Ciência Rural, Santa Maria, v.42, n.3, p.545-550, mar, 2012
ISSN 0103-8478

Addition of water-soluble soy extract and probiotic culture, viscosity, water retention capacity and syneresis characteristics of goat milk yogurt

Adição de extrato hidrossolúvel de soja e cultura probiótica e características de viscosidade, capacidade de retenção de água e de sinerese de iogurte produzido com leite de cabra

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ABSTRACT

*Yogurts from goat milk were elaborated and water-soluble soybean extract (WSSE) and **Bifidobacterium lactis** probiotic culture added during processing. The characteristics of apparent viscosity, water retention capacity and syneresis were analyzed during 29 days of storage and it was verified the influence of WSSE and the probiotic on these rheological properties. The suplementation of WSSE provoked an increase in the viscosity and water retention capacity of the yogurts while reducing the syneresis. The inoculation of the probiotic culture during elaboration of the yogurts did not significantly alter the rheological characteristics of the products. Therefore, the water-soluble soybean extract and the probiotic culture can contribute to the rheological characteristics of yogurts, besides the nutritional and functional improvement advantages already known with the use of these products.*

Key words: *yogurt, water-soluble soy extract, rheology.*

RESUMO

*Iogurtes a base de leite de cabra foram elaborados e a eles adicionados extrato hidrossolúvel de soja (EHS) e de cultura probiótica **Bifidobacterium lactis** durante o processamento. As características de viscosidade aparente, capacidade de retenção de água e sinerese foram analisadas durante 29 dias de armazenamento e verificadas a influência do EHS e do probiótico nestas propriedades reológicas. A suplementação de EHS provocou aumento na viscosidade e capacidade de retenção de água dos iogurtes e, ao mesmo tempo, a sinerese foi reduzida. A inoculação da cultura probiótica durante elaboração dos iogurtes não alterou de forma significativa as características reológicas dos produtos. Portanto, a adição de extrato hidrossolúvel de soja e a cultura probiótica, pode contribuir para melhora nas características reológicas de iogurtes, além das vantagens na melhoria nutricional e funcional já conhecidas com a utilização destes produtos.*

Palavras-chave: *iogurte, extrato hidrossolúvel de soja, reologia.*

INTRODUCTION

TAMINE & DEETH (1980), define yogurt as being the product resulting from the fermentation of milk, which is possible by the initial culture obtained from a combination of ***Streptococcus thermophilus*** and ***Lactobacillus delbuechii*** *subsp. Bulgariccus*, being the use of other microbial cultures allowed. The world production and consumption of yogurts grew considerably during the last century, a fact attributed to the increased use of probiotics organisms by the food industries.

Goat milk has been described as a highly digestible product with important allergenic properties when compared to cow's milk. It presents advantages such as smaller fat globules (FRAZIER, 1995), goat milk also has high calcium and A and B complex vitamin levels (ALFÉREZ et al., 2006). In spite of the countless benefits of goat milk, currently a high rejection of this product is verified, resulting in its low consumption. For OLIVEIRA (2009) among the viable alternatives to stimulate the consumption of this type of milk is its use

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Received 03.09.11 Approved 09.16.11 Returned by the author 02.28.12
CR-4828

in the elaboration of milk drinks, yogurts and cheeses. The elaboration of the mentioned products based on goat milk, such as yogurt, can present significant alterations in its rheological properties, such as low consistency and a tendency towards whey separation (syneresis). Therefore, to obtain satisfactory results with fermented goat milk products, the addition of stabilizers is recommended. According to LORENZEN et al. (2002), the enrichment of the dry matter content and/or the proteic content are standard measures used to avoid syneresis and to improve the texture of the yogurt. As such, the soy proteins, specifically, the water-soluble soybean extract (WSSE), deserves prominence to improve the nutritional value of the product and to affect the gel structure formation of the yogurt.

The combination of a product supplemented with proteins and fermented by probiotic microorganisms can generate a product with technological and functional properties that meet demands for healthy products. In that context, this research aimed to evaluate the influence of WSSE and the probiotic culture in the viscosity profile and syneresis of yogurts, during its shelf life.

MATERIAL AND METHODS

Characterization of raw material

The milk used in the experiment was originated from a goat herd, through milking of females of the Saanen race, under appropriate hygienic conditions. The physiochemical analyses were carried out with milk samples in triplicata, to proof its quality. Consisted of the determination of the pH by direct potentiometry in a digital pHmeter (ADOLFO LUTZ, 1985), titratable acidity, density, fat and total soluble solids percentage (BRAZIL, 2006).

