Optimization of the canning parameters of bambara groundnuts (Voandzei subterranea) using response surface methodology

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Optimization of the canning parameters of bambara groundnut (*Voandzea subterranea*) seeds using response surface methodology

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**Abstract:**
Response surface methodology was used to study the optimal pre-processing conditions that would yield the best quality canned product from bambara groundnuts. Pre-canning parameters such as blanching time, soaking time and sodium hexametaphosphate [(NaPO₃)₆] salt concentration were used as the independent variables for a Central Composite Rotatable Design (CCRD) for the canning of the bambara groundnuts and the quality characteristics (moisture content, drained weight, leached solids and seed hardness) of the canned products. Regression models were generated and their adequacy used to predict the optimum response values using blanching time of 2-12 min, soaking time 0-24 h and salt concentration [(NaPO₃)₆] of 0-1%. The optimal conditions were determined using regression models. The results revealed that soaking time, blanching time and salt concentration all significantly (p<0.05) influenced most of the quality indices of the canned products. Soaking and blanching caused significant reductions in the hardness of the seeds with consequential increases in the moisture content, drained weight and leached solids. The presence of the sodium salt influenced the hardness of the seeds. Increasing salt concentration increased the drained weight and seed hardness but decreased the splitting of the products. The optimal conditions required to achieve the optimum moisture content, pH level and other quality indices studied on the canned bambara groundnuts were blanching time of 5 mins, soaking time of 12 hours and [(NaPO₃)₆] salt concentration of 0.5 %.

**Introduction:**
Bambara groundnut (*Voandzea subterranea*) is the third most important pulse legumes in Africa. Nutritionally, it serves as a low cost protein and has 6-12% oil, 14-24% protein and 28-40% carbohydrates. They make a well-balanced food with a caloric value equal to that of a high-quality cereal grain (FAO, 1988). In spite of its wide utilization as food in most developing countries, its availability is seasonal and therefore limited to its harvesting season, making it unavailable all year round. Canning of the bambara groundnuts is therefore suggested to increase its availability all year round and to provide alternative food processing approaches to the commodity. This work was therefore aimed at optimizing the processing conditions for the canning of bambara groundnut using response surface methodology for varying soaking time, blanching time and sodium hexametaphosphate [(NaPO₃)₆] salt concentrations.

**Materials**
The bambara groundnut was obtained from the Crop Research Institute of the Council for Scientific and Industrial Research (CSIR) of Ghana and used for the study. A Central Composite Rotatable Design (CCRD) of the experiment was used with independent
variables; blanching time (X₁), soaking time (X₂) and sodium hexametaphosphate concentrate (X₃). The dependent variables studied included the following: moisture content of the canned cowpeas, pH of drained liquid, drain weight of canned product, seed splitting, leached solids and hardness of canned bambara groundnuts. Twenty sample combinations were generated from the software in experimental design using the design matrix and variable combinations in experimental runs.

**Analytical methods:**

The moisture content and pH of the samples were determined using the AOAC (1990) methods 950.40 and 14.078. The experiment was conducted in triplicate and the mean value determined. Leached solids were measured by drying 10 ml aliquot of the drained water from samples after canning at 105°C in an air oven for 24 hours. The weight of the residue was determined after drying. Drained weight of the bambara groundnuts noted (Pearson, 1976). Seed Hardness was determined using a TA-XT2 Texture Analyser (Stable Micro Systems, Surrey, England). All the statistical analysis and graphical presentations were done using Statgraphics (Graphics Software Systems, STCC, Inc, Rockville, USA). The significant probability was set at p≤0.05.

**Result and discussion:**

The results revealed that the soaking time, blanching time and salt concentration all significantly (p<0.05) influenced most of the quality indices of the canned bambara groundnuts. Increasing salt concentration had a significant effect on the physical characteristics on bambara groundnut variety.

**Conclusion:**

The optimal pre-processing conditions required to achieve the optimum quality of canned bambara groundnut were blanching time of 5 mins, soaking time of 12 hours and [(NaPO₃)₆] salt concentration of 0.5%.

**References:**
