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Effect of Some Selected Processing Routes on the Nutritional Value of Soy Yoghurt

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Abstract: The processing methods of soymilk were investigated with major focus on their effects on the nutritional values of soy yoghurt. Various chemicals such as: sodium hydroxide, sodium carbonate, sodium hydrogen carbonate and deionized water were used for treating different samples of soybeans. Soy yoghurt was prepared from the soymilk obtained from all the samples using a mixed starter culture containing *Streptococcus thermophilus, Lactobacillus bulgaricus* and *Lactobacillus acidophilus.* The yoghurt produced from the soymilk formed from soybeans sample treated with sodium carbonate solution recorded the highest mineral content (potassium-136.6ppm, calcium-179.7 ppm, magnesium-652.2 ppm, sodium-495.0 ppm). Samples A and D with additional nutrient recorded pH value of 4.76 and 3.90 after 2 h of fermentation, respectively. This observation was due to the rapid increase in acid formation in the course of product formation. Sensory test evaluation revealed that soy yoghurt produced from soybeans sample treated with sodium hydroxide solution had the highest ratings in terms of taste, texture and overall acceptability.

Key words: Flatulence, soybeans, fermentation, culture

INTRODUCTION

Soybeans cultivation and utilization which originated in China more than 3000 years ago, subsequently spread through Orient[1]. There have been reports of successful cultivation of soybeans in Africa with Nigeria being the leading producer[2]. The United States produced 75 million metric tons of soybeans in 2000, representing 50% of the global production.

The economic recession and high level of poverty with the resulting low standard of living characterized by malnutrition in developing nations can be eased by rich grain legume like soybeans[3-5]. Soybeans being one of the plants with high protein content[6,7], is a potential food material that contains all essential amino acids that are very important for the proper development of the body. Particularly soybean has an exceptionally high content of lysine in comparison to other plant proteins[5]. Soybeans is richer in proteins than most mammal milk containing up to about 39% proteins compared with 1.0-5.6% protein content of most mammal milk[8] .

Soybeans and soy products are well known for their health benefits. These include reduction in cardiovascular diseases via reduced blood lipid and cholesterol, reduced risk of various cancers, control of menopausal symptoms, weight control and longevity[9]. Intake of fermented soymilk improves the ecosystem of the intestinal tract in the body by increasing the amount of probiotics[10].

However, soybeans require adequate processing for it to become nutritionally valuable[11]. Some antinutritional compounds (e.g. trypsin inhibitors and hemagglutinins) are naturally present in soybeans, which need to be eliminated or at least inactivated[3,5]. These compounds, if fermented by the natural microfloral present in the lower intestine result in the formation of carbon dioxide, hydrogen and methane leading to flatulence[12,13]. The high nutritive value of soybeans can be appreciated and harvested as a suitable protein food, if these problems can be solved. Pinthong *et al.*[14] have shown that it is possible to develop a yoghurt-like product from soymilk supplemented with glucose and yeast extract through fermentation by lactic acid bacteria, including *streptococcus thermophilus* and *Lactobacillus bulgaricus.*

This ability of the organism combined with anticarcinogenic activity demonstrated by several compounds contained in soybeans made this study imperative, especially at this period of increased epidemic reports and cancer incidence in most developing nations. The need to improve and supplement human diet at

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cheaper and more affordable price is the principal reason for this research work. This study therefore, describes the effect of processing routes on the nutritional value of soy yoghurt.

MATERIALS AND METHODS

Soybeans (*Glycine max*) yellow variety was purchased at Arada Market, Oyo State, Nigeria; a mixed starter culture (developed from partially fermented cow milk known to contain the lactic acid bacteria-*Streptococcus thermophilus, Lactobacillus bulgaricus* and *Lactobacillus acidophilus)* was obtained from the Department of Food Science and Technology, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria. Analar grade reagents were used in preparing 0.25% Sodium hydroxide, 0.25% Sodium carbonate and 0.50% Sodium hydrogen carbonate. Other substances used included deionized water, vanilla flavor, stabilizer and thickener, glucose, lactose and preservatives.

Preparation of soymilk: Four samples of soymilk were prepared using different processing routes shown in Fig. 1. The procedures followed are discussed:

Sample A: Whole soybeans, weighing 500 g, were soaked in boiling water for 45 min and dehulled. The dehulled soybeans were soaked in an alkaline solution (0.25% Sodium hydroxide) for 24 h. The solution was changed, intermittently, every two hours. After 24 h, the beans were then thoroughly rinsed with deionized water and boiled in fresh alkaline solution for 30 min. before being thoroughly washed and finally rinsed with deionized water. The beans were then milled to very thick smooth slurry or paste which was diluted with hot water and filtered through a 0.75 mm sieve. The filtrate obtained was transferred into another container and the content was cooked and boiled for 30 min. The hot mixture was aseptically poured into a new container and stored. It was later sterilized at 120^{0}C and15 psi for 20 min. The hot sterile soymilk was then cooled in a cold-water bath to 45^{0}C before 15 g of lactose and 20 g of glucose and other additives were added.