Elaboration of the yogurt

The methodology used in this study for the development of the yogurt, was based on that described by TAMINE & ROBINSON (1991). The yogurts were prepared and identified with letters according to their processing particularities (addition of WSSE adjusted to the proteic level of the milk at the concentration of 20%, resulting in the suplementation of 14.8g L^{-1} of WSSE and 2% ***Bifidobacterium lactis*** probiotic culture), as expressed under.

- Yogurt A: without addition of WSSE, without addition of probiotic culture.
- Yogurt B: adding WSSE (20%), without addition of probiotic culture.
- Yogurt C: without addition WSSE, with addition of probiotic culture.
-Yogurt D: adding WSSE (20%), with addition of probiotic culture.

The rheological analyses of the products were conducted on the 1st, 15th and 29th day post-production.

Apparent viscosity of yogurt

Samples of yogurt were homogenized, and then about 500 mL were poured into a becker to conduct the analysis. The apparent viscosity was determined in programmable digital viscosimeter l (Brookfield, model DV-II+), using cylindrical nº 2 and 3 probes, and a speed of 50rpm (PELEGRINE et al., 2000). The results were expressed in Centipoise (cP).

Water retention capacity (expressible moisture) of yogurt

It was evaluated by expressible moisture (EM) according to the methodology proposed by JAUREGUI et al. (1981), with modifications by BEUSCHEL et al. (1992). Samples of the yogurts (1g±0.15) were weighed on Whatman filter paper number 2 and centrifuged at 700xg (2500rpm in a centrifuge) for 10 minutes at 6°C. The percentage of expressible moisture humidity was calculated through the difference in weight between the dry and wet filter paper. Each sample was analyzed twice

Syneresis of yogurt

Samples of 30 grams of yogurt were distributed evenly on filter paper (Whatman 1,Sigma) on top of a funnel connected to a 50ml graduated cylinder. After 5 hours of drainage at 4ºC, the syneresis index was calculated (RIENER et al., 2010), through the equation: [(weight of the whey after filtration/weight of the yogurt sample) x 100]

Statistical analysis

The treatments were evaluated through variance analysis (ANOVA), followed by the Scott-Knott Test, to 5% of significance, using the R statistical program (R DEVELOPMENTE CORE TEAM, 2009) software.

RESULTS AND DISCUSSION

Characterization of raw material

The results of the physiochemical analysis of the goat milk used in the yogurt treatments are 6,68 from pH, 0.17 g lactic acid 100mL^{-1} of product from titratable acidity, 1,02g L^{-1} from density, 3,1% from fat

and 11,5% from total soluble solids. These results were similar to those found by LORA et al. (2006). The results found for pH were similar to the values obtained by research done in the state of São Paulo by GOMES et al. (2004). The average value found for the goat milk acidity was 0,17g lactic acid $100mL^{-1}$ of product. Such an average is within the standards required by the legislation (BRAZIL, 2000).

The average fat value obtained in the raw milk by the Gerber method was above the minimum (3%) required by the legislation for whole milk. Density of the goat milk was within the norms of the current legislation (BRAZIL, 2000). RICHARDS et al. (2001) evaluated the pasteurized whole goat's milk, average total solid values from 12,08 to 12,23%.

Rheological properties of viscosity

The rheological property of apparent viscosity of a product significantly influences the acceptance and consumer purchase intention, thus being an important factor that should be controlled during the yogurt processing. It was observed that the apparent viscosity of the yogurts underwent an increase during storage, and can be seen in figure 1.

There was an increase in the viscosity of the yogurts during storage. This fact is due to the fermentation process of the lactic acid bacteria (LAB) used in milk products that synthesize short chain fatty acids, vitamins and exopolysaccharides (EPS) (SHENE & BRAVO, 2006). The exopolysaccharides have an important function as a natural bio-thickening agent to improve the rheology of the fermented product, as physical stabilizer and to retain water and limit the syneresis (DUBOC & BEAT, 2001).

