Food Chemistry, Vol. 61, No. 1/2, pp. 13–16, 1998

0308-8146/98 $19.00 + 0.00

PII: S0308-8146(97)00147-7

The losses of nutrients during the production of strained (Torba) yoghurt

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(Received 2 May 1997; revised version received 8 June 1997; accepted 8 June 1997)

A traditional method has been used in the production of Torba yoghurt (a strained yoghurt produced from cow's, goat's or sheep's milk) and this is based on straining with a special cloth bag. In this study, the losses of nutrients during the straining of yoghurt were as follows: 51.8% thiamin, 60.5% riboflavin, 7.28% protein, 0.77% fat, 71.1% lactose, 70.2% sodium, 68.2% potassium, 65.6% calcium and 50.2% phosphorus. Among the amino acids the least loss occurred in the amount of tyrosine (2.24%) and the loss of histidine was highest (11.4%).

INTRODUCTION

Lactic acid fermentation is one of the oldest methods used for preservation of milk (Tamime and Robinson, 1978). By using this method a number of acidic milk products are produced. One of them is yoghurt. In spite of its acidic property, it is still prone to spoilage during storage and preservation because of a high content of water (85%). Attempts are therefore made to produce different kinds of yoghurt which keep fresh for longer. For keeping quality, elimination of yoghurt whey is one of the most important factors. Traditional and new methods have been used in removing yoghurt whey for the manufacture of strained yoghurt. In the traditional method, yoghurt is strained in a special cloth bag. New methods, ultrafiltration and centrifugation, have recently been employed to produce strained yoghurt (Tamime *et al.*, 1991). Several types of concentrated yoghurt have been produced traditionally in Turkey. They are known as Kurut, Torba yoghurt, Tulum and pesküten (Tamime and Robinson, 1978; Özdemir *et al.*, 1995). Among these, Torba yoghurt is the most consumed.

Similar products are manufactured by different methods in other countries. These products are known as Labneh or Lebneh in the Middle East, Leben Zeer in Egypt, Skyr in Iceland, Chakka and Shirkland in India, Than or Tan in Armenia and Ymer in Denmark (Rao *et al.*, 1987; Tamime *et al.*, 1989*a*, 1991).

On the other hand, compositional variations occur during the manufacturing of strained yoghurt. Water-soluble nutrients are especially lost from the cold yoghurt along with the whey. Although Torba yoghurt has been manufactured by the new methods in the industrial plants, consumers have preferred the product prepared by traditional methods for their sensorial properties in Turkey.

Although several articles pertaining to chemical composition and preparation of Torba yoghurt have been published, the losses of nutrients are not available from the literature. Therefore the objective of this study was to determine the losses of nutrients during the production of Torba yoghurt by a traditional method.

MATERIALS AND METHODS

Milk samples

Whole cow's milk was obtained at different times from a small dairy plant in Manisa.

Starter culture

A commercial mixed strain of concentrated freeze-dried yoghurt starter culture (coded Bio-Industries F.Y. 100C per 100 litres) was obtained from Sanofi Ltd., Paris. The starter was a blend of *Streptococcus salivarus* subsp. *termophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus* at a rate of 1:1. From this culture, 0.05 g was taken and inoculated into 500 g milk pasteurized at 90°C for 10 min and cooled to 45°C, then incubated for 5.5 h for activation at 43°C ± 0.1. This fermented milk was used as culture for production of Torba yoghurt.

Production of Torba yoghurt

Torba yoghurt was made by a traditional method in the laboratory. The milk was heated to 90°C for 10 min, cooled to 45°C and inoculated with 3% starter culture as described above. The milk was incubated until the acidity reached pH 4.7 at 43°C ± 0.1. After fermentation, the coagula were cooled to room temperature (21°C) and stored in a refrigerator at 4°C for 12 h. The fermented milk was mixed and transferred into a cotton cloth bag which had a warp to warp spacing of approx. 210 μm and a weft spacing of 150 μm. The dimensions of the cloth bag were 33×36 cm. The weave intensity was 15×22 fibres cm^{-2}. The cloth bag was hung to drain the whey (15 ± 2°C) for 12 h. Then it was packaged into the plastic cups and stored at +4°C until analysed. The flow diagram for laboratory scale production of Torba yoghurt is given in Fig. 1.

