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Microbiological, physico-chemical and sensorial characterizations of milk produced from three varieties of soybeans in Benin

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Abstract:

Background*: The economic situation in developing countries has made the supply of milk powder very difficult and unprofitable.Consequently, populations are increasingly resorting to substitute products including soy milk. The objective of this study is to highlight the microbiological, physico-chemical and organoleptic quality of soy milk produced from three varieties of soy acclimated in Benin.*

Materials and Methods*: Soy milk was extracted from each variety after soaking and de-husking then heated to boiling before being filtered. Microbiological, physicochemical, nutritional and organoleptic analyzes were 0carried out by standard methods*

Results*: The results showed that the samples were had satisfactory microbiological quality. The different milks had dry matter contents of 16.30, 17.81 and 16.07% respectively for the samples obtained from the varieties Jupiter, TGX 1987- 62F and TGX 1951-3F. The pH of the milk samples varied from 9.16 to 9.54 and Protein content from 2.32% to 3.34%). Regarding their total ash content, this study shows that it varies from 0.10 to 0.18%. The calcium, magnesium and potassium content were higher (96.80 (mg / kg), 153.14 (mg / kg) and 774.99 (mg / kg)) respectively) for the variety TGX 1951-3F whereas the TGX 1987- 62F variety samples had the lowest calcium and magnesium contents (52.91 and 111.11 mg / kg) respectively. Finally, the lowest potassium content (353.16 mg / kg) was obtained for the variety Jupiter. Organoleptic analyzes revealed that 60 to 73.33% of tasters estimated that the milks have a dirty-white color. None of the three milk samples had presented any deposit, according to 73.33 to 80% of the tasters. The three milks had very sweet tastes.*

Conclusion:*The profiles obtained being relatively similar for the parameters evaluated, these different varieties can be used without distinction even if choices can be made depending on the nutrient sought.*

Key Word*:Soy milk, processing, storage, quality.*

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I. Introduction

Oilseeds are plants cultivated for the richness of their seeds or fruits in lipids. Their culture therefore aims to produce oils and fats for food and also industrial use. Beyond their richness in lipids, oilseeds are also rich in proteins, which means that they are increasingly referred to as oilseeds[1]. The immense need for protein on a global level, the high cost of nitrogen fertilizers, or even their insufficiency in certain cases, pushed research to study the cultivation of protein legumes capable of using atmospheric nitrogen through a symbiotic association[2]. Among these plants, there is soybean, which is the main oil-produced and traded oil in the world[3]. Soyabean (*Glycine max*) is an excellent source ofprotein (35-40%), hence the seed is the richest in food value of all plant foods consumed in the world (Kure etal., 1998). It is used in the fresh, fermented or dried form. It is also rich in calcium, iron, phosphorus and vitamins. Itis the only source that contains the entire essential aminoAcids[4].Soy processing products (flour for protein-rich porridge, cheese, mustard, cookies,milk…) are therefore very rich foods, due to the large amount of protein, carbohydrates, fats, vitamins A and B, phosphorus, potassium, calcium, magnesium, zinc and iron which it contains and can even completely replace meat[5].In a global context characterized by a food crisis resulting in a significant rise in the prices of basic necessities, the supply of milk powder has become very difficult. Faced with all these difficulties, it is necessary to explore other horizons to reach an acceptable solution.Under these conditions, the populations resort to other types of milk such as soy milk for their diet[6]. It therefore becomes interesting to assess the quality of the milk obtained

from different varieties of soybeans in order to better help the populations in their choices.The objective of this study is to highlight the microbiological, physico-chemical and organoleptic quality of soy milk produced from three varieties of soy acclimated in Benin.

II. Material And Methods

Material

Plant material

The plant material was represented by three varieties of soy, namely: TGX 1987-62F, TGX 1951-3F and Jupiter (Photo 1).

Photo 1: Jupiter (A), TGX 1951-3F (B) and TGX 1987-62F (C)variety of soybeans

Equipment

A soy milk extractor, a muslin cloth, a ladle, a needle scale, a heat source, glass bottles, capsules, a pot, an aluminum bowl, a cold source (refrigerator), a capper, drinking water were used during the production of soy milk.

