

EVALUATION OF CHEMICAL AND COLOR INDEX CHARACTERISTICS OF GOAT MILK, ITS YOGHURT AND SALTED YOGHURT

[EVALUACIÓN DE UN INDEX DE CARACTERÍSTICAS QUIMICAS Y DE COLOR DE LA LECHE DE CABRA, SU YOGURT Y EL YOGURT SALADO]

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SUMMARY

Salted yoghurt (SY) is one of the most popular dairy products in Hatay region of Turkey. It is made of goat milk, and known as “yoghurt cheese” or “winter yoghurt” due to its high solids content and long shelf life. Two different salting methods are traditionally used in manufacturing the SY: First by direct salting to the yogurt, and second by salting to whey removed yogurt before boiling. The SYs were manufactured using the direct salting method to compare the differences between the two salting methods in chemical parameters and changes in color values during salted yoghurt processing with reference to the original milk. Chemical composition and parameters such as total solids, fat, ash, salt and pH of the products were evaluated. The color characteristics of the samples were measured by the Minolta Chroma Meter CR-400 (Minolta Co., Ltd, Japan). Results showed that the mean chemical composition and indices of the original goat milk, regular yoghurt and SY were: total solids (%) 12.2, 12.0 and 31.9; total fat (%) 4.40, 4.20 and 10.20; ash (%) 0.58, 0.60 and 2.26; pH 6.53, 3.67 and 3.77, respectively. The slight decreases in total solids and fat contents of the regular yogurt may be due to the water from the yoghurt culture, where one-day old yogurt was used as starter culture. SY has substantially ($P < 0.001$) higher fat and total solids contents compared to the original milk and regular yogurt, while pHs of both yogurts significantly ($P < 0.01$) lower than that of original milk. Color values of the goat milk, regular yoghurt and SY were: L 85.2, 90.19, 92.07; a -3.38, -3.37, -7.33 and b 7.76, 7.33, 14.72, respectively. The mean L -value, lightness, was the lowest in milk. The a -value, an indicator of green color, was higher for milk and regular yoghurt. Yellowness (b -value) index was the highest in SY. The characteristics of color analysis revealed that yellowness increased two-fold during cooking of the yoghurt, and greenness decreased two-fold during cooking in comparison with those of regular yoghurt and milk samples. These color changes may be

attributable to the caramelization of carbohydrates in the milk.

Key words: *Goat milk, salted yogurt, Turkish products, chemical composition, color index*

INTRODUCTION

Salted yoghurt (SY: salted and cooked yoghurt) is one of the most popular variety of traditional dairy products manufactured in Hatay (Guler, 2007b). It has high dry matter content and long shelf life. There are two procedures in the production of Salted yoghurt. The first procedure is the set-type yoghurt which is boiled and then salt is added. The second method is where yoghurt whey is removed by using cloth bag, boiled, and then salt is added in order to shorten cooking time. Although no federal standards for salted yoghurt composition exist, small dairy producers as well as consumers are concerned about a product having uniform composition and functional properties. In Hatay province, goat milk is mainly used for production of salted yoghurt. Goat milk is used for manufacturing SY, since goat milk SY is smoother and whiter as compared with cow milk counterparts. In addition, goat milk has been reported to be different from cow or human milk in higher digestibility, distinct alkalinity, higher buffering capacity, and certain therapeutic value in medicine and human nutrition (Park and Chukwu, 1988; Park, 1994; Haenlein, 2004).

Salting is an age-old method used by humans to preserve food, but the incorporation of salt into concentrated yoghurt also acts as a neutralizing agent to reduce the acid taste of the product. The characteristics of chemical properties, mineral composition, free fatty acids and volatile compounds of SY made by the second method (after yogurt whey removal by cloth bag and salting) have been reported (Güler, 2007a; 2007b). However, scientific studies on SY manufactured by direct cooking of yoghurt using the first method have little been reported. The

objective of the present study was to compare the differences in basic nutrient composition, chemical parameters and color values among raw goat milk, regular yoghurt, and salted yoghurt products.

MATERIALS AND METHODS

Preparation of goat milk

The milk used for this study was collected from the local indigenous dairy goat breeds located at Şenköy village in Hatay province of Turkey. The goats were hand-milked twice daily in the morning and evening, and then the milk was combined to conduct the study and manufacture the experimental yoghurts.

Manufacture of salted yoghurt

Salted yoghurt (SY) was manufactured by the traditional methods used in Şenköy village. Raw goat milk was subjected to a heat treatment at 85 °C for 30 min, and cooled to 43°C. One day old yoghurt was added to the milk as starter culture. The inoculation rate was 3 g yogurt/100g milk, and then the milk was incubated for 5 hours 50 min. Yoghurt pH was 3.72 after incubation, and samples were taken as the regular yogurt treatment. The yoghurt was then transferred into a tinned copper container with a flat bottom under which a fire was set with dried bushes. Yoghurt was continuously stirred until boiling, then cooked for about 60 min at 98 °C. After cooking, salt was added by 2 g salt/100g, and cooking continued 10 more minutes with stirring. The salted yoghurt was cooled to 40°C, and then placed in glass jars and olive oil added on top to prevent mould growth, and closed. The finished SY were placed in a refrigerator at 4.5 °C. On day 1, samples were taken for analyses.