The treatments supplemented with WSSE codified with the letters B and D presented higher viscosity by the increase of total solids, provoked by the dry matter addition, that also aids in the gel formation. According to MANGINO (1984), with the increase of the proteic concentration, modification of the gel texture occurs, resulting in increased firmness and intensifying the water retention by the matrix .The desnaturation of the β-lactoglobulin and its interaction with the casein micelles had a great influence on the properties of gel formation in fermented milks (MARTÍN-DIANA et al., 2003).The lactic acid bacteria (LAB) had an important function as natural bio-thickening agent to improve the reology of the fermented product, as physical stabilizer and to retain water and limit the syneresis (DUBOC & BEAT, 2001). According to RICCIARDI & CLEMENTI (2000) bifidobacteria are capable of producing EPS in large amounts. The varied rheological behavior in fermented milks can be attributed to the differences in the multiplication speed of the bacteril culture (GASSEM & FRANK, 2001).

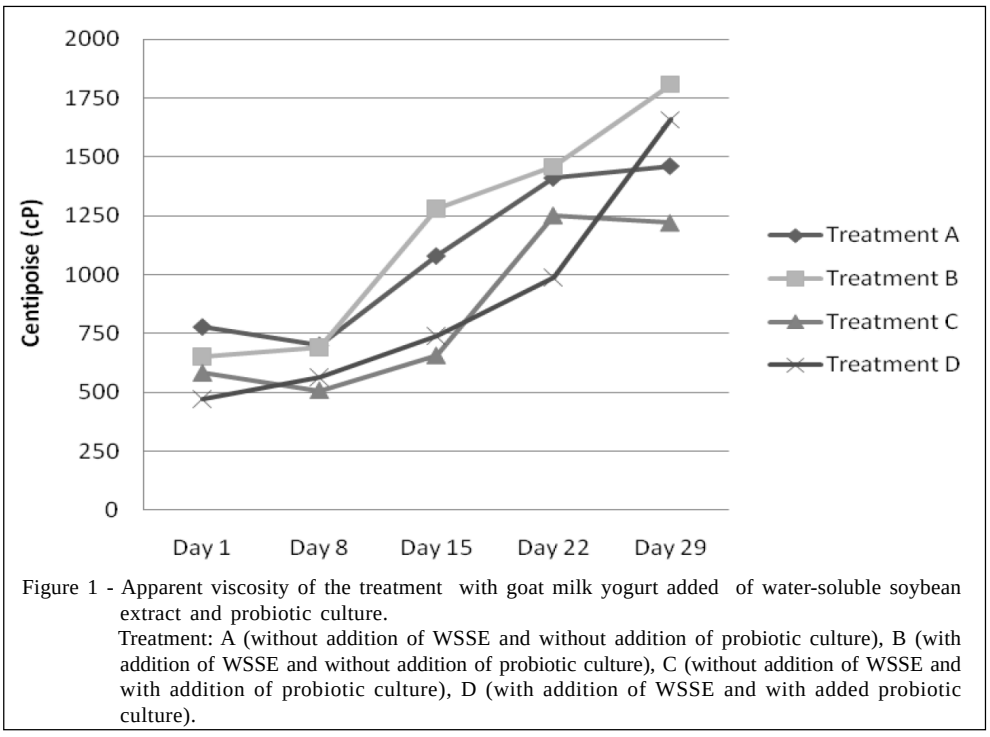

Figure 1 - Apparent viscosity of the treatment with goat milk yogurt added of water-soluble soybean extract and probiotic culture.
Treatment: A (without addition of WSSE and without addition of probiotic culture), B (with addition of WSSE and without addition of probiotic culture), C (without addition of WSSE and with addition of probiotic culture), D (with addition of WSSE and with added probiotic culture).

Water retention capacity

The physical properties of the yogurt, including the separation of the whey (syneresis), play an important role in the product quality and consumer acceptance. Therefore, to increase the water retention capacity of yogurt production is suggested the inhibition of syneresis. The common reasons for the occurrence of this alteration include the use of a high incubation temperature, high whey protein concentrations in relation to the casein, low total solid concentration and physical alteration of the product during storage and distribution (LUCEY, 2004). The results of the analysis of water retention capacity of yogurts based on goat's milk are presented in table 1.

The analyzed treatments presented high water retention capacity values, however they underwent a decrease during storage. Different rheological behavior with lower values was found by MORETI (2009) when evaluating yogurts with different concentrations of proteic supplement.

The water retention capacity on the 1st, 15th and 29th day post-production of the yogurts showed that there was no significant difference among the treatments (P≤5).

The treatments codified with the letters A and B presented a decrease in the water retention capacity during storage. According to JAROS & ROHM (2003), susceptibility to syneresis tends to decrease with the increase of the yogurt solid matter. This suggests that the supplementation with soy extract can be used with success in the production of yogurts, because it stabilizes the separation of the whey.

