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Extrusion Cooking Coupled with Food-To-Food Fortification with Baobab and Moringa Could be a Solution to Low Iron Bioavailability in Sorghum-Based Foods

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Abstract

Introduction: Iron deficiency is a major health concern in sub-Saharan Africa. In part, this is due to overreliance on diets based on cereals as they also contain inhibitors of iron bioavailability such as phytate and phenolics. Extrusion cooking is a process that applies high heat, pressure, and shear to raw food materials to produce ready-to-eat products. The application of high heat, pressure, and shear can destroy anti-nutrients in plant foods and hence enhance the bioavailability of minerals. Food-to-food fortification of cereal-based diets with micronutrient-rich plant foodstuffs is gaining increasing interest as a sustainable way to alleviate micronutrient deficiencies.

Methodology: Sorghum-based porridges (wet cooked or instantized using extrusion cooking) fortified with moringa leaf powder and baobab fruit pulp were prepared. Fortification of the sorghum porridges was done before processing. Iron bioaccessibility of the porridges was assayed as ferritin-formation by Caco-2 cells.

Results and discussion: Extrusion cooking enhanced ferritin-formation in Caco-2 cells (by 38%) compared to conventional cooking, most likely because extrusion reduced the contents of phenolics (by 33%) and phytate (by 17%), freeing more iron. Fortification with baobab and moringa reduced the ferritin-formation, with moringa causing significantly higher reductions, probably due to its high phenolic and phytate contents. The smaller reduction in iron bioaccessibility with baobab fortification was probably related to the promoting effect of organic acids on the iron present counteracting the low iron content of the food.

Conclusions: Extrusion cooking enhanced iron bioaccessibility measured as ferritin-formed by Caco-2 cells which is indicative of the enhancing effect of extrusion cooking on iron bioaccessibility. This is largely because it reduces the content of phytate (by dephosphorylation) and phenolic content (by degradation). While food-to-food fortification is an emerging strategy to combat iron malnutrition, this study revealed that the presence of mineral inhibitors in the foodstuffs, particularly moringa, could outweigh their mineral bioaccessibility-enhancing potential. Baobab while low in iron could hold the potential to enhance iron bioaccessibility in cases where there is sufficient total iron due to the high organic acids content. Extrusion cooking coupled with food-to-food-fortification with baobab could enhance iron bioaccessibility of whole-grain sorghum-based foods.