Chemical analysis

Total solids, fat, ash, lactose and protein contents in normal yoghurt (unstrained), Torba yoghurt and whey were determined according to James (1995). Protein content was calculated by using the factor 6.38. The pH measurements were carried out using a WTW microprocessor pH meter fitted with combined glass electrode. Titratable acidity was determined by titrating 10 ml of whey or 10 g of normal yoghurt sample with N/4 NaOH using 1 ml of phenolphthalein (1% in 95% ethanol) solution as indicator.

Levels of Na, K, Ca were determined by using a Jenway PFP 7 Flame Photometer. In calcium analysis, 1 ml of 10% lanthanum chloride solution was added to 10 ml of sample solution to minimize the interference effects of phosphate. Phoshorus content of the samples was determined by a colorimetric method (James, 1995).

The analysis of thiamin was performed according to Turkish Standards (Anon, 1988). For the determination of riboflavin, the AOAC method (1975) was used. Amino acid analyses were performed according to the procedure given by Rao *et al.* (1987) using a Biotronic L.C. 3000 amino acid analyzer.

Whole Milk

↓

Heat Treatment (90 °C for 10 min)

↓

Cooling (45 °C)

↓

Inoculation (with 3% starter culture)

↓

Incubation (43 °C ± 0.1 until pH 4.7)

↓

Cooling (room temparature, 21 °C)

↓

Mixing (gently)

↓

Straining (in a cloth bag, 15 °C ± 2)

↓

Packed and Stored (4 °C)

Fig. 1. The flow diagram of laboratory scale production of Torba yoghurt.

Calculation of nutrient losses

Total levels of each nutrient in a certain amount of normal yoghurt before the draining process were determined: (a) after the yoghurt sample was hanged to drain off the whey for 12 h, the collected whey was weighed. Then the amounts of each nutrient were also determined in the collected whey; (b) the percent losses for each nutrient were calculated by the ratio of total nutrients of whey to their amounts present in normal yoghurt (100×b/a).

RESULTS AND DISCUSSION

The Torba yoghurts under study were made in February and April 1995 from different samples of whole cow's milk. Average chemical compositions of normal yoghurts and wheys are shown in Tables 1 and 2. About 65% of normal yoghurt was separated as whey. The

Table 1. Chemical composition of normal yoghurt and its whey and nutrient losses during the production of Torba yoghurt[a]

	Yoghurt[b]	Whey[c]	% Losses
Protein (g)	3.7 ± 0.20	0.3 ± 0.002	7.3 ± 0.7
Fat (g)	3.4 ± 0.57	0.03 ± 0.006	0.8 ± 0.1
Lactose (g)	4.7 ± 0.40	3.32 ± 0.136	72.1 ± 5.08
Sodium (mg)	56.1 ± 8.91	38.9 ± 4.71	70.2 ± 8.61
Potassium (mg)	143 ± 13.32	96.4 ± 4.47	68.2 ± 7.02
Calcium (mg)	163 ± 30.32	107 ± 23.09	65.6 ± 7.82
Phosphorus (mg)	155 ± 10.95	77.8 ± 9.08	50.2 ± 2.73
Thiamin (mg)	0.04 ± 0.008	0.02 ± 0.002	51.8 ± 2.73
Riboflavin (mg)	0.13 ± 0.013	0.077 ± 0.012	60.5 ± 12.90
Total solid (g)	12.6 ± 0.76	4.2 ± 0.171	33 ± 1.38
Ash (g)	0.8 ± 0.82	0.5 ± 0.025	65.7 ± 3.81
pH	3.9 ± 0.10	4 ± 0.175	
Acidity (°SH)	47.5 ± 6.71	34.1 ± 4.08	

[a]Results are the average of six trials ± SD.
[b]Values are for 100 g yoghurt samples.
[c]Values are for wheys collected from 100 g yoghurt samples.

Table 2. Amino acid composition of yoghurts and wheys and their losses during production of Torba yoghurt[a]

Amino acid	Yoghurt[b]	Whey[c]	(%) Losses
Aspartic acid	2.14	0.093	**4.33**
Threonine	1.52	0.0687	**4.52**
Serine	2.14	0.0990	**4.63**
Glutamic acid	5.31	0.191	**3.59**
Proline	0.21	0.0058	**2.77**
Glycine	0.96	0.0542	**5.64**
Alanine	2.24	0.114	**5.07**
Valine	1.68	0.0686	**4.08**
Methionine	0.79	0.0218	**2.76**
Isoleycine	1.42	0.0592	**4.17**
Leucine	2.63	0.0736	**2.80**
Tyrosine	1.08	0.0242	**2.24**
Phenylalanine	1.35	0.0378	**2.80**
Histidine	1.01	0.115	**11.3**8
Lysine	2.05	0.0775	**3.78**
Arginine	0.64	0.0555	**8.67**

