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# Tempeh Fermentation Improves Nutritional Quality and Modulates Colonic Metabolite Production of Jack beans (*Canavalia ensiformis* (L.) DC.)

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**Abstract**

Jack bean (*Canavalia ensiformis* (L.) DC) is an underutilized legume with high protein and complex carbohydrate contents, but its utilization is limited by low protein digestibility. Tempeh fermentation using *Rhizopus oligosporus* has been recognized as an effective processing strategy to improve the nutritional and functional properties of legumes. This study investigated the effect of tempeh fermentation on the nutritional composition, in vitro protein and starch digestibility, and microbial metabolite production during colonic fermentation of Jack beans. Two preparations were compared: cooked beans (CB) and cooked tempeh (CT).

Jack beans were processed into CB through soaking, dehulling, and prolonged cooking, while CT was produced through acidification, cooking, inoculation with *R. oligosporus*, and incubation at 30 °C for 48 h. Compositional analyses included protein, starch, fiber, phenolic compounds, and amino acid profiles. In vitro gastrointestinal digestion was performed using the standardized INFOGEST protocol, followed by in vitro batch colonic fermentation using human fecal inoculum to evaluate short-chain fatty acids (SCFAs), γ-aminobutyric acid (GABA), and tryptophan (Trp) metabolites.

Tempeh fermentation significantly increased protein content (31.6% vs. 26.6%) and free phenolic compounds while reducing total starch and total fiber compared with cooked beans. CT also exhibited improved protein digestibility and lower starch hydrolysis during intestinal digestion, suggesting a reduced glycemic impact. During colonic fermentation, both CB and CT produced comparable concentrations of total SCFAs and GABA. However, CT generated a higher proportion of propionate, whereas CB produced significantly higher levels of total Trp metabolites, particularly indole, indole-3-acetic acid, and indole-3-propionic acid. The lower production of Trp metabolites in CT was associated with reduced amounts of undigested protein reaching the colon after gastrointestinal digestion.

Overall, the findings demonstrate that fungal fermentation improves the nutritional quality and digestibility of Jack beans while maintaining the production of beneficial microbial metabolites. Tempeh processing therefore represents a promising strategy for developing sustainable plant-based foods with enhanced nutritional functionality and potential metabolic health benefits.

**References**

[1] F. A. Purwandari, V. Fogliano, E. Capuano, “Tempeh Fermentation Improves the Nutritional and Functional Characteristics of Jack beans (*Canavalia ensiformis* (L.) DC)”, Food Function, Vol. 15, pp. 4680-3691, 2024.

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