

Effect of Flavourings on Quality and Consumer Acceptability of Soy-Yoghurt

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Abstract: *In spite of the characteristic objectionable painty odour, soybean is an attractive value added food grain because of its higher nutritive value. The effect of different flavourings on the quality and acceptability of soy-yoghurt were studied. The flavourings were added at 5% (W/V). Soy-yoghurt flavoured with synthesized vanilla, banana, strawberry, pineapple and natural ginger flavourings, control without flavouring and commercial yoghurt were all compared for proximate, pH, percentage lactic acid, specific gravity, soluble solids, percentage syneresis and microbial count. Sensory evaluation was also conducted in order to determine the acceptability of the samples. The protein content of plain soy-yoghurt was 3.33; commercial yoghurt was 3.74 while that of flavoured soy-yoghurt ranged from 3.47 and 3.69. The pH and %lactic acid contents ranged from 4.2-5.0 and 0.70-1.31 respectively on the second day of storage while the values were 4.0-4.7 and 1.30-1.71 on the eighth day of storage at refrigeration temperature. The lactic acid values increased with decreasing pH values. The %syneresis ranged from 41.30-54.09 and 42.65-56.21 for flavoured soy-yoghurt while it was 37.75 and 38.13 for plain soy-yoghurt on the second and eighth day of storage. The values increased with increasing storage days. Microbiological examination revealed that the samples were within the minimum acceptable standards. The sensory evaluation also showed that there was no significant difference ($P \leq 0.05$) for taste, consistency and overall acceptability among all the samples. However, banana soy-yoghurt was the most preferred by the sensory panelists with respect to all quality attributes except consistency while ginger soy-yoghurt was the least preferred with respect to all quality attributes except taste.*

Key Words: *Consumer acceptability, flavourings, objectionable painty odour, quality, soy-yoghurt.*

I. Introduction

Yoghurt is pasteurized milk or low-fat milk coagulated to a custard-like consistency with a mixed pure lactic acid culture containing *Lactobacillus bulgaricus* and *Streptococcus thermophilus* [1]. It is most often flavoured with fruit preserves or other ingredients but is also consumed unflavoured (plain yoghurt). Yoghurts are usually eaten as such but can be used as ingredients in desert products and candy bars and as frozen soft-serve product. Yoghurt products have high viscosity and generally set in weak gel. To enhance gel formation and to increase the viscosity of the finished product, a high solid content is desirable. In most cases, concentrated milk or non-fat dry milk is added to increase the solid content [2].

Yoghurt, a fermented milk product obtained by souring of milk using a mixed pure lactic acid culture can be manufactured from liquid cow milk, powdered milk and vegetable milk (soymilk) as base materials [3]. Milk is a unique substance in that it is consumed as fluid milk with minimal processing and it is the raw material used to manufacture a wide variety of products. Milk also has unique nutritional properties that make it an especially important food, particularly for the young ones. Milk is the normal secretion of the mammary glands of all mammals. Its purpose is to nourish the young of the species. The nutritional needs of species vary and so it is not surprising that the milk from different mammals differs in composition [1]. Milk provides the sole source of nourishment during the period directly after birth for a newborn mammal of the particular species of animal. It has a high nutritional value and thus, cow's milk is not only a complete food for babies and young children but also an excellent and valuable food for adults [4].

Soymilk is milk produced from soybeans. Soybeans are generally considered to be a source of complete protein. A complete protein is one that contains significant amount of all the essential amino acids that must be provided to the human body because of the body's inability to synthesize them. For this reason, soy is a good source of protein, amongst many others, for many vegetarians and vegans or for people who cannot afford milk and meat, since it is the least expensive source of dietary protein. The gold standard for measuring protein quality, since 1990, is the Protein Digestibility Corrected Amino Acid Score (PDCAAS) and by this criterion soy protein is the nutritional equivalent of meat and eggs for human growth and health. Soybean protein isolate has a biological value of 74, whole soybeans 96, soybean milk 91, and eggs 97 [5]. The increasing concern about fat and cholesterol content of animal milk is another factor promoting the selection of vegetable substitute for animal milk. Unsaturated fatty acid in the diet is recommended to reduce the incidence of cardiovascular disease [6]. Consumption of vegetable milk may also be beneficial in cases of lactose intolerance.

