been found to play a preventive role in the development of cardiovascular disease (Mehra *et al.*, 1995). Benzie and Stain (1997) reported that the ingestion of vitamin C causes a dose-related increase in plasma ascorbic acid concentration. These authors demonstrated that a dose of 50mg of vitamin C is optimal and cost effective in terms of increasing the plasma concentrations of this vitamin. The RDA for vitamin C is 40 mg (Weber *et al.*, 1996). The amounts of vitamin C in the malt drinks were estimated to range between 3.13 and 9.97 mg/dl. Brewers advertise malt drinks as having been fortified with vitamin C. The values obtained in this study are varied but generally below 1/3 RDA.

The levels of iron, copper and zinc in the malt drinks were found to be generally low. The level of iron ranged between 0.25 and 0.50 mg/dl. These are similar to the reported values of iron in Nigerian lager beers (Okon and Akpanyung, 2000). For an average consumption rate of 6 dl (600 ml) per day, this amounts to a maximum of 1.5 mg of iron per day. The RDAs for iron are 10 mg/day for men and 15 mg/day for women (NRC, 1989). Obviously, malt drinks do not contribute substantially to the RDA for iron but are however a good source. The deficiency of iron is a problem of global concern (UN ACC/SCN, 1991). Iron deficiency reduces learning and working capacity as well as appetite (Pollit, 1993). Hence the inclusion of iron as one of the food fortifants which is aimed at reducing micronutrient deficiencies (Blum, 1997).

In the malt drinks, zinc ranged in value between 0.12 and 0.18 mg/dl. The values were generally higher than that in lager beer (Okon and Akpanyung, 2000). The RDA for zinc in adults is 15 mg (NRC, 1989). Sandstead (1995) reported that Zn deficiency is a public health problem.

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Table 1: Nutrients and Anti-nutrients in Malt Drinks*

	Sample code						
	A	B	C	D	E	F	G
Nutrients							
Sugar (mg/dl)	826.65±30.55	718.38±27.54	693.46±15.28	943.52±30.14	646.74±25.17	923.37±32.15	603.66±38.84
Protein (mg/dl)	31.65±6.11	33.23±5.71	27.54±2.52	35.28±2.33	32.83± 3.12	30.55±3.52	32.46±3.22
Vitamin A (µg/dl)	48.13±10.98	54.83±10.92	51.70±12.40	45.28±5.52	40.50±10.00	48.33±5.46	44.88±8.36
Vitamin C (mg/dl)	9.97±1.34	6.78±0.81	9.33±1.58	4.17±1.72	3.13±0.67	4.43±1.40	4.57±1.36
Fe (mg/dl)	0.13±0.04	0.50±0.10	0.25±0.08	0.45±0.06	0.25±0.06	0.33±0.07	0.54±0.08
Zn (mg/dl)	0.25±0.02	0.30±0.04	0.14±0.02	0.18±0.05	0.16±0.08	0.12±0.03	0.15±0.05
Cu (mg/dl)	ND	ND	ND	ND	ND	ND	ND
Antinutrients							
Phytate (mg/l)	9.22±0.17	7.50±0.04	6.79±0.08	7.50±0.05	6.50±0.04	5.72±0.05	6.66±0.02
Oxalate (mg/dl)	5.50±0.37	7.33±0.63	8.43±0.32	7.70±0.22	7.50±0.35	6.20±0.16	6.85±0.41
HCN (mg/dl)	0.36±0.06	0.54±0.00	0.57±0.05	0.25±0.06	0.63±0.04	0.46±0.03	0.38±0.00

ND = Not detected. * Values represent the mean of triplicate determinations ± SD for each sample.

The effects of Zn deficiency include delayed wound healing, suboptimal immune functions, increased plasma lipid peroxides and reduced taste/smell acuity (Fortes *et al.*, 1997).

Copper was not detected in any of the samples of malt drinks analyzed. This element is an essential component of many enzymes including the antioxidant enzyme, superoxide dismutase (Valentine and De Freitas, 1985). The antioxidant defense protects the body against the deleterious effects of free radicals (Halliwell and Gutteridge, 1989), hence, the need for adequate body stores of copper. Unfortunately, suboptimal intake of copper is common in developing countries (Olivares and Uauy, 1996).

The antinutrient levels of phytate, oxalate and hydrogen cyanide were low in the malt drinks. High levels of phytate and oxalate are known to exert negative effects on the bioavailability of some mineral nutrients (Passmore and Eastwood, 1986; Sandberg *et al.*, 1996). On the other hand, high levels of hydrogen cyanide inhibit the respiratory chain at the level of cytochrome oxidase (Lehninger, 1982). However, consumers of malt drinks are very unlikely to attain these toxic levels of the anti-nutrients.

Conclusion: The present study has shown that malt drinks produced in Nigeria are rich in sugar, protein, vitamin A and vitamin C. Nigerian breweries advertise that malt drinks are fortified with vitamins A and C. The wide variations in the level of these vitamins in the malt drinks call for proper standardization in the extent of fortification. The study also observes the need to consider additional fortification of malt drinks with essential mineral nutrients.

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