SHORT COMMUNICATION

Comparative rheological study of goat milk yoghurt and cow milk yoghurt

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Abstract Goats are popularly known as the poor man’s cow (or mini-cow) because of their immense contribution to the poor man’s economy. Like milk, yoghurt is also very nutritious. It has been demonstrated that acid milk is better to digest than normal milk. The most important benefits of yoghurt consumption cover the reduction of blood cholesterol level, anti-cancer effects and the improvement of antimicrobial activity and immunity in the human body. From the point of view of rheology, yoghurt is a non-Newtonian, rheological unstable, viscoelastic and pseudoplastic fluid. Beside the sensory quality, another important factor for the consumer’s acceptance of the product are the rheological properties of yoghurt, such as apparent viscosity and flow behaviour. An important role is also played by the composition and physicochemical properties of milk which yoghurt is prepared from. Because of the differences in composition and physicochemical properties of goat and cow milk, differences in the rheological properties of yoghurt from these types of milk can be expected. Texture analysis of goat and cow milk yoghurt was carried out to compare the quality of yoghurt using instrument namely TA.XT Plus texture analyzer. Study revealed that goat milk yoghurt was having lower firmness, consistency, cohesiveness and index of viscosity than cow milk yoghurt.

Keywords: Cow milk yoghurt, goat milk yoghurt, rheology, texture analysis, viscosity

In this age of liberalization and globalization, there will be renewed focus on product diversification, value addition, quality improvement and export promotion, which will define a more challenging role for the professionals engaged in the pursuit of dairy technology and allied sciences. Goat is popularly known as the poor man’s cow (or mini-cow) because of its immense contribution to the poor man’s economy. The goat milk is better than cow milk for the reasons like the goat milk is less allergenic, naturally homogenized, easier to digest due to a smaller fat globules as well as higher levels of medium chain fatty acids and it matches up to human milk better than cow milk (Cooke, 2010). Like milk, yoghurt is also very nutritious. It has been demonstrated that acid milk is better to digest than normal milk. The most important benefits of yoghurt consumption cover the reduction of blood cholesterol level, anti-cancer effects and the improvement of antimicrobial activity and immunity in the human body (Desobry-Banon et al., 1999). Beside the sensory quality, another important factor for the consumer’s acceptance of the product are the rheological properties of yoghurt, such as apparent viscosity and flow behaviour. These properties are also of main significance in dairy technology, especially in the manufacturing, storage, process design, product development and establishment of the product’s quality (Benezech and Maingonnat, 1994; Lucey and Singh, 1997). From the point of view of rheology, yoghurt is a non-Newtonian, rheological unstable, viscoelastic and pseudoplastic fluid. It is also shear thinning, which means that its viscosity decreases as the shear rate increases and depends on the “shear history”. Jumah et al. (2001) determined the flow curves of yoghurt curd during the gelation process and at the maximum viscosity value for sheep, goat, cow and camel milks. They found that the measured viscosity decreased with increasing angular velocity of the inner cylinder, suggesting that the yoghurt behaved as a shear-thinning fluid. Rheological properties of yoghurt may be influenced by some technological factors, which mainly include the type and amount of dry matter fortification, preheating intensity of the milk and whey protein denaturation, specific properties of starter culture and addition of stabilizers (Rohm and Schmidt, 1993; Rohm, 1993). An important role is
also played by the composition and physicochemical properties of milk which yoghurt is prepared from. Because of the differences in composition and physicochemical properties of goat and cow milk differences in the rheological properties of yoghurt from these types of milk can be expected. The milk curd is formed with the acid produced by lactic acid bacteria, which is a consequence of removing calcium and neutralizing the negative charges of casein micelles, causing destabilization of casein, which aggregates and forms a curd (McMahon et al., 1984). Curd texture or firmness is an important property of yoghurt, which determines the quality and acceptability of the product. Adequate firmness without syneresis is essential for the superior quality of yogurt (Kroger, 1973). Hassan et al. (1995) postulated formation of yoghurt curd structure during acid gelation of milk may occur in a three-stage process: (a) induction period without any changes in viscosity, (b) flocculation stage with maximum increases in viscosity, and (c) decrease in viscosity due to contraction with rearrangement of casein micelles and the syneresis of gel. The effect of the gelation process on the rheological properties of yoghurt curd made from sheep, goat, cow and camel milks was investigated by Jumah et al. (2001). They found that the highest value for viscosity was exhibited by sheep milk, followed by goat, cow and camel milks.

The aim of this work was to compare the rheological properties, such as apparent viscosity, flow behaviour and rheological parameters of yoghurt produced from goat and cow milk. The goat milk (Mehsani goat) having 3.6% fat and Cow milk having 4.4% fat was obtained from Livestock Research Station (LRS), S.D.A.U., S.K. Nagar. The samples of goat and cow milk yoghurt was prepared with the use of Streptococcus thermophilus and lactobacillus bulgaricus culture NCDC – 144 culture in the ratio of 1:1 and the standard operating procedure were followed i.e. Milk - Filtration - Testing of milk - Heat treatment (85-90°C for 15 min.) - Cooling at 37-42°C - Inoculation with culture @ 3% - Filling in sterilised container - Incubation (for 8 hrs) - Storage (4±1°C).

Texture analysis of goat and cow milk yoghurt was carried out to compare the quality of yoghurt using instrument namely TA-XT Plus texture analyzer at College of Home science and Nutrition, SDAU, S K Nagar.