Efforts have been devoted to exploiting soybean and soybean products for the manufacture of palatable food products [7]. Products obtainable from soymilk include soy yoghurt, soy cheese, soy ice cream and the likes. Enrichment of cereal-based traditional weaning food by complementing with soybean tempeh has been reported [8]. These attributes have been reported to make soybean potentially an excellent food crop for the protein deficient countries of the world [9] [10].

One of the major limiting factors that are hindering the use of soybeans in foods is the flavour, which is objectionable. Flavours are very important in food appreciation [11]. It is a complex of sensations derived from food, including the sensations of taste and smell [12]. However, flavour play a very important role in the judgment of the consumer and in this respect, the off-flavor inherent in unrefined soy-products places them at a distinct disadvantage [2]. Volatile components or compounds that arise from three main sources, including the beans themselves, processing and deterioration during storage, are responsible for highly characteristic odour associated with soybean and its various products, which in many case are undesirable and even offensive. As a result, there is need to suppress these odours by subjecting the products to different flavours. The use of different fruit flavourings in soy-yoghurt has been attempted increasingly.

II. Materials And Methods

2.1. Materials

The Soybean seeds were obtained from Bodija market in Ibadan, Oyo State. Good quality and mould-free seeds were selected. Electric cooker, steam/water bath, hammer mill, plastic bowls, muslin cloth, thermometer, blender, freezer, beaker, electric oven, conical flasks, stirrer, chemical and media were gotten from the Food Processing Laboratory, University of Ibadan, Oyo State. Also, materials like stabilizer (Carboxyl Methyl Cellulose, CMC), sucrose (granulated sugar), glucose, synthetic flavours (banana, pineapple, strawberry, vanilla) and ginger powder were purchased from a retail shop in Ibadan, while freeze-dried starter culture was purchased from a supermarket in Ojota, Lagos State.

2.2. Methods

2.2.1. Production of Soybean Milk

1000g of soybean seeds were cleaned and soaked overnight in cold 0.5% NaHCO₃ solution with plenty of cold water (5000cm³). The soaked bean was then blanched in 0.5% NaHCO₃ solution for about 10 minutes, washed in cold water and milled into paste while water was added in ratio 1:4 to give 12% total solid. The slurry was strained and the recovered milk was cooked for about 20-30minutes at 82⁰C while stirring continuously with a wooden stirrer to prevent from burning. The milk was homogenized using a blender and cooled to 45⁰C [13] [14] [15]. Fig 1 shows the flow chart for soymilk production.

2.2.2. Production of Yoghurt

The recovered milk (soymilk) was used to prepare yoghurt. Various step involved in the preparation is shown in Fig 2.



Figure 1: Process Flow Chart for Soymilk

Source: [13] [14].

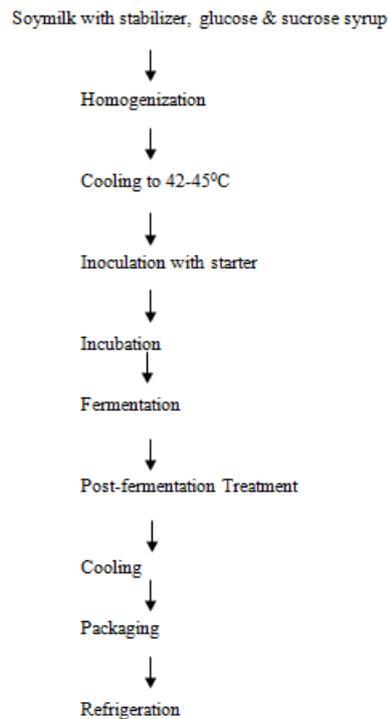


Figure 2: Process Flow Chart for Yoghurt Production

Source: [16] [17].

2.3. Homogenization

Immediately after boiling, the milk was homogenized using blender while 0.3% stabilizer, 1% glucose and 5% sugar (syrup) were added and mixed together. The order of addition of various ingredients was

determined by their temperature and solubility. The mix was then cooled rapidly in cold-water bath to 42-45°C after having obtained a homogenous mix [17].