Milk production technology

After sorting, weighing and washing, the soybeans soaked for 12 to 24 hours at room temperature were drained and then skinned. The raw soy milk was then extracted from the dehulled seeds using a milk extractor by adding water (small amounts of water are added as the extraction takes place. A total of 8 liters of water were been used for 1kg of seeds). Baking soda (two pinches) and sugar (300g) were added to the raw milk and heated to 100° C for 30 min. Citronella leaves (150g) were added to raw milk at the start of boiling to improve the aroma. The milk thus obtained was filtered using aids, then packaged in glass bottles before their appertization (Fig 1).

Microbiological analysis

Samples microbiological characteristics were evaluated by using standard methods. Thus, the total mesophilic aerobic flora was enumerated by inoculation on the Plate Count Agar medium (PCA) and incubation at 30 ºC for 24-48 h[7], whereas the total coliforms were searched on the Violet Red Bile Lactose medium (VRBL) with incubation at 30 ºC for 24 h[8]. Positive coagulase Staphylococci was tested on Baird Parker medium with incubation at 37°C for 24-48[9], while yeasts and molds on Sabouraud medium with chloramphenicol were incubated at 25 °C for 3 to 5 days[10].

Physicochemical/nutritional analysis

The pH was measured with a digital pH-meter (HANNA HI 98129). Dry matter content was determined according to AOAC method[11] while protein was analyzed by the Microkjedhal nitrogen method, using a conversion factor of 6.25.The ash content was determined according to method AACC[12] while the Calcium (Ca), Potassium (K) and Magnesium (Mg) were measured by atomic absorption spectrophotometry after incineration in the oven. 550 ° C for 4 hours followed by treatment with H_2SO_4 and hot water[13].

