

## Research Article

# Probiotic Yogurt from Soy Hydrosoluble Extract, Mango Flavor, Rich in Fiber

Silva SKN<sup>1</sup>, Barros APL<sup>1</sup>, da Cruz Ximenes GN<sup>2</sup> and de Sá Silva C<sup>3\*</sup>

<sup>1</sup>Nutritionist, Collegiate of Nutrition, University of Pernambuco, Brazil

<sup>2</sup>Chemical Engineer, Department of Food Engineering, Federal University of Pernambuco, Brazil

<sup>3</sup>Adjunct Professor, Dra. In Food Science and Technology, Collegiate of Nutrition, University of Pernambuco, Brazil

\*Corresponding author: Claudileide de Sá Silva, BR 203, KM 2, s/n, University Campus, Vila Eduardo, Petrolina, Pernambuco, Brazil

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## Abstract

The effects of changes in lifestyle, as well as, in the population's food consumption represent a strong indicator of quality of life, where they directly and indirectly affect individuals in the most diverse ways. In the dairy sector, a trend that has always shown innovations is the production of functional yoghurts and fermented milks. This is because, in addition to these products having great acceptance by the general public and presenting excellent nutritional value, they are potential vehicles for the consumption of probiotics. Therefore, the objective of this work was to elaborate different concentrations of fiber-rich yogurt, mango flavor, from water-soluble soy extract, supplemented with sesame and inulin, and to evaluate the purchase intention by possible consumers. Thus, the yogurt was made from water-soluble soy extract, supplemented with sesame flour, administered for enrichment in the beverage's fibers, obeying concentrations of 0.0% (control), 20%, 25% and 30%. The formulations were offered and analyzed by 30 untrained tasters, with the data obtained by 2 affective tests, a 9-point hedonic scale, in which the attributes such as texture, aroma, flavor and global acceptance of the sample were evaluated, ranging from very much to the taste. I really disliked it; and 3-point hedonic scale regarding purchase intent. The standard formulation (control), followed by the formulation supplemented with 1.5% inulin and 20% sesame flour, were well accepted, the latter being analyzed by physical-chemical methods for its characterization. As for the purchase intention, yogurt supplemented with 20% sesame flour and 1.5% inulin, was well evaluated by the 18 to 24 year old age groups, as well as by the 46 to 54 age group, this public, heterogeneous. In the physical-chemical analyzes, the contents of ash (1.08%), proteins (5.59%), and total fibers (4.9g), were high, demonstrating that it is a source of fiber, as this last one. The moisture content (39.00%) and total fat (2.02%), were low. In this way, the present study fulfilled the proposed objectives, providing the general population with another functional drink option, both rich in fiber and probiotic. As well, by encouraging the use of the pink mango pulp, widely produced in the region, to contribute even more to its economic growth and development.

**Keywords:** Soy Yogurt; Inulin; Fibers; Mango; Buy Intention; Sensory Analysis

## Introduction

Due to the stressful routine, adaptations to new lifestyles and the indecision in choosing a good meal, we ended up facing new health complications. Thus, people have been looking for functional foods as a way to qualify their choices regarding food.

Functional foods are those that, in addition to nourishing, are capable of promoting the improvement of the individual's health. This is possible because balanced nutrients are distributed in them, such as high amounts of fiber, with reduced levels of fats and sugars [1].

In this context, the dairy sector has a trend that has always been developing innovations in the production of functional yoghurts and fermented milks. This is because, in addition to these products having great acceptance by the general public and presenting excellent nutritional value, they are potential vehicles for the consumption of probiotics. Thus, yogurt is a highly nutritious dairy derivative, since

its main constituents, then partially digested due to the fermentation process, are of good digestion and absorption, and also have a good ability to improve the intestinal microbiota, caused by the presence of living microorganisms. Another reason for the good acceptance of yogurt is due to the fact that it is a product of fast and practical consumption [2].

Among the diversity of functional foods, soy is currently one of the most prominent products and has been considered as an important protein source, composed of fibers, isoflavones, oligosaccharides with prebiotic potential, such as raffinose and stachyose, vitamins and minerals.

The isoflavones present in soy have anticarcinogenic activity, it helps prevent osteoporosis and cardiovascular diseases [3]. The anticarcinogenic activity attributed to isoflavonoids is related to the control of cell growth and apoptosis [4,5].

In soy, isoflavones are phytoestrogenic compounds found in

the forms of daidzein, glycitein and genistein [6]. The isoflavonoids aglycone,  $\beta$ -, acetyl and malonylglycosides are predominantly found in unfermented soybeans and soy products. However, in unfermented soy foods, isoflavonoids in glucoside forms are not absorbed at the brush edges of the small intestine [7].

