Hydrocyanate, oxalate, phytate, calcium and zinc in selected brands of Nigerian cocoa beverage

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Abstract. Hydrocyanate, oxalate, phytate, calcium and zinc were determined in five brands of cocoa beverage which were coded NC, BT, PN, CT and CA. Hydrocyanate ranged from 5.40 to 9.64 mg/100 g dry matter (DM), oxalate 68 to 146 mg/100 g DM, phytate 590 to 750 mg/100 g DM, calcium 28.7 to 116.4 mg/100 g DM and zinc 0.516 to 0.675 mg/100 g DM. The computed phytate:zinc, calcium:phytate and [calcium] [phytate]/[zinc] molar ratios ranged from 89 to 132, 0.80 to 3.01 and 0.64 to 3.03 respectively. The discussion is focused on toxic levels of hydrocyanate and oxalate, and the significance of the molar ratios in predicting the bioavailability of dietary zinc.

Introduction

Cocoa bean has been processed into numerous products including cocoa powder beverage, chocolate, cocoa butter, and so on [Are and Gwynne-Jones, 1975]. It is quite unfortunate, however, that reliable data on the levels of production and consumption of these products in Nigeria are not available. The various brands of cocoa beverage have probably been the most popular cocoa products, although chocolate products are now also becoming widely accepted.

Raw cocoa bean is fairly rich in nutrients, containing the following: crude protein, 14.3; fat, 42.8; carbohydrate, 29.3; crude fibre, 9.0; and ash, 4.6% among others. The protein is a good source of lysine (11.84 mg/100 g protein) [Are and Gwynne-Jones, 1975; Oyenuga, 1968]. Similarly, cocoa powder has also been shown to be a rich source of nutrients. Wood (1975) reported the following composition for cocoa powder: protein, 20.4; fat, 25.6; carbohydrate, 35.0%; and 452 calories/100 g. Cocoa powder ash contains variable amounts of calcium (51–130 mg/100 g); phosphorus (685–712 mg/100 g) and
iron (10–14 mg/100 g) (Buss and Robertson, 1976; Taylor and Coleman, 1979; Wood, 1975).

The variability in nutrient compositions of foods is attributable to various factors, one of the most important being the method of processing. The present study was undertaken to determine the variability of two nutritionally essential mineral elements, calcium and zinc in different commercial brands of cocoa beverage. Moreover, phytate and oxalate were determined because of their known effects on mineral metabolism and hydrocyanate because of its toxicity when ingested in large quantities.

Materials and methods

Materials

Five commercial brands of cocoa beverage (powder), three samples of each, were purchased at different locations and on different days to aid randomization of sampling.

Determination of moisture, phytate, oxalate and hydrocyanate

The moisture content of each sample was determined on a 2 g portion at 105°C for 2 h (AOAC; 1975).

Phytate was estimated by a modification of the method of McCance and Widdowson (1935) as described previously (Aremu, 1989). Briefly, phytate was extracted from the powder with dilute HCl, and precipitated from solution as ferric phytate by addition of a ferric chloride solution. The precipitate was subsequently solubilized by adding a dilute NaOH solution with heating to give a Na phytate solution which was treated with a mixture of concentrated H₂SO₄ and 65% perchloric acid to liberate phytate phosphorus. Finally, the inorganic phosphorus was determined by the AOAC (1975) method. Phytate content was calculated from inorganic phosphorus taking the molecular weight of phytic acid to be 660.

The determination of oxalate was done on 2.5 g of each sample by the method of Dye (1956). The sample was digested for 4 h at 50°C by addition of dilute HCl. An aliquot of the digest was evaporated to a brownish suspension which was filtered and the filtrate treated with concentrated ammonia. Oxalate was precipitated from the solution by treating it with a dilute CaCl₂ solution at 90°C. The precipitate was solubilised with hot dilute H₂SO₄ and titrated against a dilute KMnO₄ solution. The oxalate content was calculated taking 1 ml of 0.05 KMnO₄ as equivalent to 2.2 mg of oxalate.