Technical Note

Influence of breed and husbandry on viscosity of Israeli goat milk yogurt

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Abstract

Goat’s milk yogurt prepared from milk of different goat breeds on different farm types resulted in different viscosity. Yogurt from milk of goat breeds browsing on pasture was richer in solids and resulted in significantly higher viscosity compared with that of cow milk yogurt and yogurt produced from milk of goats fed hay and concentrate indoors. Milk from goats browsing on pasture was diluted in total solids content close to that of milk from goats kept indoors and cows. Yogurt made from this diluted milk still resulted in higher viscosity. It appears that milk from goat breeds browsing on pastures contains certain factor(s) that causes an increase in the viscosity of yogurt produced from it.

Keywords: Goat milk; Yogurt; Viscosity; Goat breed

1. Introduction

In Israel, there are about 40,000 dairy goats that produce about four million liters of milk annually. Two million liters milk is processed by 17–22 small dairies into a variety of products, such as fluid milk, butter and cultured products, among which are yogurt and cheeses. The rest is collected by a large cooperative (Gollop et al., 1997). Gross composition of goat milk in Israel varies according to feeding regime and stage of lactation (Merin et al., 1988, 1997). One of the major products of the small dairies is yogurt, made by fermenting milk using commercial thermophilic cultures intended for cow milk. Some commercial cultures are designed to increase the viscosity of the yogurt by the use of ‘viscosity’ increasing bacteria (Rasic and Kurmann, 1978; Wacher-Rodarte et al., 1993).

Factors known to affect yogurt viscosity include variations in milk composition, especially fat and protein content, which vary among goat breeds. According to Rasic and Kurmann (1978), the ratio of fat to solids non-fat and slime producing cultures are among the major factors responsible for yogurt viscosity. Polysaccharide slime producing cultures were also claimed to serve as ‘fillers’ in both cow and goat yogurt (Valhopoulou and Bell, 1993). In general, the strains responsible for producing polysaccharide in commercial cultures are related to Lactobacillus delbruekii subsp. bulgaricus (Valhopoulou and Bell, 1993; Wacher-Rodarte et al., 1993; Wiesby, 1997).

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Since goat milk produced in Israel is obtained from different breeds of goats and their crossbreds and different husbandry regimes (Gollop et al., 1997), the consistency of yogurt made from such milk varies according to producers. Compared to marketed cow milk yogurt, goat milk yogurt is sometimes less viscous. Viscosity of cow milk yogurt is usually enhanced by the addition of milk powder, or caseinate, up to ~16% total solids (Tamime and Robinson, 1984; Ozer et al., 1997). This practice may not be possible in the small industry for goat milk because of little availability of goat milk powder.

In general, two main goat-farming systems are practiced in Israel, (A) with grazing and (B) without grazing. Grazing herds are out in the field for most of the day and return to the sheds in the evening for overnight stay. The (A) herds are composed of crossbred Shami × Anglo-Nubian goats; and the (B), non-grazing, herds are kept indoors and are fed concentrate, hay and other foodstuff. These herds are composed mainly of Saanen and Saanen Shami crossbreds.

The animals are milked twice a day, morning and evening. (A) herds, supplementary concentrate is given only in the evening during milking (Gollop et al., 1997). Milk yields are around 2 l for type (A) and 3 l for type (B) per goat per day, during 300 days per year, on average. The peak in milk yield occurs after kidding, around March–April. It starts declining around June–July until October–November when the goats enter the dry period. Most herds are composed of one-third young ewes that are introduced to the herd every year to replace the low producing ewes.

In the present work, the viscosity of goat yogurt produced from milk from different farm types was studied and compared with that of cow milk yogurt, as a reference.

2. Materials and methods

2.1. Milk

Goat milk was obtained from four herds, two of farm type A (A1, A2) and two of farm type B (B1, B2). The size of the herds was ~200 goats. Cow milk was obtained from the Volcani Center farm from Israeli black and white cows (C). Two liters milk was transferred to the laboratory at 4°C in a cooler and processed within 3 h.

2.2. Starter culture

The starter culture used was freeze dried Yogurt V2, type MK, which is intended for producing high viscosity yogurt (Wiesby, 1997). Mother culture was prepared by inoculating 1% (w/v) culture in 500 ml of UHT cow milk and incubating at 45°C overnight.

2.3. Yogurt preparation

Milk was batch pasteurized at 80°C for 20 min, following the usual practice of most producers. The milk was cooled immediately to 45°C and inoculated with 2% (v/v) mother culture. It was then incubated at 45°C for 5.5 h in 100 ml polystyrene cups. After 5.5 h fermentation, the cups were transferred to 4°C for stabilization for 24 h before analyses. In a preliminary experiment, 2, 3 and 5% (v/v) milk were inoculated with the same mother culture. Since no differences in acid development were recorded and the entire yogurt was ready after 5.5 h incubation, 2% culture was chosen for further experiments. Four consecutive experiments of yogurt preparation were performed.

The content of fat, protein, dry matter and ash was analyzed by standard methods (Marshall, 1992). Lactose was calculated by difference. During incubation, yogurt samples were checked for pH and development of lactic acid, according to Sohxlet-Henkel (SH). Viscosity was measured in the cups using a Brookfield viscometer (Brookfield Engineering Laboratories, Inc., MA, USA), equipped with a T spindle running at 12 rpm and at a constant descending speed of 2 cm min⁻¹. All viscosity measurements were performed in quadruplicate.

2.4. Milk ash

Ash for dilution of milk from farm (A) was prepared from the same milk by incineration at 550°C, after overnight drying at 100°C.