Higher levels of aglycone are found in fermented soy foods, which have antioxidant and antihypertensive effects and are associated with reduced oxidative stress and the stability of vasodilating agents. Thus, fermentation by lactic acid bacteria hydrolyzes glycosides and increases bioavailability and nutritional values in soy products.

The fermentation of soy derivatives also improves the sensory qualities of the products, masking the flavor of the beans [8], which is responsible for the impairment of palatability leading to low consumption power by the population. As a result, the industries are investing in the production of yogurt, because through the lactic fermentation process responsible for the formation of acetaldehyde and diacetyl, there is an improvement in the degree of acceptance and consequently its commercial power [9].

On the other hand, the use of inulin has also been explored [10]. Its use is due to the ability to reach the colon intact and contribute to the increase of the benefits of bifidobacteria and, consequently, for the improvement of the conditions of the entire gastrointestinal system, besides being indicated for diabetics for helping to reduce the glucose content blood [11].

Another important source of fiber is sesame (*Sesamum indicum* L.) which has been applied as a supplement in beverages, as is the case with yoghurts, due to its global economic potential, caused by the great scaling of its nutritional image [12]. Sesame stands out for having considerable values of fibers and antioxidants with greater emphasis on phenolic compounds, phytates, lignans and tocopherols. Thus, its consumption is capable of improving reproductive function, glycemic control and body weight, increasing antioxidant enzyme activity under oxidative stress conditions, reducing serum cholesterol and increasing antioxidant capacity in hypercholesterolemia [13].

Another important fact is due to the notoriety of mango, which has become a great economic product, which, in turn, is mostly produced in the Northeast region of Brazil, corresponding to 51% of the national total, but about 82 % of its exports come from the São Francisco Valley region, specifically in the cities of Petrolina and Juazeiro. This type of fruit can be used in several ways such as pulp, fruit in syrup, juices, nectars and jellies.

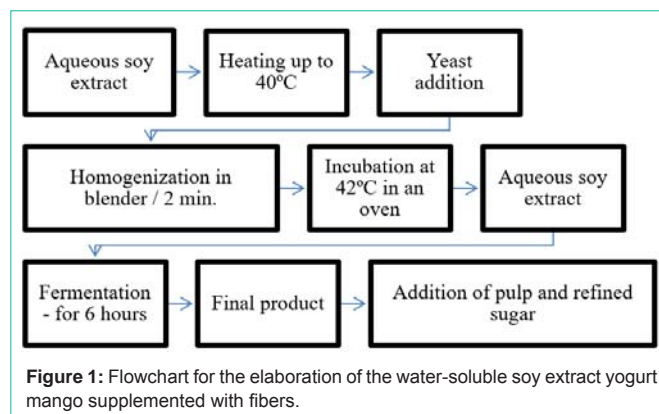
Thus, the present work aimed to prepare a yogurt rich in fiber, from water-soluble soy extract, supplemented with inulin, and flavored with mango, fruit with high production in the region, in addition to good acceptance in general by the population, as a way of corroborate with the development of new functional foods. And thus, contribute to health promotion.

## Material and Methods

The present work used the factorial design 2<sup>2</sup>, in which the independent variables constituted the concentration of sesame flour (%) and inulin (%).

### Elaboration of yogurt

Yogurts were made using the following ingredients: water-soluble



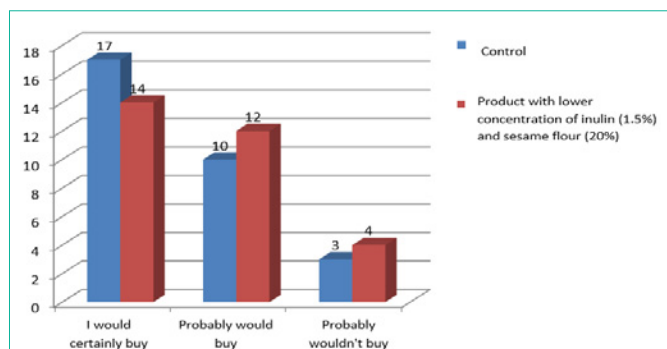
soy extract, milk yeast, inulin, sesame flour, concentrated pink mango pulp (*Mangifera indica*) and refined sugar. Regarding the production method, a single production flow chart (Figure 1) was followed for the base formulation, followed by the variation in the concentrations of inulin and sesame flour. Sesame flour was administered to enrich the drink's fibers, obeying concentrations of 0.0% (control), 20%, 25% and 30%. The concentration of added inulin varied from 0.0 (control), 1.5%, 2.0% and 2.5%. It should be noted that both inulin and sesame flour were added after the formulation of the base yogurt, as described in Figure 1.

