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ZINC CONTENT AND STORAGE PERIOD IN FORMULATED AFRICAN INDIGENOUS FOOD PRODUCTS

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ABSTRACT- Preservation of agricultural produce is one of the central problems facing developing countries, where foods consumed are basically staple food crops and cereals. Owing to the lack or inadequacy of preservation methods, large quantities of urgently needed food spoil there. These problems will be aggravated by the growing dietary needs of these burgeoning populations. Six food products were formulated (cookies, pre-cooked flour, fermented four, noodles, crackers & sim-balls) based on indigenous grains, nuts, seeds, roots and vegetables as follows: finger millet (*Eleusine coracana*), groundnuts (*Arachis hypogaea*), simsim (*Sesamum orientale L.*), cassava (*Manihot esculenta*) and slenderleaf (*Crotalaria ochroleuca* and *Crotalaria brevidens*). Raw materials were dried, spatially roasted, grinded and fermented ready for product formulation. The formulations were analyzed for zinc content monthly for three months. Zinc analysis was done according to the standard procedure described in AOAC (2000). There were high zinc levels in the formulated indigenous food products which could be attributed to increased diversity of the crops used to formulate the products as not a single crop was used but a combination of at least two crops. As storage time increased, the content also increased, it is therefore evident that storage period increased zinc content of the products.

Keywords: Zinc,Indigenous, Food, African, Products

INTRODUCTION

Trace mineral deficiencies is a large health and nutrition problem affecting populations in both developed and developing countries (Institute of Medicine, Food and Nutrition Board, 2001). African Indigenous crops are important for dietary diversification, they are a rich source of many micronutrients needed for good health (Oniang'o *et, al.,* 2005 & Abukutsa-Onyango, 2003), and they contribute to income generation, food and nutrition security (Schippers, 2000 & Mnzava, 1997). Zinc deficiency is widespread in developing countries, but it's under-recognized because of lack of sensitive biomarkers of zinc status (FAO/WHO/IAEA, 1996). Zinc is required for the catalytic activity of approximately 100 enzymes (Sandstead, 1994 and Institute of Medicine, Food and Nutrition Board, 2001) and it plays a role in immune function (Solomons, 1998 & Prasad, 1995), protein synthesis (Prasad, 1995), wound healing (Heyneman 1995), and DNA synthesis (Institute of Medicine, Food and Nutrition Board, 2001 and Prasad, 1995), and cell division (Prasad, 1995). Zinc also supports normal growth and development during pregnancy, childhood, and adolescence (Simmer & Thompson, 1985; Fabris & Mocchegiani, 1995; and Maret & Sandstead, 2006) and is vital for proper sense of taste and smell (Prasad *et. al*., 1997).

A daily intake of zinc is required to maintain a steady state because the body has no specialized zinc storage system (Rink & Gabriel, 2000). A wide variety of foods including whole grains and plant-based foods are a good source of zinc (IMO, Food and Nutrition Board, 2001). Zinc concentrations in foods vary depending on environmental (soil, geographic location, fertilizer use, season, and water source) and inherent (genetics, age, maturity, and varieties) conditions of plants and food handling methods of processing, and cooking (IMO, Food and Nutrition Board, 2001). The purpose of the study is to assess the effect of storage period on the zinc content of formulated African indigenous food products.

This information is crucial to assess the risk of zinc deficiency or excesses if any emanating from eating indigenous food stored for a long period after product formulation given that these indigenous foods are highly perishable especially after processing and cooking.

MATERIALS AND METHODS

Source of Indigenous Crops (raw materials)

The foods used in this study were indigenous grains, nuts, seeds, leafy vegetables and tubers. They included: finger millet (*Eleusine coracana*), groundnuts (*Arachis hypogaea*), simsim (*Sesamum orientale L.*), and cassava (*Manihot esculenta*). They were bought from the open air market and used in food products formulation that involved innovative use of indigenous knowledge. Slenderleaf (*Crotalaria ochroleuca* and *Crotalaria brevidens*) were also incorporated in food product formulations; they were planted and harvested from Maseno University Botanical garden. Land preparation involved first and second tillage to ensure fine tilt. Furrows with small hoes were made 30cm from each other and in them farmyard manure (poultry manure) mixed with the soil thoroughly. Seeds were mixed with soil then drilled in these furrows and then covered with a thin layer of soil. After germination, thinning was done at a spacing of 15cm interplant and frequent weeding carried out to reduce competition for nutrients, water and sunlight. Irrigation was also done to supplement soil moisture.

