

# MEAT ANALOGUE PRODUCTION FROM FERMENTED OKARA, TO IMPROVE SENSORY AND FUNCTIONAL PROPERTIES, AS WELL AS OXIDATIVE STRESS REDUCTION

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## I. OBJECTIVES

The aim of this research was to develop meat analogues based on okara (a byproduct of soy milk production, usually used as animal feed) with sensory properties similar to those of meat products, as plant-based diets are more sustainable and have greater environmental benefits by utilizing considerably fewer natural resources than meat-based diets.

## II. MATERIALS AND METHODS

Chemical compositions of okara (raw protein content, fat content, saturated fatty acids, total fiber content, and carbohydrate content) were analyzed by standard methodologies, besides evaluating sensory and textural properties. Protein content was calculated, according to ISO 20483: 2007. Fiber content was determined, according to AOAC 985.29: 1990. Fat content and saturated fatty acid were measured, according to ISO 12966-1:2015 and ISO 12966-2:2017, respectively. Total amino acid composition was analyzed, according to ISO 17025:2005. Water as well as oil absorption capacity were measured. Protein oxidation levels of press cakes were measured by applying the methods described by Soglia et al. (2016).

## III. RESULTS

Chemical composition of okara clearly shows that it is a rich source of protein, fiber, essential amino acids, and energy with a low amount of saturated fatty acids. Normally, microbiological contamination of byproducts, such as okara, is high, therefore thermal treatment of okara is necessary before further usage. Due to the low sensory quality of okara, lactic acid fermentation was applied with the aim to reduce its unpleasant flavor, besides improving the protein digestibility. Okara samples were fermented by 4 specific *Lactobacillus* strains. After fermentation, meat analogues were produced based on fermented okara. The functional properties (water-/oil-holding capacity; effective on juiciness/oiliness of products) and protein oxidation levels of products were analyzed. Instrumental color testing showed no significant differences ( $P < 0.05$ ) on lightness, yellowness, and redness of the meat analogue products, in comparison with the control (vegan) sample. There were no significant differences between okara-based meat analogue products, regarding water-holding capacity values or meat analogues mass spreadability or hardness, measured instrumentally. Results of sensory analysis revealed that meat analogues from okara fermented by *L. plantarum* and *L. brevis* strains had more neutral and slightly acidic smell and taste and decreased bitterness perceived in okara. However, those products incorporated with okara fermented by *L. acidophilus* strains showed more dry texture and significant increase of oil-holding capacity values than other strains, resulting in an intensive oily mouthfeel of products. Carbonyl content analysis of those products using *L. acidophilus* strains for fermentation of okara showed a more significant reduction in protein oxidation between products.

#### IV. CONCLUSION

This research demonstrated the potential of fermentation of okara by applying *L. plantarum* and *L. brevis* strains (as sensory properties' improver) and *L. acidophilus* strains (as functional properties' enhancer and protein oxidation reducer) beside the pasteurization process to convert okara into a suitably applied ingredient in the matrices of the meat analogues. However, further research is necessary for protein quality analysis, and to get juiciness and mouthfeeling similar to meat products.

Keywords: lactic acid fermentation, meat analogue, okara, protein oxidation, water- and oil-holding capacity