For the formulation of base yogurt, the water-soluble soy extract Supra soy<sup>®</sup> without Lactose was used, which was reconstituted in a doubly concentrated manner in relation to the manufacturer's indication, in order to improve its palatability and texture. For flavoring, the frozen Brasfrut<sup>®</sup> pink mango pulp, purchased from local stores, was used. Inulin and BioRich<sup>®</sup> milk yeast (composed of lactobacillus acidophilus LA-5, Bifidobacterium BB-12<sup>®</sup> and Streptococcus thermophilus), were obtained through a specialized commercial house in the local Petrolina trade, as well as sesame flour.

To monitor the fermentation, the pH was monitored, which was considered complete when the sample reduced the pH value to 4.45 [14], which was checked with the aid of a pH meter, and the total soluble solids, in a portable refractometer.

### Sensory analysis

To perform the sensory analysis tests, water-soluble soy extract yoghurt enriched with inulin and sesame flour in different concentrations was used. Sensory data were obtained from two affective tests, the first of which was through the 9-point hedonic scale, in which the attributes such as texture, aroma, flavor and global acceptance of the sample were evaluated, ranging from very much to very disliked. The second test was based on the 3-point hedonic scale as to its purchasing power (it would certainly buy, probably buy, probably not buy). For this purpose, questionnaires adapted from Oliveira et al. [15] were used. The samples were evaluated from 25 ml of each treatment, which were served in disposable plastic cups with a capacity of 50 ml and were coded with three-digit numbers. The order of presentation of the samples was randomized. As it is an affective type test with untrained tasters, 30 (thirty) tasters were invited and selected according to Teixeira et al. Among the tasters, students and professors from University of Pernambuco campus Petrolina, and members of the general population of this city, aged between 18 and 60



**Figure 2:** Evaluation of purchase intention of water soluble soy extract yogurt with mango flavor supplemented with fibers, by untrained tasters. Petrolina, 2014. p-value < .496.

years were randomly invited. Exclusion criteria were adopted: being a smoker, having health problems that cause ageusia or anosmia, the use of drugs that cause these disorders, diseases that limit food intake, fructose intolerance and / or aversion to the test food. Following the ethical requirements, the present study was submitted, evaluated and approved under CAE N° 23550813.6.0000.5207, by the research ethics committee.

**Physico-chemical analyzes**

The characterization of the most widely accepted product was through physical-chemical analyzes, in which the moisture, protein, lipid and ash determinations were carried out according to the procedures of AACC, methods number 44-15 A, 46-12, 30-20 and 08-12, respectively. The determinations of total dietary fiber were carried out according to the AOAC procedure, method number 991.43. The carbohydrate content was estimated by difference, reducing the sum of proteins, lipids, ash, moisture and total dietary fiber by 100. The caloric value was calculated from the data of approximate percent composition, according to the RDC n° 360 of the Ministry of Health [16]. The total energy value of the yogurt was estimated considering the Atwater conversion factors of 4 kcal/g of protein, 4 kcal/g of carbohydrate and 9 kcal/g of lipid. The analyzes were performed in duplicate and the results expressed as a percentage.

**Microbiological analysis**

The microbiological evaluation was carried out in parallel to the physical-chemical evaluation, in samples collected at random. The number of cells of the essential microflora present in the drink after fermentation and addition of sesame flour, inulin and sugar (acidophilus LA-5, Bifidobacterium BB-12' and Streptococcus thermophilus), was determined by the account total viable cells. To measure the water value in the sample, the method of Loss by desiccation (humidity) - direct drying in an oven at 105°C was used, as described by the Instituto Adolfo Lutz.

**Statistical analysis**

The database was built in Excel (Version 1910 Microsoft Office 365 ProPlus) and the statistical analysis was carried out using Epi Info 7.2 (Version 7.2.3.1, 28 June 2019, CDC), using the X<sup>2</sup> test, and the Prisma Version 5.0 (Graph Pad, USA) with application of descriptive statistics (mean and standard deviation) with a value of p <0.05.

**Table 1:** Characterization of yogurt from soy hydro soluble extract, mango flavor, supplemented with 1.5% inulin and 20% sesame flour.

