

Extruded High-Protein Snacks Enriched with Alternative Proteins: Shelf-Life Stability, Nutritional Quality and Sensory Performance



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Snack products represent an attractive vehicle for increasing dietary protein intake while meeting consumer demand for convenient and sustainable foods. This study investigated the development of extruded protein snacks formulated with fava bean protein, YnMeal insect-based protein and freeze-dried Pleurotus mushroom protein. Products were manufactured through twin-screw extrusion and evaluated during storage up to 70 days under modified atmosphere packaging.

Physicochemical parameters, microbiological safety, texture evolution, nutritional composition and sensory quality were monitored throughout shelf life. All formulations remained microbiologically stable, with no detection of *Salmonella*, *Listeria monocytogenes* or *Escherichia coli* and low water activity values supporting ambient storage. Fava bean snacks achieved the strongest nutritional profile, qualifying for high protein, source of fibre, low fat and low sugar claims. YnMeal snacks exhibited the highest consumer acceptance scores, maintaining desirable crispiness and flavour throughout storage. In contrast, Pleurotus-based snacks provided valuable fibre enrichment but did not reach protein claim thresholds at the tested inclusion level. The findings demonstrate that alternative proteins can be successfully incorporated into extruded snack products, offering manufacturers a scalable route towards nutritious and shelf-stable sustainable snacks.

Recommendation: Consider extruded snacks as an effective format for delivering high-protein, nutritious and shelf-stable foods that meet consumer demand for healthy and convenient products.