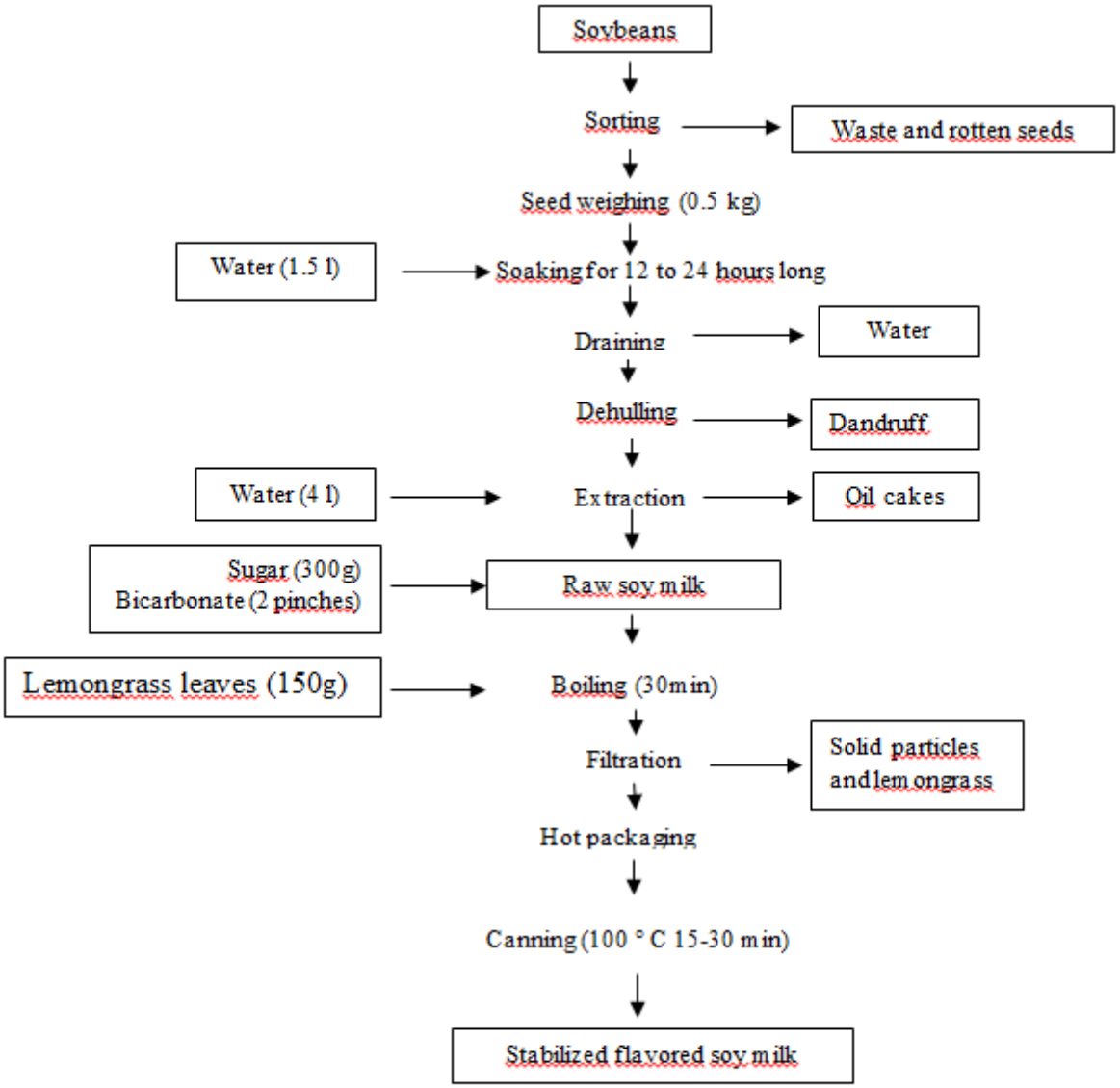

Fig 1: Soy milk production technology

Sensory analyzes

The tasting test consisted in evaluating the organoleptic characteristics of the different milk samples. A panel of with 15 tasters was formed. The parameters evaluated were color, homogeneity and taste.

Statistical analyzes:

The data collected were analyzed using a Microsoft Excel 2007 spreadsheet for the calculation of the means and the statistical description of the results.

III. Result

Microbiological characteristics of the samples

Analysis of Table 1 reveals that your total flora is counted in the three samples at levels slightly above 1.0 x 10^5 (CFU / ml), normative value. Coliforms, on the other hand, were absent from all the samples. As for staphylococci, the values counted varied between 7x10^1 and 10^2 CFU / ml. Finally, yeasts and molds were counted in milk obtained from the variety TGX 1951-3F (4x10^3 and 2x10^3 CFU / ml) respectively while the yeasts were absent from the sample of the Jupiter variety and molds are absent from the sample of variety TGX 1987-62F.

Table no 1. Microbiological characteristics of samples.

Parameters / Samples	Total flora (CFU/ml)	Total coliforms (CFU/ml)	Staphylococci (CFU/ml)	Fungal flora (CFU/ml)	
				Yeasts	Mold
Milk from Jupiter variety	$2x10^5$	<1	$9x10^1$	<1	$1x10^3$
Milk from TGX 1951-3F variety	$1.7x1O^5$	<1	$7x10^1$	$4x10^3$	$2x10^3$
Milk from TGX 1987-62F variety	$1.5x10^5$	<1	10^2	$8x10^3$	<1
Normative criteria	$1,0 \times 10^5$	10	Unspecified	Unspecified	Unspecified

Physicochemical and nutritional characteristics of samples

The results presented in Table 2 showed that the different milks had dry matter contents of 16.30, 17.81 and 16.07% respectively for the samples obtained from the varieties Jupiter, TGX 1987- 62F and TGX 1951-3F. The pH of the milk samples varied from 9.16 to 9.54 depending on the soybean varieties. Protein content was higher (3.34%) for milk from the TGX 1951-3F variety and was 2.72 and 2.32% for the samples from TGX 1987-62F and Jupiter respectively. Regarding their total ash content, this study shows that it varies from 0.10 to 0.18% depending on the variety. The calcium, magnesium and potassium content were higher (96.80 (mg / kg), 153.14 (mg / kg) and 774.99 (mg / kg)) respectively) for the variety TGX 1951-3F whereas the TGX 1987- 62F variety samples had the lowest calcium and magnesium contents (52.91 and 111.11 mg / kg) respectively. Finally, the lowest potassium content (353.16 mg / kg) was obtained for the variety Jupiter (Table 2).