Evaluation	Values / 100 g (%)
Kcal	126.18
pH	6.2
Carbohydrates	21.41
Total fat	2.02
Total Proteins	5.59
Ashes	1.08
Moisture	39
Total dietary fiber	4.9g
Total soluble solids (°Brix)	26

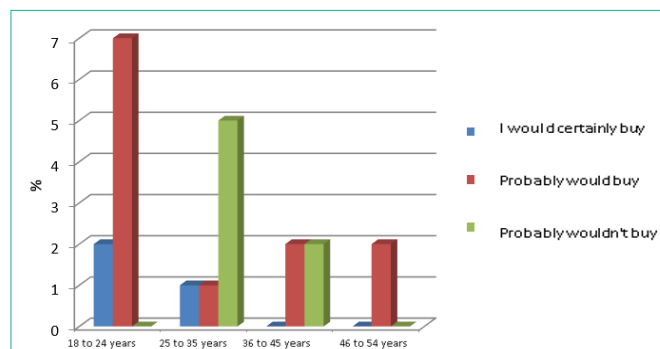
**Results and Discussion**

The formulation followed what was expected according to the applied methodology and according to the results found in the literature [14,17]. The base formulation, that is, the base yogurt obtained through the lactic fermentation of the water-soluble soy extract reached pH 4.5 after 6 hours of the addition of the milk yeast. After this step and the addition of the other ingredients (refined sugar, mango pulp, inulin and sesame flour) the verified pH was 6.2, as can be seen in Table 1.

**Sensory analysis**

The sample of untrained tasters consisted of 30 people, most of them female (73.33%, p <0.0001), whose median age was 22 years old (CI 18-54 years old). The median age of men was 23 years and 06 months (CI 21-51). However, this heterogeneity reflects the consumer audience, demonstrating the interest of diversified audiences for this new product. This characteristic becomes important, since food, in its vital function, is characterized as an effective condition for human survival [18], as well as, it is fundamental in the performance of prevention, maintenance and, still, in recovering the health of individuals.

Regarding the acceptance of the formulation, the most accepted was the control for all the characteristics analyzed, from the flavor, aroma, texture to the global acceptance, as can be seen in Table 2. This result may reflect the little acceptance of supplementation with sesame, considering that inulin does not impart flavor or odor to the



**Figure 3:** Evaluation of purchase intention of the water-soluble soy extract yogurt mango flavored supplemented with 20% sesame flour and 1.5% inulin, by untrained tasters. p-value < 0.496.

**Table 2:** Sensory analysis of yogurt from soy hydro soluble extract, mango flavor, supplemented with inulin and sesame flour.

Sample	Global acceptance	Flavor	Aroma	Texture
Control	43.33% (n=13) Really enjoyed	33.33% (n=10) Really enjoyed	33.33% (n=10) Really enjoyed	46.67% (n=14) Really enjoyed
T1	24.14% (n=7) Really enjoyed	20.00% (n=6) Really enjoyed	23.33% (n=7) Really enjoyed	16.67% (n=5) Really enjoyed
23.33% (n=7) Really enjoyed	36.67% (n=11) I liked it moderately	16.67% (n=5) Neither liked nor disliked	33.33% (n=7) I slightly disliked	
T3	20.00% (n=6) Slightly liked it	30.00% (n=9) I liked it moderately	16.67% (n=5) Really enjoyed	20.00% (n=6) I liked it moderately

preparations in which they are inserted. This given to be justified by the change in aroma, flavor and mainly texture modified with the addition of sesame flour, which causes a sandy sensation. This unusual sensation of sandiness has been reported by other studies [19,20] has been reported as a limiting factor for acceptance of yogurts. However, the first treatment, whose concentration of inulin and sesame flour was 1.5% and 20%, respectively, received the classification I liked very much, as can be seen in Table 2. Thus, the greater or lesser addition of sugars, the enrichment of the product with substances that increase the solids content can collaborate in the variability of acceptance and also in the increase of the caloric value of the products, as suggested by the study by Rodas et al. [21].

In this context, the introduction of yoghurts in the diet in this age group is relevant and can be justified because they are better informed about the benefits and the importance of consuming this food. What can be demonstrated in the study by [22], in which he estimated the frequency of ingestion of different types of milk and dairy products and the profile of consumers. Thus, it demonstrated a positive association between the age of consumers and the consumption of milk and dairy products, thus leading to the reflexes of differences in the formation of eating habits, considering that older generations possibly formed their eating habits in a period in which the consumption of processed foods and sugary drinks was less exacerbated [23] and that the search for food and healthy habits was not relevant.

Regarding the purchase intention, the best results were those related to the evaluation of the control product and the one with the lowest supplementation in sesame flour and inulin, as can be seen in Figure 2. However, there was no statistically significant difference ( $p < 0.496$ ) between the purchase intention of one or the other. Therefore, both products would be well accepted by the consumer market.