Sample B: The main difference in the preparation procedure for this sample was that the dehulled beans were soaked in 0.25% Sodium carbonate solution for 24 h and solution was changed intermittently in every 2 h and nutrient (glucose and lactose) was not added. The soybeans were boiled in deionised water before further processing as in Sample A.

Sample C: The preparation procedure for this sample followed the same route with that of sample A except that, the dehulled beans were soaked in 0.5% Sodium hydrogen carbonate solution and was boiled in fresh 0.5% $NaHCO_3$ for 30 min and lactose and glucose was not added. The soybeans were washed repeatedly in deionized water before further processing as in the Sample A.

Sample D: In this sample, deionized water was used to soak the soybeans after it had been dehulled as in the other samples stated above. The beans were soaked in deionized water for 24 h and the water was changed intermittently in every 2 h. The beans were later boiled in deionized water for 30 min before further processing as in Sample A.

Preparation of the soy yoghurt: The starter culture was introduced into the sterile soymilk sample and incubated at 43°C in a thermostatically controlled incubator. The total period of incubation allowed was 16 h for proper fermentation to take place upon which the semi - solid soy yoghurt was formed. The soy yoghurt sample was then stored in a refrigerator at 4°C so as to preserve it.

Mineral analyses: The mineral analyses of all the samples were carried out using the Atomic Absorption Spectrophotometer-AAS (Alpha 4, Chem. Tech. Analytical, UK).

Determination of pH: A digital pH meter (CD70 WPA Linton Cambridge, UK) was used for the determination of pH values of all the samples. The meter was first calibrated using buffer solutions of pH values of 7 and 4.01, respectively before the pH of each sample was measured. The pH of the soymilk samples were measured at interval of 1 h for the first six hours.

Sensory evaluation of samples: A total of 10 panelists, who were selected randomly, assessed the quality of the yoghurt samples through sensory evaluation. The hedonic rating test was used and the extent of the differences between the yoghurt samples for each quality was measured on a standard nine-point hedonic scale[15]. The panelists rated the yoghurt samples successively on a scale ranging from 1-dislike extremely to 9-like extremely. The sensory qualities assessed were colour, taste, aroma, firmness, and overall acceptability.

RESULTS AND DISCUSSION

In Table 1, the analysis revealed that the potassium content (136.0 ppm) of Sample A was the highest while the calcium content (179.7 ppm), magnesium content (652.2 ppm) and sodium content (495.0 ppm) of Sample B were found to be the highest of all the samples. However, Sample D recorded 240.0 ppm of Iron content being the highest of all the samples. The variation observed in the mineral contents of all the samples could be as a result of the different treatments that each sample had undergone