Indigenous Foods Processing

The indigenous seeds, nuts, tubers and grains were dried, spartially roasted and underwent grinding in preparation for product formulation. Cultivated slenderleaf (*Crotalaria ochroleuca* and *Crotalaria brevidens*) was harvested separately, destalked and washed to remove surface soil contamination. The leaves were rinsed three times with distilled water and their life processes stopped immediately by blanching and dried under shade to minimize nutrient loss for product formulation.

Indigenous Food Products Formulations

Recipes were formulated and used to formulate three food products. The formulated products included: cookies (product-**1**), pre-cooked flour (product-**2**), fermented four (product-**3**), noodles (product-**4**), crackers (product-**5**) &

Table 1. Composition of formulated indigenous food products

Main Ingredients	Formulation name	Mixing ratios (in gram & percentage)
Millet flour + cassava flour + groundnuts flour + simsim powder + slenderleaf powder (bitter & mild)	**Cookies**	90g millet+66g cassava+120g groundnuts, 96g simsim+12.5g mild slenderleaf+10g bitter slenderleaf+½ cup H_2O+25g sugar+ 50g margarine +2g table salt+1.3%vinegar
Millet flour + slenderleaf powder (bitter & mild)	**Pre-cooked flour**	250g millet + 6.25g bitter slenderleaf + 6.25g mild slenderleaf + 2.5g salt
Cassava flour + millet flour	**Fermented flour** 1	25g cassava + 125g millet + 1cup H_2O at 37°C
Simsim flour + binder (gelatine) + slenderleaf powder (bitter & mild)	**Noodles**	96g simsim + 1.25g bitter slenderleaf + 1.25 mild slenderleaf + 1.5g binder + H_2O+ 0.75g salt + 1.3% vinegar + food color
Millet flour + groundnuts flour + Slenderleaf powder (bitter & mild)	**Crackers**	180g millet+211.5g groundnuts+6.25g mild slenderleaf+6.25g bitter slenderleaf+ 37.5g margarine+10g binder+37.5g sugar+ 1.3% vinegar+7.5g baking powder
Millet flour + cassava flour + Groundnuts particles + simsim seeds + slenderleaf dried leaves (bitter & mild)	**Sim-balls**	60g millet+60g cassava+60g groundnuts+ 360g simsim+30g mild slenderleaf+30g bitter slenderleaf+306.5g sugar

Zinc content analysis

Zinc analysis was carried out after every month according to the standard procedure described in AOAC (2000). Atomic Absorption Spectrophotometer was used with the wavelength of 213.9 nm, peak of 213.34 nm, slit width of 0.7 nm, lamp current low of 8 mA, and with emission lamp mode. The results were expressed in mg/100g. The formulated were packaged in polythene bags and kept under room temperature throughout the analysis period.

Data Analysis

Scores were computed into mean scores for various products and various time periods.

RESULTS

Formulated African Indigenous Food Product Recipes

Six food recipes (Table1) were formulated in the study; out of which six food producs were developed from African indigenous food crops. The objective of this study was to formulate food products from African indigenous crops. Using various formulated compositions (Table 1), the following procedures were used in the formulation of the following products.

Cookeis

Heat the oven to 350°F. Mix thoroughly flour, sugar and other dry ingredients then rubb in margarine. Mix as water is added little by little until soft then press evenly on bottom of a greased square pan. Bake for 10 min at 200°C. Remove from oven and leave to cool.

Pre-cooked flour

If using sugar or salt, grind them first. Mix all the ingredients and put them on a hot pan. Frequently turn the mixture on heat. Continue heating and turning until the mixture changes to golden brown color. Remove from heat and leave to cool.

Fermented flour

Warm wate to 37°C. Mix the flour and pour the water into the mixture. Mix them to form a paste in a metalic bowl. Tightly cover with a lid and keep in a warm place for 3 days. Remove and heat on a pan while frequently turning until it dries. When dry, leave to cool and grind into fine powder.

Noodles

Mix all the dry ingredients in a bowl and make a well in the centre. Add water little by little mixing thoroughly after each addition. Add enough water to form dough into a very light paste. Knead till smooth and elastic for about 10 minutes. Roll the dough into paper thin reactangle. Cut dough cross wise into inch strips for narrow noodles and ¼ inch strips for wide noodles. Shake out the strips and place on towel to dry for about 2hrs. When dry cook into 3 quarts boiling water (add salt) for 12 to 15 minutes or till tender. Drain throughly.