**TA.XTPlus APPLICATION STUDY**

**Product: YOGHURT**

**Objective**: Comparison of consistencies of yoghurt by back extrusion

**TA Settings**

*Mode*: Measure Force in Compression, *Option*: Return to Start, *Pre-Test Speed*: 1.0 mm/s, *Test Speed*: 1.0 mm/s, *Post-Test Speed*: 10.0 mm/s, *Distance*: 30mm, *Trigger Type*: Auto - 10g, *Tare Mode*: Auto and *Data Acquisition Rate*: 400pps

**Accessory**: Back Extrusion Cell (A/BE) with 35mm disc and extension bar using 5kg load cell

**Test Set-Up**: Tests are carried out either in a standard size back extrusion container (50mm diameter) approximately 75% full or in the original container (with a similar or larger diameter) immediately after removal from storage. The extrusion disc should be positioned centrally over the sample container. For comparison of cohesiveness and ‘work of cohesion’ the probe must return to the same position above the samples after each test. To do this it is necessary to calibrate the probe to a distance that is a starting distance of e.g. 30mm, above the top of the container or the sample surface. When the probe is returning to the start (i.e. pulling out of the sample) it is recommended that the container is held to prevent it from lifting.

**Typical plots**

**Observations**: When a 10g surface trigger is attained (i.e. the point at which the disc’s lower surface is in full contact with the product) the disc proceeds to penetrate to a depth of 30mm (or other specified distance). At this point (most likely to be the maximum force), the probe returns to its original position. The ‘peak’ or maximum force is taken as a measurement of firmness - higher value indicate firmer sample. Area of the curve up to this point is taken as a measurement of consistency - highervalue indicates thicker consistency of sample. The negative region of the graph, produced on probe return, is as a result of the weight of sample which is lifted primarily on the upper surface of the disc on return, i.e. due to back extrusion and hence gives again an indication of consistency/resistance to flow off the disc. The maximum - ve force is taken as an indication of the cohesiveness of the sample - the more negative value indicates more ‘cohesive’
Table 1  Texture analysis of goat milk and cow milk yoghurts

<table>
<thead>
<tr>
<th>Yoghurt type</th>
<th>Firmness</th>
<th>Consistency</th>
<th>Cohesiveness</th>
<th>Index of Viscosity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Max. +ve Force</td>
<td>Mean +ve Area</td>
<td>Mean Max.-ve Force</td>
<td>Mean -ve Area</td>
</tr>
<tr>
<td>Sample 1</td>
<td>0.204238±0.0078</td>
<td>5.042±0.1009</td>
<td>-0.101789±0.0054</td>
<td>-0.283±0.0093</td>
</tr>
<tr>
<td>Sample 2</td>
<td>0.085960±0.0039</td>
<td>2.194±0.0913</td>
<td>-0.030779±0.0032</td>
<td>-0.118±0.0083</td>
</tr>
</tbody>
</table>

Sample 1 - cow milk yoghurt  
Sample 2 - goat milk yoghurt

Figure 1  Texture profile analysis of cow milk yoghurt

Figure 2  Texture profile analysis of Goat milk yoghurt
sample. The area of the negative region of the curve may be referred to as ‘work of cohesion’—with increase in value resistant become more to withdrawal the sample which is an indication of the cohesiveness and also consistency/viscosity of sample.

Results of textural analysis of intact yoghurt samples in the three experiments are summarized in Table 1 and Fig. 1 and 2.

It is evident from the table 1 that the mean for firmness (Mean Max. +ve Force) and consistency (Mean +ve Area) of sample 1 was higher than that of sample 2 and was significantly differ (p<0.05) from each other. This parameters were higher in sample1 indicating that the sample 1 having a more firmness than that of sample 2. It was also seen from the table that the mean for cohesiveness (Mean Max. -ve Force) and index of viscosity (Mean -ve Area) of sample 1 was higher than that of sample 2 and was significantly differ (p<0.05) from each other. These parameters were higher in sample 1 indicating that the sample 1 was more viscous than that of sample 2.

It was recorded from the result (table1 and fig 1, 2) that the goat milk yoghurt had less firmness than cow milk yoghurt. It might be due to total solids contents of milk that was used for the preparation. Pennaet al. (1997) and Kristoet al. (2003) were stated that the firmness of yogurt is dependent on TS content. The textural differences between the yoghurts are attributed to the kind of milk used and their compositional differences. The result found is in line with Aggarwal, (1974) who reported that firmness of goat milk yoghurt was lower than cow milk yoghurt. It was also seen that goat milk yoghurt was less viscous than cow milk yoghurt (table1and fig 1, 2). Farnsworth et al. (2006) reported that increasing total solids of the milk was shown to improve yogurt viscosity. The result is in agreement with the result of Duitschaever (1978) reported that goat milk yoghurt was less viscous than that made from cow milk. Bozanic et al. (1998) reported that yoghurt prepared from goat milk had a softer consistency and lower viscosity than those prepared from cow milk. Domagla (2008) stated that apparent viscosity of goat milk yoghurt was lower and its flow curve was characterized by a smaller hysteresis loop area and slant than these of yoghurts from cow milk.

Texture analysis of cow milk yoghurt and goat milk yoghurt revealed that goat milk yoghurt was having lower firmness, consistency, cohesiveness and index of viscosity than cow milk yoghurt. The goat milk yoghurt was less firm and less viscous than cow milk yoghurt.

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References