2.4. Fermentation Process

Yoghurt is fermented at 40-45°C, the optimum growth condition for the mixed culture (*L. bulgaricus* and *S. thermophilus*). 5g of starter culture was added to 1 litre of milk, mixed with a glass rod for even distribution and filled into plastic containers. The containers were covered to minimize the possibility of contamination while the milk was incubated at 42°C for 6 hours undisturbed until the desired custard consistency was reached [16] [17].

2.5. Post-fermentation Treatments

The fresh-made yoghurt is ready for consumption when it is set. However, 5% sweetener and different flavour was added at 5% W/V to each of the milk samples.

2.6. Cooling and Packaging

Yoghurt production is a biological process and cooling is one of the popular methods used to control the metabolic activity of the starter culture and its enzymes. The coagulum was cooled directly after fermentation while the acidity reaches about pH 4.6 and this was done by refrigeration [18]. The yoghurt was then packaged in polyethylene bags and plastic containers.

2.7. Analyses

The quality parameters carried out include the physicochemical, proximate and microbiological analyses. The percentage yield for the soymilk was done using the methods described by [19] and [20], the total solids, total titratable acidity and specific gravity measurements were determined by [21] technique while pH determination was done using pH metre.

The proximate analysis determined involved the moisture content, the fat content, the crude protein content, the ash content, the total solid content and the carbohydrate content. The carbohydrate content was determined by difference while all others were done with the [21] methods.

For the microbiological analysis, the sample media was prepared first before carrying out the analyses. One millilitres of sample mixture was aseptically pipetted into a test tube containing 9ml sterile distilled water and serial dilutions was made to make 10⁻⁵ dilution. Growth media was prepared according to specifications on the containers. Total viable counts, fungal counts, and coliform counts were determined by the methods described by [22] [23] respectively.

2.8. Sensory Evaluation

Sensory evaluation was carried out on the soy-yoghurt samples containing different flavours. An organoleptic study was carried out to evaluate the level of acceptability of the samples. Ten-member panels of judges consisting of people that are conversant with yoghurt in Ibadan city were constituted. The panelists were asked to rate the samples for taste, appearance/colour, odour/aroma, consistency, and overall acceptability using a 7-point hedonic scale where 1 to 7 represent dislike extremely (1) to like extremely (7) [24]. The responses generated were analysed using one-way Analysis of Variance (ANOVA) in a Completely Randomized Design.

III. Results and Discussion

The proximate composition of the soymilk and soy-yoghurt produced are presented in Table 1. The analyses were carried out on soymilk and each soy-yoghurt samples with different flavourings. The protein content reported in freshly prepared soymilk is comparable to 3.58% reported by [25] and a little lower than that reported by USDA Nutrient Database for Standard Reference (2004). There are no appreciable difference between the protein content in the milk and yoghurt samples, this may be due to errors in the analyses and or processing. [7] recommended that the total solid of soymilk used for the production of soy-yoghurt should range between 9 to 12%, therefore the total solid content is comparable. The total solid content for each yoghurt samples were between 12.21 and 14.09 and are higher than that obtained in soymilk. The percentage yield of the milk used was 65.7% while the ratio of slurry to water was 1:4. This is a little higher than the result obtained by [27] which could be as a result of water to slurry ratio. All other proximate compositions are within the range reported by [7].

[7] reported the lactic acid of about 0.9-1.08 in soy-yoghurt. The value reported in this study is comparable and considered satisfactory. The pH value reported for cow milk ranged between 6.6 and 6.7 according to [28], whereas the pH value of the freshly prepared soymilk was 7.0 while that of soy-yoghurt ranged between 4.2 to 5.0. Table 2 shows the pH value of freshly prepared soymilk and pH value and lactic acid content of soy-yoghurt samples on the 2nd and 8th days of storage. The lactic acid contents increased with

decreasing pH values at refrigeration temperature. The change in pH and lactic acid content indicated that the activity of the starter culture was not completely arrested though markedly decreased.

