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Nutritional enhancement through germination: A comparative evaluation of pearl millet grains and microgreens for functional food application

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Abstract:
Pearl millet (*Pennisetum glaucum*), a climate-resilient staple cereal of Africa and South Asia, holds underutilized nutritional potential. Germination into microgreens offers a low-cost strategy to improve cereal nutritional quality. This study comparatively evaluated proximate composition, anti-nutrient content, antioxidant properties, and functional characteristics of pearl millet grains and microgreens for application in fortified functional food supplements. Grains were germinated under controlled conditions; both samples were analyzed for proximate composition (AOAC methods), anti-nutrients (phytates and condensed tannins), antioxidant activity (DPPH, ABTS, FRAP, TPC, TFC, and total antioxidant capacity), and functional properties. Proximate analysis revealed that grains had higher carbohydrate content (63.00 ± 0.16% DW) with moderate protein content (11.72 ± 4.39% DW), while microgreens showed markedly elevated protein (24.91 ± 3.01% DW) and ash content (2.35 ± 0.3% DW), indicating superior mineral density. Both samples contained phytates and condensed tannins within acceptable safety limits; phytate levels were 392.34 ± 17.45 mg 100 g^{-1} DW in grains and 437.06 ± 4.38 mg 100 g^{-1} DW in microgreens, with condensed tannins being minimal in both. Microgreens demonstrated substantially greater radical-scavenging activity: DPPH IC50 of 12.69 ± 1.02 µg mL^{-1} and ABTS IC50 of 11.41 ± 0.91 µg mL^{-1}, versus 38.40 ± 1.38 µg mL^{-1} and 36.27 ±0 .20 µg mL^{-1} in grains. Phenolic profiling confirmed superior antioxidant capacity in microgreens: TPC 0.767 ± 0.04 mg GAE g^{-1} DW, TFC 0.810 ± 0.03 mg CAE g^{-1} DW, FRAP 0.01 ± 0.006 µmol Fe^{2+} g^{-1} DW, and total antioxidant capacity 0.670 ± 0.03 mg AAE g^{-1} DW. Under functional properties, only the water absorption capacity showed slight differences; other characteristics remained the same. These findings support incorporating pearl millet microgreens as a nutrient-dense biofortificant in functional food products to address protein-energy malnutrition and micronutrient deficiencies in vulnerable populations.

Keywords: Antioxidant activity; Anti-nutrient properties; Microgreens; Pearl millet grains; Proximate analysis

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