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Food-To-Food Fortification of Ready-To-Eat Cereal-Based Porridges: A Potential Sustainable Food-Based Strategy to Improve Bioavailable Iron and Zinc in Plant-Based Diets

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Abstract

Introduction: Iron and zinc deficiencies are prevalent in Africa, often due to monotonous plant-based diets low in bioavailable minerals. Food-to-food fortification (FtFF) is an emerging tool in the fight against mineral deficiencies. However, due to rapid urbanisation in Africa, demand for convenience-type ready-to-eat staple foods is increasing. Thus, the effect of FtFF with combinations of plant foods rich in minerals (moringa leaves) and their bioavailability enhancers, namely organic acids (baobab fruit) and provitamin A (β-carotene) (mango, papaya) and together with a commercial micronutrient premix (MP) (iron (2.1 mg) zinc (1.65 mg), vitamin A (840 IU)) on iron and zinc bioaccessibility in ready-to-eat (extrusion-cooked) wholegrain pearl millet-based porridges was investigated.

Methodology: Three extrusion-cooked pearl millet-based porridges were formulated: 1) Pearl millet-carrot-mango-baobab-moringa; 2) Pearl millet-carrot-papaya-baobab; 3) Pearl millet-carrot-papaya-baobab-MP. Raw pearl millet served as the control. Porridge mineral, phytate and total phenolics contents were determined. In vitro equilibrium dialysability assay was performed to predict mineral bioavailability.

Results and Discussion: All the FtFF-porridges had greatly increased percentage and total bioaccessible iron, by up to 22-fold compared to the control. However, the porridges were unnaturally high in iron caused by contamination during the extrusion process. FtFF with combinations of carrot, papaya, baobab plus MP or with carrot, mango, baobab plus moringa leaves increased percentage and total bioaccessible zinc, by up to 4-fold, with the porridge containing MP enhancing iron and zinc bioaccessibility the most. The increases in the mineral bioaccessibility were likely primarily because the organic acids and β-carotene in the food fortificants enhanced the solubility of the contaminating iron and the intrinsic iron and zinc in the porridges. Also, extrusion cooking decreased the porridges' phytate contents, by 53-100% compared to their respective uncooked porridges. This may have reduced the phytate's chelating effect and contributed to the observed increases in mineral bioaccessibilities.

Conclusions: FtFF of ready-to-eat cereal-based porridges with combinations of baobab fruit, carrot, papaya, mango with moringa leaves, especially in the presence of abundant potentially available iron and zinc, as in micronutrient premixes, can be a sustainable food-based strategy to improve bioavailable iron and zinc in the diet of at-risk communities in Africa.

Biography: Oluyimika Y. Adetola

Oluyimika Adetola is currently a post-doctoral fellow at the Consumer and Food Sciences Department, University of Pretoria, South Africa. She had obtained a B.Sc. in Nutrition and Dietetics and later proceeded to acquire professional expertise in medical nutrition therapy in 2011, at the University of Nigeria Teaching Hospital, Nigeria. More recently, her interest has grown toward research focused on combating micronutrient deficiencies of iron, zinc and vitamin A in at-risk populations, notably women and children, especially in Africa, where high prevalence of these essential micronutrient deficiencies is prevalent. She believes that if properly harnessed, Africa has the potential to meet her nutritional needs with her rich and diverse indigenous food resources. This informed her M.Sc. Nutrition (2016) and recently completed PhD Nutrition (2021) research, which was on improving iron, zinc and vitamin A nutritive value of African staple foods by food-to-food fortification using widely and locally available micronutrient-dense plant foods.