2.5. Preparation of diluted milk

Milk from farm (A1) was diluted at a ratio of 3 : 1 with a solution of 4.6% lactose in distilled water, and 8 g of ash was added to 1 l of the diluted milk.
2.6. Statistical analysis

Data were analyzed by a general linear model procedure of the Student–Newman–Keuls test using SAS. This test combines ANOVA with comparison of differences between the means of the treatments.

3. Results and discussion

The evolution of pH and acidity during yogurt making is presented in Fig. 1. The culture used produced lactic acid at a higher rate in goat milk compared with cow milk using 2% culture.

Experiments lasted from February to April while pasture browse is abundant in Israel. The milk composition of the different herds in the experiment is presented in Table 1. It is seen that the milk of herd (A) was relatively high in solids content.

Table 1
Average (±S.D.) milk composition (g l⁻¹) used for yogurt making, according to herd type

<table>
<thead>
<tr>
<th></th>
<th>A1</th>
<th>A2</th>
<th>A1*</th>
<th>B1</th>
<th>B2</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sh × AN</td>
<td>Sh × AN</td>
<td>Sh × AN</td>
<td>S × Sh</td>
<td>S</td>
<td>Cow</td>
</tr>
<tr>
<td>Fat</td>
<td>44.00 ± .21</td>
<td>50.00 ± .39</td>
<td>30.00 ± .19</td>
<td>40.00 ± .37</td>
<td>33.50 ± .25</td>
<td>30.00 ± .31</td>
</tr>
<tr>
<td>Protein</td>
<td>35.40 ± .09</td>
<td>39.10 ± .16</td>
<td>30.50 ± .07</td>
<td>32.60 ± .12</td>
<td>29.70 ± .11</td>
<td>29.60 ± .15</td>
</tr>
<tr>
<td>Dry matter</td>
<td>130.80 ± .54</td>
<td>138.70 ± .67</td>
<td>116.80 ± .38</td>
<td>123.40 ± .33</td>
<td>114.50 ± .27</td>
<td>115.80 ± .25</td>
</tr>
<tr>
<td>Solids-non-fat</td>
<td>86.80</td>
<td>88.70</td>
<td>86.80</td>
<td>83.40</td>
<td>81.00</td>
<td>85.80</td>
</tr>
<tr>
<td>Lactose</td>
<td>43.50</td>
<td>41.10</td>
<td>43.10</td>
<td>42.30</td>
<td>43.30</td>
<td>48.90</td>
</tr>
<tr>
<td>Ash</td>
<td>8.50 ± .05</td>
<td>8.50 ± .10</td>
<td>8.20 ± .02</td>
<td>8.50 ± .04</td>
<td>8.00 ± .06</td>
<td>7.30 ± .07</td>
</tr>
</tbody>
</table>

*Herd type: A1, A2, with grazing; A1*, same as A1, but diluted 3 : 1 with 4.6% lactose solution and 0.8% milk ash (see Section 2); B1, without grazing; B2, without grazing, but composed mainly of Saanen.

Goat breed: Sh × AN, Shami × Anglo-Nubian; S × Sh, Saanen × Shami; S, Saanen.

Viscosity measurements of yogurt made using the same procedure are presented in Table 2. Milk from farms (A) resulted in yogurt with higher viscosity compared with yogurt made of milk from farms (B) and cow milk (C). The yogurt made from milk of goats from farms (B) had viscosity similar to that of cow milk, regardless of breed. The statistical summary is given in Table 2. It is interesting to note that the yogurt of farms (A1) and (A2) resulted in a significantly higher and different viscosity, although the breed is similar. This could be due to the fact that the herds are located about 150 km apart and browse on different types of pasture. Viscosity of the yogurt of milk from farms (B1) and (B2) was similar to that of cow yogurt.

Yogurt consistency and gel properties were attributed to milk composition (Rasic and Kurmann, 1978), and especially to the casein fraction in the milk (Tamime and Robinson, 1984). To assess the contribution of the elevated protein and fat in the milk of farms (A), milk from herd (A1), which resulted in the highest viscosity, was diluted as described in Section 2. The composition of the diluted milk and its viscosity is given in Tables 1 and 2 under (A1*). The reduction of viscosity, due to the dilution factor, resulted in yogurt similar to that of farm (A2), and significantly higher than that of farms (B1) and (B2) and cow milk yogurt (Table 2).

The differences in viscosity of yogurt made of the different milks could be attributed to goat breed and to their milk, which is richer in solids. No positive correlation was found between the ratio of fat to solids non-fat of the different yogurt, as noted by Rasic and Kurmann (1978). It was shown that the same starter
produced more lactic acid in a shorter time in goat milk compared with cow milk (Fig. 1). Faster fermentation was also noted in yogurt made from milk treated with proteolytic enzymes (Gassem and Frank, 1991). It is common knowledge that the amount of acid produced by the same culture is proportional to the number and/or activity of bacteria cells. In addition, when milk from farm (A1) was diluted to the solids level of milk from farms (B1) and (B2) and cow milk, it still resulted in yogurt with almost doubled viscosity. It is assumed that the milk from farm (A) contains factor(s) that enhances the activity or the growth of the starter culture (Fig. 1). These, or other factors, might also be responsible for the increased viscosity. This factor(s) could be attributed to goat breed and pasture in diet, and little to the solids content of the milk.

4. Conclusions

Yogurt made of milks of different goat breeds and different farming types resulted in different viscosity, which was measured using a rotating viscometer. Cow milk yogurt was similar in viscosity to yogurt from milk of goat breeds that include Saanen and its crossbreds, and which were fed hay and concentrate indoors without grazing. It appears that milk obtained from goat breeds Shami × Anglo-Nubian that browse on pasture, contains certain factor(s) that causes an increase in the viscosity of yogurt produced from it.

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References