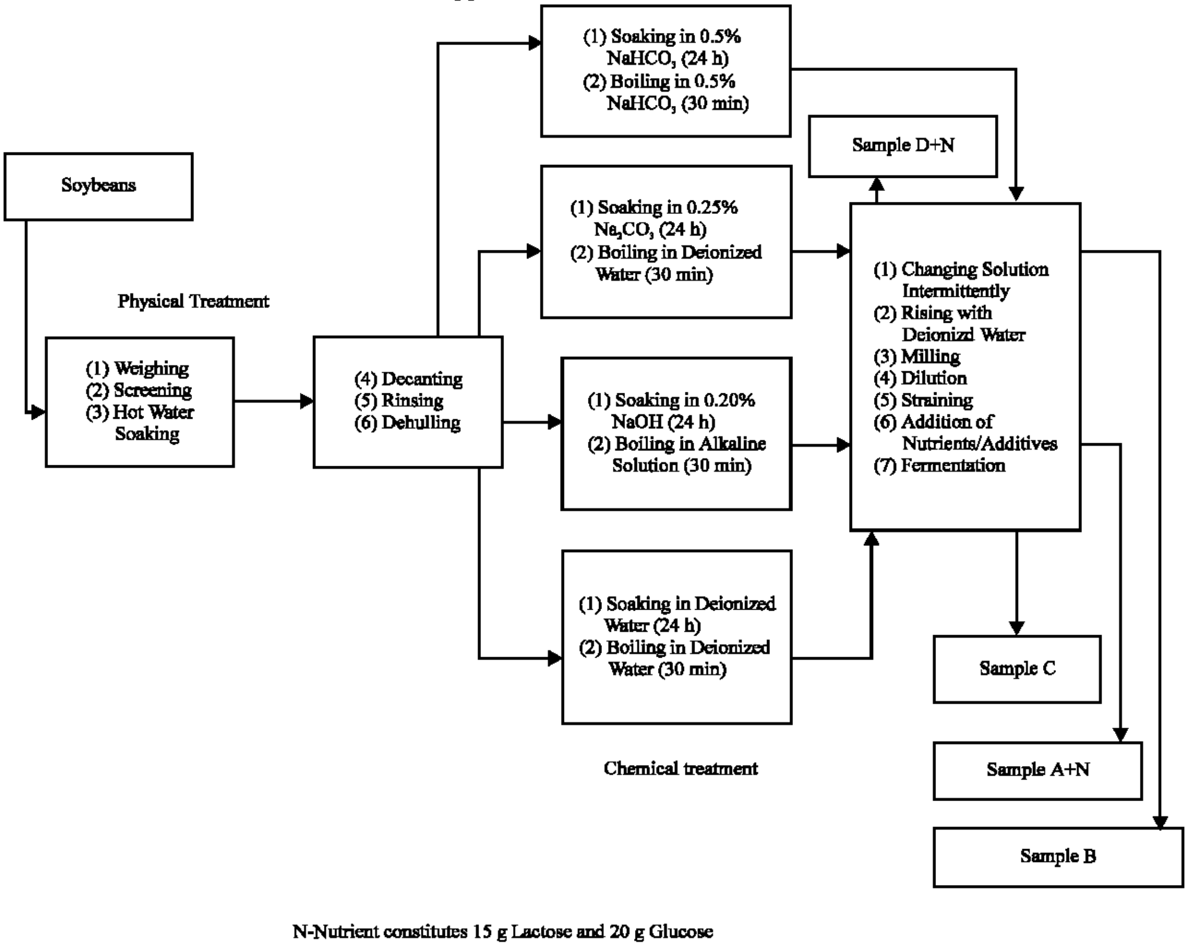

Fig. 1: The process diagram showing the different processing routes for preparation of soy yoghurt

and to that extent demonstrate the level of supplementation obtainable by consuming the products. Meanwhile, the soy yoghurt samples developed from soymilk produced from soybeans treated with 0.25% Na_2CO_3 solution had the highest mineral content (Table 1).

Effect of processing routes on the pH during fermentation: The time dependence of the pH values presented in Table 2 indicates that the rate of acid formation during fermentation is high. This observation implies that the fermentation can be stopped after few hours if the pH range of 3.63 - 4.02, which has been found to be acceptable for yoghurts[16], is chosen as reference. The initial pH values of Sample B and C were neutral, which favored the growth of the microorganisms in the starter culture and in essence extend the fermentation time further for an improved product. This is comparable with the fermentation time used in production of most industrial yoghurts[17].

Effect of processing routes on the sensory attributes of the soy yoghurt: Statistical analysis showed that the colour observed for various soy yoghurt samples was not significantly different (Table 3). This may be due to the fact that the four soy yoghurt samples were produced from the yellow variety of soybeans. The heat and chemical treatments applied to the soybean samples did not produce a significant difference in the colour of the soy yoghurt samples produced. The mean values obtained for the colour of the soy yoghurt samples support the above observation (Table 3).

In addition, Table 3 shows that Sample A had the most preferred taste while Sample B had the least. This may be attributed to the heat treatment and the concentration of chemical used in treating Sample B[11]. However, the use of chemicals on Samples A and C greatly improved their tastes. This could be as a result of the inactivation of the trypsin inhibitors, haemagglutinin and urease that was achieved via the chemical and heat treatments[3, 5]. The mean values recorded for the aroma of each samples (Table 3), were not significantly different except for Sample B that had the least value. This observation in Sample B may be the resultant effect of the heat and chemical treatments or unidentified reaction pathways especially during the chemical treatments.