Crakers

Preheat oven to 175°C (350°F). Grease a large baking sheet. Whisk together the flours and vegetable powder in a bowl and set aside. Beat the margarine and sugar together until light. Stir in the flour mixture. Slowly pour in the water, stir until dough is formed. On a well floured board, roll dough to between and ¼ inch thick. Use knife or cookie cutter to cut dough into desired shapes, glaze them then bake in preheated oven for 10 minutes or until light brown. Remove crackers from oven and use a fork to pierce multiple holes on their tops.

Sim-balls

Mix all the dry ingredients except sugar and put a side in a metalic pan. Melt sugar on a separate pan, while hot mix in the dry ingredients and mould the misture into prefered shapes. Leave to dry and serve while cold or keep for later consumption.

Zinc Content of the Formulated Food Products as affected by Storage Period

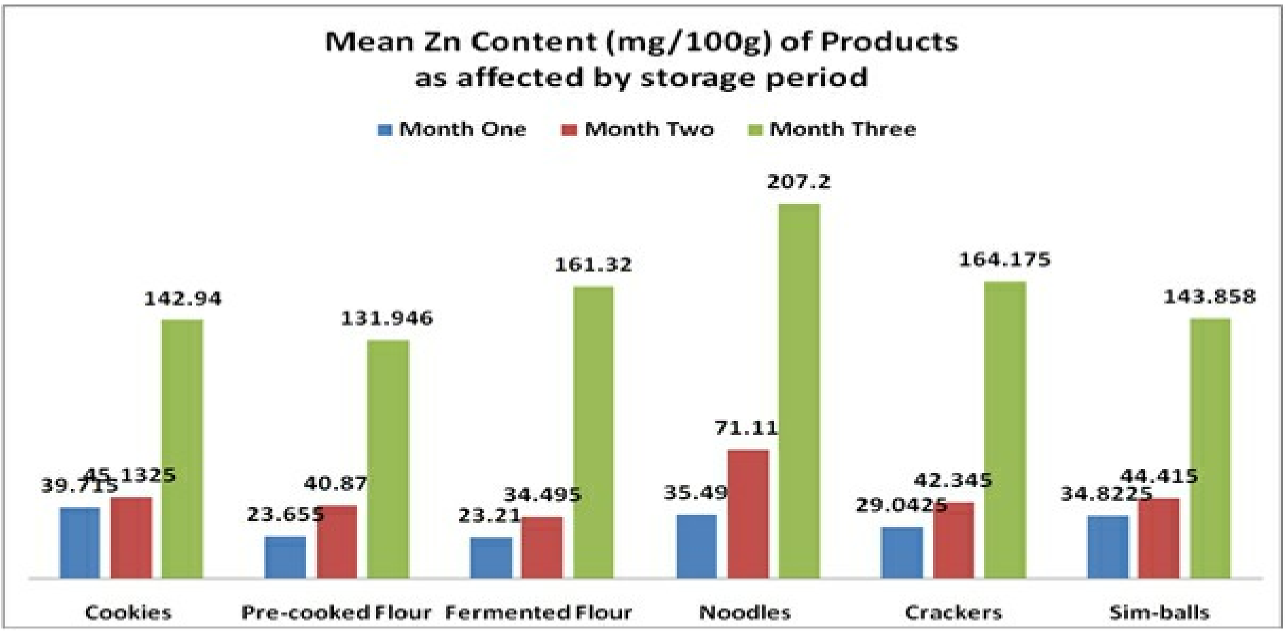

Fig.1. Mean Zinc Levels (mg/100g) in Formulated Products under Different Storage Periods DISCUSSION

It is well known that conditions of plants and food handling methods of processing, and cooking affect its zinc content (IMO, Food and Nutrition Board, 2001). Maximum Zinc RDA is set at 12 mg, this is far way below the levels found in the formulated indigenous products. These high levels could be attributed to the increased diversity of the crops used to formulate the products as not a single crop was used but a combination of at least more than two crops. As storage time increased, the content also increased, it is therefore evident that storage period increased zinc content of the formulated food products. Although zinc content is much high in these products, more research should be done on zinc bioavailability because according to (IMO, 2001; Sandstrom 1997; and Wise 1995) phytates, which are present in whole-grain, cereals legumes and other foods bind zinc and inhibit its absorption; and also to ascertain safe quantities which do not result to toxicity. Zinc deficiency occurs usually due to inadequate zinc intake or absorption, increased losses of zinc from the body, or increased requirements (Hambidge, 1989; King and Cousins 2005; & Prasad, (1996). People at risk of zinc deficiency or inadequacy need to include good sources of zinc in their daily diets like these formulated indigenous food products which contain higher levels of zinc.

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