The specific gravity and soluble solid content of the soy-yoghurt samples are shown in Table 3. [29] reported that the specific gravity of pure milk should range between 0.9396 and 1.5125. If it is a little below 0.9396 it is still regarded as pure but if it is higher than 1.5125 it is impure, therefore the specific gravity of each samples are satisfactory because it is comparable to that reported by [29]. There were irregularities in values of the soluble solids reported for each samples with plain and strawberry soy-yoghurts having the lowest soluble solid content in this order. The soluble solid content of these samples are generally lower than that reported by [7].

The percentage syneresis ranged between 37.75 to 54.09% on the 2nd day and 38.13 to 56.21% on the 8th day of production (Table 4). [7] reported the range of 40.9 to 47.0% on the 1st day and 42.6 to 52.7% on the 8th day of production. [30] reported an average of 52.6% syneresis in soy-yoghurt fortified with 1.104% calcium sulphate. [31] reported an average of 31.5% in Mexican plain yoghurt. However, with the addition of 0.3% gelatin and 0.104% calcium sulphate [32], a range from 42.06 to 46.3% syneresis was obtained for flavoured soy-yoghurt. In this study, higher percentage syneresis was reported for vanilla soy-yoghurt in comparison with other samples.

The microbial populations of the soy-yoghurt samples are shown in Table 5. The microbiological evaluation was done to examine the finished product on the survival of starter organisms as well as the presence of undesirable spoilage and pathogenic organisms. The total viable count was between 210×10^6 and 380×10^6 CFU/ml while fungal count was between 1.1 and 1.6 CFU/ml and there was no count for coliform. The fungal count reported could be due to the microorganisms present in the inoculums as a result of careless handling during production and analysis, but it is more reduced than the amount found in the commercial yoghurt that was used as the control. [33] reported that the total viable count of yoghurt should be greater than 200×10^6 , and the yeast count less than 10/ml while the coliform/ml count should be less than 1. The absence of coliform signifies that all the samples were free from faecal contamination therefore the microbial status of the soy-yoghurt samples conforms to the accepted standard.

The mean scores for quality attributes of the soy-yoghurt samples are shown in Table 6. The result shows that there was no significant difference for taste, consistency and overall acceptability among the treatments. Banana soy-yoghurt was the most preferred by the sensory panelists with respects to all quality attributes except consistency, the consistency of plain soy-yoghurt was the most preferred. Ginger soy-yoghurt was the least preferred by the panelists with respect to all quality attributes except taste.

TABLE 1: The proximate composition of freshly prepared soymilk and soy-yoghurt samples

Samples	Protein	%				
		Total solids	Moisture	Fat	Ash	Carbohydrate
Freshly prepared soymilk	3.58±0.11	10.50±0.21	89.74±1.05	2.80±0.07	0.69±0.01	3.19±0.01
Vanilla soy-yoghurt	3.47±0.07	13.50±0.03	86.50±0.99	3.30±0.14	0.74±0.03	5.99±0.01
Strawberry soy-yoghurt	3.59±0.11	14.09±0.14	85.91±0.01	3.10±0.07	0.79±0.01	6.61±0.01
Pineapple soy-yoghurt	3.62±0.10	14.08±0.04	85.92±0.26	3.00±0.03	0.71±0.04	6.75±0.03
Banana soy-yoghurt	3.54±0.01	13.91±0.06	86.09±0.03	3.40±0.07	0.76±0.01	6.21±0.01
Ginger soy-yoghurt	3.69±0.01	12.95±0.06	87.05±0.64	3.50±0.07	0.83±0.01	4.93±0.03
Plain soy-yoghurt	3.33±0.24	12.55±0.49	87.45±0.07	3.60±0.14	0.62±0.03	5.00±0.06
Commercial yoghurt	3.74±0.03	12.21±0.13	87.79±0.10	3.20±0.04	0.69±0.01	4.58±0.01

Results are mean ± SD of samples in duplicate.