Chemical analyses

Total solids content was determined by gravimetric method using oven drying at 105 °C for 24h (AOAC, 2003). The results were cross-checked with infrared drying method. Fat and salt contents were determined by the Gerber method and potentiometric titration method as described in Turkish standards, respectively (TSI, 1981; 1999; 2001). pH was determined by a pH meter (Thermo, Orion 3 Star, US). Ash content was assayed by dry ashing in a muffle furnace at 550 °C for 24 h.

Color analysis

The color of samples was measured by the Minolta Chroma Meter CR-400 (Minolta Co., Ltd, Japan). This is the CIELAB system measuring parameters *L*, *a*, *b* from the samples. The *L*-value, is a measure of lightness, ranges between 0 and 100. Positive and

negative increases of *a*-value correspond to increases in red or green color proportions, respectively. The *b*-value represents color ranging from yellow (+) to blue (-).

RESULTS

The analytical results of chemical compositions, pH and color index values of the raw goat milk, yoghurt and salted yoghurt are shown in Table 1. The SY showed marked increases in total solids, crude fat and ash contents compared to those of the original milk and regular yogurt. As there is no dry matter fortification to the milk, the chemical composition of regular yoghurt was nearly similar to the original milk. On the other hand, the SY had significantly higher salt (2.32%) compared to the milk and regular yogurt. The pHs of regular yogurt and salted yogurt were substantially decreased compared to the original milk sample, apparently due to acid production by fermentation in the two types of yogurts. In the light of color changes, *L*-values significantly increased from the milk to the two yogurts. The *b*-value of SY was doubled compared to the milk and regular yogurt samples.

DISCUSSION

The total solids and fat contents of the goat milk in this study were similar to those reported by Güler (2007a), while ash and pH values were lower. Substantial increases in total solids and crude fat contents in SY compared to the milk and regular yogurt would be expected since the whey of the SY was removed and salt was added before cooking. In addition, water was evaporated during cooking of the SY. There has been difficulty in obtaining representative and comprehensive information on mineral concentrations in the goat milk, since many factors may not be consistent which affect ash and mineral concentrations such as diet, season, age, genetic traits, stage of lactation, locality, plane of nutrition, feeding and management conditions, etc. (Park and Chukwu, 1988; Rincon et al., 1994; Rodriguez et al., 1999).

As shown in Table 1, ash content of SY is significantly ($P < 0.01$) higher than the raw milk and regular yoghurt because of removal of whey, salt addition and evaporation of moisture during salted yoghurt manufacturing process. Furthermore, the SY contained 2.32% more salt, while the milk and regular yogurt remained negligible salt content. Lactic acid production apparently increased by the yogurt fermenting bacteria (*Streptococcus thermophilus* with *Lactobacillus delbrueckii* subsp. *bulgaricus*), which considerably increased the acidity of the two yogurts, resulting in significantly lower pH in yogurts than in the raw milk.

Few reports have been available, if any, on the *L*, *a* and *b* values of goat milk, its yoghurt and salted yoghurt. During SY making processes, the lightness (*L*-value) increased, yellowness (*b*-value) markedly increased, whereas greenness (*a*-value) decreased (Table 1). In CIELAB systems, *a*- and *b*- scales use as indications of pigment content in sample. The increases in lightness value of the yogurt products may be attributable to the decrease in fat globule dimension by continuous stirring since fat globules may provide better reflection of light. The increases in yellowness could be due to the caramelization of the milk carbohydrates by high processing temperatures.

CONCLUSIONS

During cooking process of the yogurt, total solids content of salted yoghurt increased about 3-fold in comparison with the regular yoghurt. The SY has a longer shelf-life due to high dry matter content and added salt. The acidity of the two yogurts, compared to the original milk, significantly increased after the incubation. Because the yoghurts held at high temperatures for the extended time, yellowness index of salted yoghurt was markedly increased in comparison with the regular yoghurt and raw milk. Greenness index, however, decreased during the cooking process.

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Table 1. Chemical and color characteristics of goat milk and its yoghurt and salted yoghurt.

Chemical indices	Goat milk	Yogurt Salted Yogurt	
Total solids (%)	12.19±0.32	11.99±0.01	31.90±0.60
Crude fat (%)	4.40±0.07	4.20±0.20	10.20±0.28
Ash (%)	0.58±0.05	0.60±0.06	2.26±0.03
Salt (%)	-	-	2.32±0.53
pH	6.53±0.02	3.67±0.05	3.77±0.04
Color index			
<i>L</i> -value	85.2±2.98	90.19±1.25	92.07±0.05
<i>a</i> -value	-3.38±0.25	-3.37±0.08	-2.19±0.04
<i>b</i> -value	7.76±0.26	7.32±0.08	14.72±0.03

Submitted June 02, 2008 – Accepted February 09, 2009