[a]Results are means of duplicates.
[b]Values are given as mg amino acid per g yoghurt samples.
[c]Values are given as mg amino acid for wheys collected per g yoghurt samples.

normal yoghurts contained 12.6% total solids, 3.4% fat, 3.7% protein and 4.7% lactose. Total solids content of normal yoghurt was lower than the set type yoghurts. This difference may be attributed to the unstandardized milk samples used for manufacturing yoghurt. However, Torba yoghurts contained 26.4% total solids, 11.5% fat, 10.7% protein and 3.4% lactose. Due to the standards of Lebanon and Saudi Arabia, total solids content of labneh ranges between 22 and 26%, respectively (Tamime *et al.*, 1989*b*). Our results are within the range of the above reported values.

Important losses of nutrients occurred during the manufacturing of Torba yoghurts (Tables 1 and 2). The highest losses were found for lactose and minerals. From Table 1, it can be seen that the average loss of lactose was 71%. A large proportion of lactose was transferred from normal yoghurt to the whey when the yoghurts were strained to produce Torba yoghurts. Minerals of yoghurt are generally found as colloidal or free forms in the liquid phase. Normally calcium and phosphorus are bound to casein as calciumphoshocaseinate. During fermentation of yoghurt, pH decreases and the minerals begin to be lost from casein which is completely free of minerals when the pH reaches 4.6–4.7 (John, 1990). During the draining process, large amount of minerals are separated with whey. As shown in Table 1, the average losses of sodium, potassium, calcium and phosphorus were 70.2%, 68.2%, 65.6% and 50.2%, respectively. The amount of fat passed from yoghurt to whey was 0.78% (on average). This means that nearly all of the fat was retained by the cloth bag.

The average losses of yoghurt proteins were determined as 7.3%. Most of the casein remained in the cloth bag. It was reported that whey contains non-coagulated proteose peptone, non-protein nitrogen components like urea and creatine and little casein (Yöney, 1974; Tamime and Robinson, 1988). Tamime *et al.* (1991) reported that the protein losses during production of labneh by a traditional method (from cow's, goat's and sheep's milk) were 0.3, 0.6 and 0.9%, respectively. Our results were higher than the above values. The differences can be attributed to the type of milk as well as different traditional methods, since the composition of strained yoghurts can be affected by many factors such as the length of straining period, relative humidity and temperature of the surrounding air and the kind of cloth bag used. In the traditional method, the production conditions could not be controlled and cloth bags used for straining are not standard. For this reason, the content of strained yoghurts produced by traditional methods may change from country to country.

The mean losses of thiamin and riboflavin were found to be 51.8 and 60.5% respectively. It was thought that both vitamins were lost with the whey from normal yoghurt during the straining period due to their water-soluble properties. No literature was found about the losses of vitamins during the production of Torba yoghurts. So, no comparison has been made for the losses of vitamins.

The composition and losses of amino acids are shown in Table 2. The individual amino acids including glutamic acid, leucine, aspartic acid, alanine, serine and lysine were higher than the other amino acids in normal yoghurt. Proline, arginine and methionine were found to be lowest. Decreases in the amounts of individual amino acids varied between 2.24 and 11.4%. Among the amino acids, histidine and arginine losses were found to be 11.4 and 8.67%, respectively. They are essential amino acids for growth of children (Rao *et al.*, 1987). The other amino acids were also reduced during production of Torba yoghurt. There is no correlation between the amount of amino acids present in normal yoghurt and their losses.

CONCLUSION

This study shows that the traditional method markedly reduces the amounts of nutrients present in normal yoghurt. Large amounts of Torba yoghurt have been produced traditionally in small dairy plants and rural populations in Turkey. About 92% of whey solids are composed of lactose and minerals. A large amount of whey obtained in draining process is wasted. This whey could be added into some foods for enrichment in nutrients when it is produced domestically. Traditional methods for manufacturing Torba yoghurt on the factory scale are not appropriate from a nutritional and technological point of view, because they need a long straining time, a large floor space, are labour-intensive and the yield is very low. Instead of the traditional method, centrifugation or ultrafiltration processes should be considered.

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