TABLE 2: The pH value and lactic acid content of freshly prepared soymilk and soy-yoghurt samples on the 2nd and 8th day

Samples	pH	2 nd day		8 th day	
		pH	Lactic acid (%)	pH	Lactic acid (%)
Freshly prepared soymilk	7.0				
Vanilla soy-yoghurt	4.3		1.06	4.0	1.70
Strawberry soy-yoghurt	5.0		0.70	4.7	1.30
Pineapple soy-yoghurt	4.7		0.74	4.5	1.44
Banana soy-yoghurt	4.2		0.82	4.0	1.42
Ginger soy-yoghurt	4.4		0.89	4.0	1.51
Plain soy-yoghurt	4.3		0.86	4.0	1.46
Commercial yoghurt	4.5		1.13	4.0	1.71

Mean of two determinations in each of two replicate samples

Table 3: The specific gravity and soluble solid content of soy-yoghurt samples

Samples	Specific gravity	soluble solid content (%)
Vanilla soy-yoghurt	0.8910	19.24
Strawberry soy-yoghurt	0.8462	13.37
Pineapple soy-yoghurt	0.8865	15.29
Banana soy-yoghurt	0.7867	15.23
Ginger soy-yoghurt	0.8628	15.23
Plain soy-yoghurt	0.9000	11.38
Commercial yoghurt	0.9396	15.62

TABLE 4: The percentage syneresis of soy-yoghurt samples on 2nd and 8th day

Samples	2 nd day		8 th day	
	(%)			
Vanilla soy-yoghurt	54.09		56.21	
Strawberry soy-yoghurt	43.88		44.96	
Pineapple soy-yoghurt	41.30		42.65	
Banana soy-yoghurt	43.80		45.28	
Ginger soy-yoghurt	47.94		48.25	
Plain soy-yoghurt	37.75		38.13	
Commercial yoghurt	40.08		40.12	

TABLE 5: The Microbiological evaluation of soy-yoghurt samples

Samples	Total count × 10 ⁶	(CFU/ml)	
		fungal count × 10 ⁴	Coliform count × 10 ³
Vanilla soy-yoghurt	240	1.3	-
Strawberry soy-yoghurt	210	1.1	-
Pineapple soy-yoghurt	270	1.7	-
Banana soy-yoghurt	290	1.4	-
Ginger soy-yoghurt	290	1.5	-
Plain soy-yoghurt	380	1.6	-
Commercial yoghurt	310	2.6	-

- : Not found

TABLE 6: Mean ranks for quality attributes of soy-yoghurt samples

Attributes	Flavors					
	Banana	Strawberry	Pineapple	Vanilla	Ginger	Plain
Taste	6.3 ^a	5.8 ^b	5.7 ^b	5.7 ^b	5.8 ^b	6.2 ^a
Color	5.9 ^{ab}	5.6 ^b	5.9 ^{ab}	5.2 ^{bc}	4.8 ^c	5.8 ^b
Aroma	6.1 ^a	5.8 ^b	5.8 ^b	5.7 ^b	5.3 ^{bc}	5.7 ^b
Consistency	5.5 ^{ab}	5.5 ^{ab}	5.5 ^{ab}	5.2 ^{bc}	5.2 ^{bc}	5.7 ^{ab}
Overall Acceptability	6.1 ^a	6.1 ^a	5.8 ^b	5.9 ^b	5.8 ^b	6.1 ^a

Values in the same row with the same superscripts are not significantly different (p<0.05)

IV. Conclusions

Increasingly, low milk production in West Africa to meet the present population demand, high cost of milk, the protein demand in developing countries of the world, incidence of cardiovascular disease, lactose intolerance and other contributing factors has led to efforts in finding alternative sources of protein in legume seeds and production of “imitation milk”. Production of yoghurt and other dairy products from soybeans should be of considerable economic interest/importance.

It was found in this study that there was no appreciable difference between the chemical composition of the soy-yoghurt samples and the commercial yoghurt made with cow milk. Microbiologically, the samples were free from faecal contamination. Also the samples were not significantly different from each other in terms of flavouring but banana soy-yoghurt was the most preferred while ginger soy-yoghurt was the least preferred. Flavourings enhance the acceptability of soy-yoghurt, and if this is being done for all other soy-products, they will be more acceptable by the public and the overall nutritional status of the populace in the developing countries will be improved.

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