Table no 2: Physicochemical and nutritional of samples

Parameters / Samples	DM (%)	pH	N (%)	P (%)	Ashes (%)	Ca (mg/kg)	Mg (mg/kg)	K (mg/kg)
Milk from Jupiter variety	16,30	9,17	0,406	2,32	0,10	90,10	119,40	353,16
Milk from TGX 1951-3F variety	16,07	9,16	0,585	3,34	0,18	96,80	153,14	774,99
Milk from TGX 1987-62F variety	17,81	9,54	0,477	2,72	0,10	52,91	111,11	489,06

DM: Dry matter; N: Nitrogen; P: Protein.

Organoleptic characteristics of samples

Organoleptic analyzes revealed that 60 to 73.33% of tasters estimated that the milks have a dirty-white color (Figure 2). None of the three milk samples had presented any deposit, according to 73.33 to 80% of the tasters (Figure 3). The three milks had very sweet tastes according to the tasters (Figure 4).

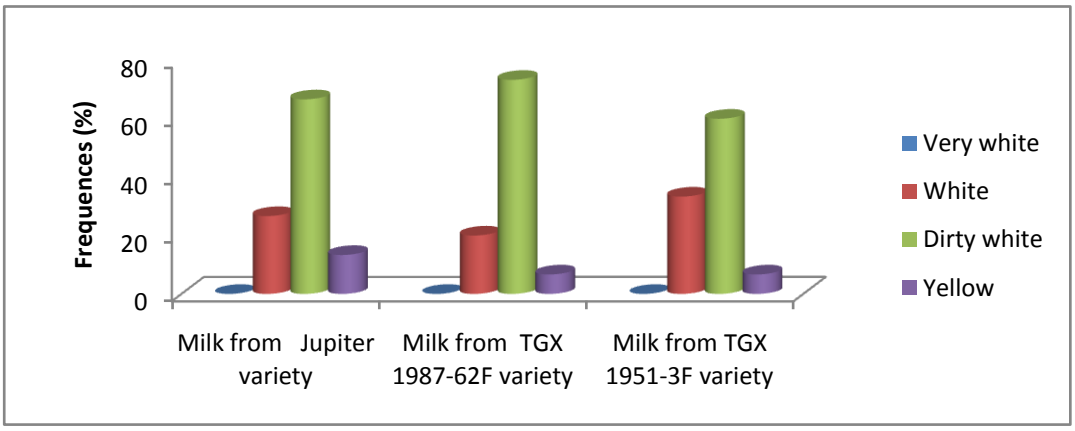

Fig2: Perception of the tasters in relation to the color of the milks

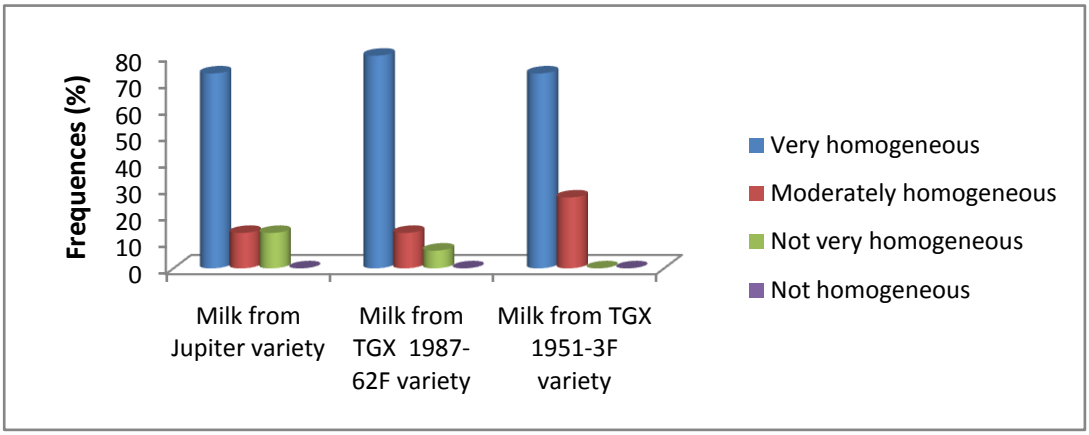

Fig3: Perception of the tasters in relation to the homogeneity of the milks

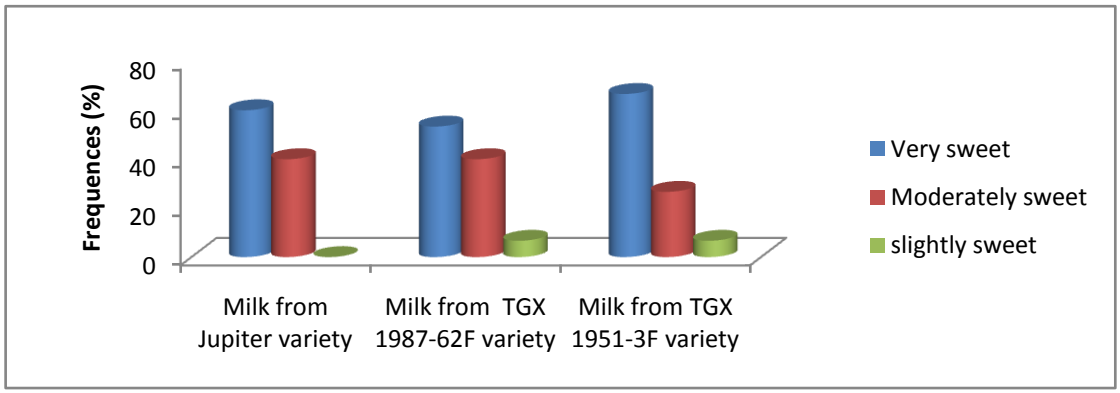

Fig4: Perception des dégustateurs par rapport au goût des laits

IV. Discussion

The results presented from the physicochemical characterization showed that the samples have high water content. Despite adding the same amount of water during production, the water content varied from 82.19 to 83.93% depending on the variety. This could be due to the water absorption and retention capacity of each variety.

The pH of the milk samples varied from 9.16 to 9.54 depending on the soybean varieties. These values were much higher than that reported by Houssou et al[14] which is 7.14; and were not included in the range reported by several authors[15, 16, 17, 18, 19, 14] which states that the pH of freshly prepared soy milk is between 6.5 and 7.71. They are also different from those reported by Punoo et al[22] which vary from 6.2 to 6.5. This difference in pH could be explained by the addition of bicarbonate during production, unlike the technology used by them. Indeed, bicarbonate having a pH of 8.4 could increase the pH of milk.

The protein content varied from 2.32 to 3.34%. These contents were in the same order of magnitude as that of the regional standard for non-fermented soy products (CXS 322R-2015) which stipulates that the protein content in 100g of soy milk must be greater than or equal to 2.0g. However, they were lower than the protein content reported by Houssou et al[14] which was 4.30%. This difference observed could be due to the protein content in soybean varieties. This content would also vary depending on the concentration (water / soy ration) of soy milk[20].