Table 1: Mineral analysis for each soy yoghurt samples produced

Mineral	Sample A	Sample B	Sample C	Sample D
Potassium	136.0	126.6	105.9	94.5
Calcium	118.5	179.7	113.7	96.3
Magnesium	342.3	652.2	309.3	280.2
Iron	84.0	75.0	189.0	240.0
Sodium	468.0	495.0	321.0	444.0

Table 2: Variation of pH with fermentation time during production of soy yoghurt from soybeans

Fermentation Time (h)	Sample A	Sample B	Sample C	Sample D
0	9.23	7.0	6.93	5.51
1	5.55	4.73	4.8	4.05
2	4.76	4.45	4.32	3.90
3	4.46	4.02	4.02	3.63
4	4.19	3.69	3.8	3.36
5	4.19	3.73	3.68	3.29
6	4.12	3.82	3.74	3.31

Table 3: Mean ranks for quality attributes of yoghurt samples

Attribute	Sample A	Sample B	Sample C	Sample D
Colour	6.8	6.4	6.5	5.8
Taste	5.4	2.6	5.3	3.2
Aroma	6.9	3.4	5.9	6.9
Consistency/Firmness	6.6	4.4	4.9	6.0
Overall acceptability	6.8	4.3	4.7	3.5

Meanwhile, the 'beany' flavor or off-flavour of the soybeans, which is strongly linked to the action of the lipoxygenase enzyme[1], was successfully masked with the vanilla flavor (Table 3). However, the firmness/consistency of the samples varied significantly. The sample that had the most preferred consistency/firmness was Sample A, followed by Sample D. Sample A was accepted overall to be the best out of all the samples under consideration, making sodium hydroxide a good candidate for treating soybeans before fermentation.

CONCLUSION

In conclusion, it is possible to produce yoghurt that is rich in mineral elements and acceptable to consumers from soymilk.

REFERENCES

1. Hosken, B., 2003. Advances in soybean processing and utilization. 12th Australian Soybean Conference Proceeding, www.australianoilseeds.com.
2. Ade-Omowaye, B.I.O., J.O. Olajide, E.T. Otunola and V.A. Omotade, 2004. Effect of some processing parameters on the quality characteristics of soybean curd. Sci. Focus, 7: 53-57.
3. Burton, J.W., 1985. Breeding Soybeans for Improved Protein Quality and Quantity. In: Proceeding of the 3rd World Soybean Research Conference, (Shibles R. Ed.) West Views Press, Boulder, Colorado, pp: 136-165.
4. Nelson, A.L., L.S. Wei and K.G. Wangartner, 1987. Home and Village Preparation of Soya Products in Soybean for the Tropics, John Willey and Sons U.K.
5. Anonymous, 1997. Agriculture, food and nutrition for Africa-A resource book for teachers of Agriculture. FAO, Rome, Italy. (http://www.fao.org), 23rd August, 2005.
6. Onwueme, I.C. and T.D. Sinha, 1991. Field crop production in Tropical Africa. C.T.A Netherlands, pp: 337-342.
7. Berk, Z., 1992. Technology of production of edible flours and protein products from soybeans. FAO Agric. Ser. Bull. 97, Rome Italy. (http://www.fao.org).
8. Zeman, J.F., 1983. Clinical Nutrition and Dietectics. The Collamore Press, Toronto, pp: 26-27.
9. Messina, M.J., 1999. Soyfoods, Their Role in Disease Prevention and Treatment. In: Soybeans: Chemistry, Technology and Utilisation (Lui Ed.), Aspen Pub Inc. Maryland, pp: 442-448.
10. Cheng, I.C., H.F. Shang, T.F. Lin, T.H. Wang and H.S. Lin, 2005. Effect of fermented soy milk on the intestinal bacterial ecosystem. World J. Gastroenterol., 11: 1225-1227.
11. Tamine, A.Y. and H.C. Deeth, 1980. Yogurt: technology and biochemistry. J. Food Prot., 43: 939-977.
12. Christofaro, E., F. Mottu and J.J. Wuhrmann, 1974. Sugars in Nutrition, (Sipple, H.L. and K.W. McNutt Eds:), Academic Press, New York, pp: 768.
13. Alais, C. and G. Linden, 1991. Food Biochemistry. France, Aspen Publishers Inc., pp: 133.
14. Pinthong, R., R. Macrae and J. Rothwell, 1980. The development of a soya based yoghurt Part II: sensory evaluation and analysis of volatiles. J. Food Technol., 15: 647-652.
15. Taiwo, K.A., C.T. Akanbi and O.O. Ajibola, 1997. Establishing processing conditions for canning cowpea seeds in tomato sauce. Intl. J. Food Sci. Technol., 32: 313-324.
16. Fávaro Trindade, C.S., S.C. Terzi, L.C. Trugo, R.C.D. Modesta and S. Couri, 2001. Development and sensory evaluation of soy milk based yoghurt. Archivos Latinoamericanos Nutr., 51: 1-10.
17. Robinson, R.K. and A.Y. Tamine, 1986. The Role of Protein Yoghurt. In: Developments in Food Proteins. England, Elsevier Applied Science Publishers Ltd, 4: 8, 21-28.