When evaluating the intention to purchase yogurt supplemented with 20% sesame flour and 1.5% inulin, according to age, it can be seen that it would certainly be purchased by the 18 to 24 age group, that is, teenagers and young people, as well as, by the age group of 46 to 54 years old, this public is heterogeneous, as can be seen in Figure 3. However, it can be seen that young adults aged 25 to 35 years old would not buy it.

### Physical and chemical analysis

For the composition in macronutrients, that is, proteins, lipids and carbohydrates, significant levels were identified for the composition of the total protein value, 5.59%, which can be explained by the reconstitution doubly concentrated in relation to the indication of the extract manufacturer water-soluble soybean used in the present study. This value is high when compared to similar studies [14,24] using water-soluble soy extract to obtain yoghurts. As for total fats (2.02%), the percentage was similar to that found in other experiments

[24], also performed to obtain “soy yogurt”, which varied from 1, 73% [14] to 2.9% [25]. High values were found for the ash content, 1.08%; and low humidity, 39.00%, when compared to other studies [15,10], which demonstrate that the adequate humidity for the main raw material of yogurt, milk, is approximately 87%. Thus, the low percentage of moisture can be explained by the super-concentration of the soy extract used.

Regarding the percentage of carbohydrates (21.41%), according to Almeida et al. [26], tends to rise during the fermentation process, followed by a decrease as it passes. This is because, these sugars are used as an energy source for microorganisms in the fermentation process, being, therefore, irrelevant for characterization, as well as alteration of the aroma and flavor obtained from fermentation. On the other hand, according to Silva et al. [27], this value is justified by the amount of fibers added, since they are included in the broad category of carbohydrates.

Observing the values of total soluble solids, the yogurt presented 26° Brix, being in accordance with the Brazilian legislation, which determines a degree of 26% for this product. Therefore, indicating that the quantity of substances that are dissolved intensifies the quality of the product [25,28,27].

### Microbiological analysis

Regarding the microbiological analysis for counting total lactic acid bacteria, the value obtained was  $5.8 \times 10^6$  CFU/g, which according to Brazilian legislation [16] for fermented dairy drinks, is in accordance with its Technical Regulation of Identity and Quality, since the minimum value for fermented milks to be considered probiotics is  $10^6$  CFU/ml of total lactic acid bacteria. A fact which, according to Flores et al, [29], demonstrates that the product is suitable for human consumption, assuming great relevance for the present work, because in addition to the high fiber content present in the formulation that was well accepted, claim the probiotic name to the product developed.

Since probiotics known as live microorganisms, which are administered in adequate amounts, confer benefits to the health of the host [30], this type of food, in addition to nutritional benefits, promotes the action of digestive proteins and enzymes, ensuring better functioning of the organism and, consequently, promoting a better intestinal microbial balance and absence of diseases, especially in the gastrointestinal tract, beneficial effects to the individual's health [16]. It is also a relevant factor in improving the taste.

Allied to this fact, the fibers consumed daily in the diet, can also help in increasing the number of microorganisms that promote normal microbiota. In this way, inulin, as a soluble fiber, contributes as a base or medium where bifidobacteria develop, thus also playing a prebiotic role, as suggested by Funchs et al. [24] and Santos et al.



[10]. That is, in addition to adding nutritional as well as technological benefits, with satisfactory nutritional value for both manufacturers and consumers, it is ideal for consumption as a functional food, apart from replacing fat or sugar and reducing the caloric intake of food [31].

Regarding the fiber content, as it presents 4.9g in 100g of the product, it can be designated as a functional food. According to the National Health Surveillance Agency, in order to assign a functional name to a food due to its fiber content, it must present 2.5 g per serving when it comes to solid foods, or 1.5 g when liquid.

As for the caloric of 126.18 Kcal/100g, in turn, it proved to be quite satisfactory when evidenced by others of the same nature, which vary between 321 Kcal /100g [32] to 524 Kcal/100g [33-36]. This fact can be explained by the lower content of lipids and the supplementation with inulin, of low calorie and texture that refers to the sensation produced by the fat.

## Conclusion

Although treatments with higher supplementation of sesame flour have not been well accepted, this fact does not preclude fiber enrichment through inulin and small percentages of sesame flour. What instigates the realization of new researches use smaller percentage values.

On the other hand, even though just the formulation with a lower concentration of inulin and sesame flour was better accepted, the goal of providing the consumer market with the new formulation of a soy extract yogurt rich in mango fiber was achieved. A probiotic formulation was also obtained and with a lower fat content compared to similar formulations, and with that it was possible to achieve yet another benefit.

Thus, the present work can contribute to health promotion through these three strands.

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