Regarding their total ash content, this study showed that it varies from 0.10 to 0.1886%. These values were much lower than that reported by Bokossa et al[21] (6.87 ± 0.65%). The total ash content gives an idea of the quantity of minerals contained in the different samples. Compared to the contents of calcium, magnesium and potassium, they varied respectively from 52.911 to 96.808mg / kg; 111,112 to 153,142 mg / kg and from 353,160 to 774,992 mg / kg depending on the varieties. These results showed that the milks have a low calcium content compared to those of magnesium and phosphorus. This could be explained by the low content of the varieties used in calcium.

60 to 73.33% of the tasters estimated that the milks have a white-dirty color. This color is similar to that reported by Vololoniaina[22] which states that soy milk is white-yellowish in color. This color could be explained by the fact that the flavoring of this milk was made with lemongrass leaves. These green leaves may have disintegrated in this milk, giving the milk a little of its greenish color. However, this color obtained may

also be due to the ß-carotene contained in soybean oils since soybeans contain up to 21% fat[24]. Indeed, ß-carotene is a dye that is particularly sensitive to heat[23].

The three milk samples showed no deposit, according to 73.33 to 80% of the tasters. This homogeneity noted by the tasters could be explained by the efficiency of the filtration of raw soy milk. All milks samples were very sweet according to the tasters. Indeed, sugar has been used to improve the bland flavor of soybeans because of the raw bean taste quite strongly pronounced in milk[23].

V. Conclusion

This study allowed to highlight the microbiological quality as well as the physicochemical and nutritional profile of milks produced from three varieties of soybeans in Benin.By considering the analitic tolerance, it can be deduced that the samples had a satisfactory microbiological quality. The physicochemical and nutritional profile varied according to the samples and the organoleptic quality of the samples is acceptable according to consumers.

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