Table 1 - Mean values (%) of water holding capacity of samples of fermented milk made with goat milk (A), goat milk added with water-soluble soybean extract (WSSE) (B), goat milk with added probiotic culture (C) and goat milk added WSSE and probiotic culture (D).

Fermented Milk	-------Water retention capacity (%)-------		
	Day 1	Day 15	Day 29
A	86,90 a	85,00 a	77,45 a
B	90,10 a	85,00 a	82,00 a
C	80,45 a	77,50 a	73,20 a
D	88,00 a	84,50 a	79,20 a
CV (%)	2,84	8,63	8,02

Means followed by same letter don´t differ statistically among themselves, by Test Average Scott-Knott, to 5% probability.

In the treatments C and D, the analyzed water retention was slightly inferior to the other treatments, however, the yogurt supplemented with WSSE, identified by the letter D, presented less syneresis that product C, without supplementation. Therefore it was observed that with addition of ***Bifidobacterium lactis***, the water retention capacity in the treatments was reduced. Similar results were verified by SAXELIN et al. (1999) in milk fermented by probiotic strains.

Syneresis of yogurts

The syneresis reduction of the whey corresponds to the improvement of the water retention capacity of proteins, which increases with denaturation (BRITTEN & GIROUX, 2001; MARTIN DIANA et al., 2003). The average syneresis values can be seen in figure 2.

It is observed that there was a tendency towards an increase in the syneresis values in all of the appraised yogurts during the storage time. However, it is worth pointing out that in the treatments with added soy extract, the susceptibility to syneresis was lower. In the treatments where there was inoculation of the probiotic bacterium ***Bifidobacterium lactis***, the syneresis values accompanied the treatments in which there was no soy extract addition and, as such, little influence of this procedure is noticed.

LIMA (2001) when evaluating the syneresis in yogurts with added whey protein concentrate (WPC) verified that the increase in the protein fortification tends to reduce the syneresis. MARTIN-DIANA et al. (2003) when developing fermented milk based on cow's and goat's milk containing probiotic culture and soy protein verified a higher syneresis tendency of the fermented milk elaborated with goat's milk and reduction of the susceptibility to syneresis with the increase in the amount of protein. This fact suggests that the soy can be used to elaborate fermented milk products by acting on the control of whey separation.

CONCLUSION

This study showed that the addition of water-soluble soybean extract in the yogurts elaborated from goat's milk propitiated better viscosity and water retention capacity characteristic. The use of probiotic culture showed little influence on these rheological properties. The syneresis of the yogurts was lower in the treatments with added soy extract, the addition of probiotic culture provoked a reduction in this characteristic.

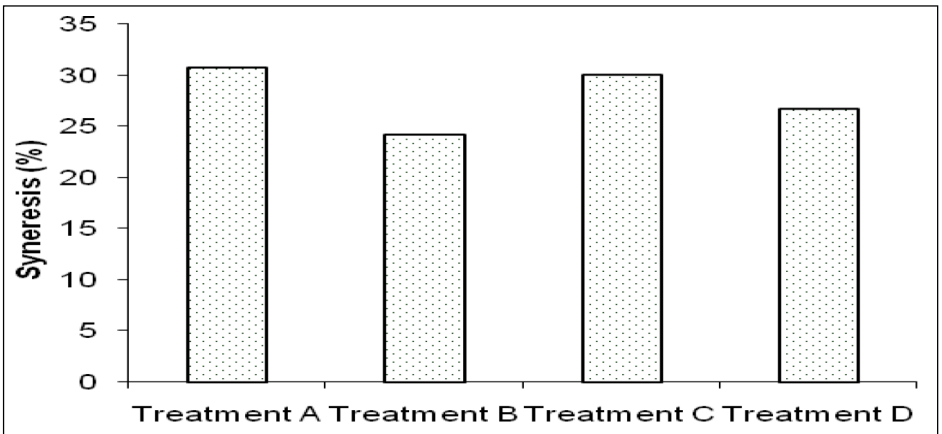

Figure 2 - Mean values of syneresis treatment with goat milk yogurt added of water-soluble soybean extract and probiotic culture.
Treatment: A (without addition of WSSE and without addition of probiotic culture), B (with addition of WSSE and without addition of probiotic culture), C (without addition of WSSE and with addition of probiotic culture), D (with addition of WSSE and with addition of probiotic culture).

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