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Physicochemical and Functional Properties of Dry Bean, Orange-Fleshed Sweet Potato, Cassava, and Fermented Maize Composite Flours and Porridges

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Abstract

Maize (Zea mays L) is a dietary staple in developing countries, providing adequate calories but is limited in lysine and tryptophan essential amino acids and vital micronutrients such as vitamin A and iron. In addition, maize is used to prepare complementary foods introduced to infants after exclusive breastfeeding. However, complementary porridges made from maize flour are thick and viscous with high dietary bulk, which is difficult for infants to consume due to their limited oral-motor capacity. Consequently, these porridges are diluted with water to achieve a suitable consistency. Unfortunately, this leads to a further reduction in nutrient density. Therefore, this study aimed to utilize composite flour technology, maize decortication, fermentation, and food-to-food fortification to develop a nutrient-dense porridge with low viscosity.

Whole and decorticated maize flours were spontaneously fermented at 30°C for 32 hours and composited with dry bean (Phaseolus vulgaris) (a protein source), cassava (Manihot esculenta Crantz), and orange-fleshed sweet potato (OFSP) (Ipomoea batatas L) (pro-vitamin A source) flours. Six composite flours and their resulting porridges were formulated [Bean, Fermented maize (whole/decorticated), OFSP, Cassava flour] in 25:25:25:25, 40:20:20:20, and 50:15:20:15 ratios and analysed for proximate composition and functional properties (bulk density, water solubility index, water absorption capacity, texture, and pasting properties).

Decortication decreased the crude fat and fibre content, while bean flour increased protein content by 60% in the composite flours and porridges. Compositing increased the water solubility index while reducing the paste viscosity by 78% and textural properties (firmness and consistency) by 67% of the composite porridge compared to 100% whole maize flour porridge. The fermentation process led to the degradation and hydrolysis of starch structures to low molecular weight compounds with reduced water binding sites. Additionally, increased bean flour ratio in composite flours probably increased lipids and amylose content, possibly forming hydrophobic amylose complexes with limited water uptake capability. Limited water uptake reduced the starch swelling power leading to low viscosity. Fermented maize-bean-cassava-OFSP composite porridge had reduced viscosity, with the potential for easier consumption by infants and young children and to improve their nutritional status.