FULL LENGTH ARTICLE

Determination of chemical composition, and storage on dried fermented goat milk product (Oggtt)

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Oggtt; Chemical composition; Storage; Energy value; Dried fermented milk

Abstract A sample of dried fermented goat milk product (Oggtt) obtained from the local market of Riyadh city in The Kingdom of Saudi Arabia, was stored for 6 months at 4 °C and subjected to chemical composition analysis before and after storage. The result showed that the sample moisture increased significantly (P ≤ 0.05) after storage from 7% to 10%, total ash decreased non-significantly (P > 0.05) from 8% to 7.6%, total carbohydrates decreased non-significantly (P > 0.05) from 35.5% to 33.8%, protein increased non-significantly (P > 0.05) from 16 to 16.1 g/l, fat content was found to have the same values in all samples before and after storage at 5%, lactose increased (P ≤ 0.05) non-significantly from 28.4% to 29%, acidity decreased (P ≤ 0.05) significantly from 0.45% to 0.39%, and pH decreased (P > 0.05) non-significantly from 4.3% to 4%. On the other hand, mineral composition showed (P ≤ 0.05) non-significant results before and after storage. Ca concentration decreased from 118 to 1149 mg/kg and K concentration increased from 185.8 to 1888 mg/kg. While Mg increased from 105 to 123 mg/kg, Zn increased from 8.3 to 8.6 mg/kg, Mn and Fe were found to have the same values of concentrations before and after storage which were 0.2 and 0.1 mg/kg, respectively. Accordingly, we can conclude that Oggtt is a stable product and have a good nutritional value in comparison to daily required amounts for healthy human life.

1. Introduction

Oggtt is dried fermented goat milk that belongs to the group of dairy products, made by a process involving lactic acid ferment-
for churning of milk). After that, the residual butter milk is boiled with stirring until it thickens, then the thick paste is allowed to cool to about 30-35 °C and then shaped by hand into small cake-like pieces, which are pressed on a canvas fabric and sun dried. (EL-Erian, 1979; AL-Ruqai et al., 1987 and Kurmann, 1931) The pieces are irregularly shaped, having yellow to white color.

A new product called Tamur-oggtt is produced in which dates and Oggtt are mixed as one product then shaped in the form of biscuits (Sidhu and AL-Hooti, 2005). Other Oggtt variants are flavored with chocolate, date, coffee, mint, orange, pineapple and strawberry (Al-Ruqaie et al., 1987). The importance of fermented milk products is it helps increasing the lactose digestion avoiding intolerance symptoms in persons who had showed lactose intolerance (Vrese et al., 2001). Yogurt and other fermented milks are also reported to have other health benefits, including blood cholesterol reduction and possible cancer prevention (Guo, 2003; Ripudaman et al., 2003). Nutritive value depends on the type of milk or butter milk utilized, where most fermented dairy products contain lactic acid bacteria which stimulate the immune system (Gatesoupe, 2008 and Zmarlicki, 2006), as well as yeast and molds, which give special features to the fermented products (Jan et al., 2001). The aim of this work is to determine the chemical composition of Oggtt (dried fermented dairy product) and to identify its functional properties.

2. Materials and methods

2.1. Samples

A sample of dried fermented milk product (Oggtt) was obtained from the local market of Riyadh city and ground using a high speed grinder (Philips, Brazil) then divided into two parts. The first part was immediately analyzed and the second part was kept in a plastic container and stored for 6 months at 4 °C in a refrigerator until analysis.

2.2. Physical and chemical analyses

2.2.1. Moisture determination

The level of moisture was determined gravimetrically according to AOAC (1990) using a Vacuum Oven, Haraeus VT5042EK, Germany.

2.2.2. pH determination

Ten grams of the Oggtt was diluted with 70 ml distilled water and mixed thoroughly for pH measurement. The pH meter (Mettles, Toledo MP220, Switzerland) was calibrated with standard buffers 4 and 7 (BDHL laboratory, England), before measuring the pH of the mixture.

2.2.3. Titratable acidity

The acidity of Oggtt was determined by titration following the method described by AOAC (1990) using phenolphthalein (Riedel DE HAEN AG, Germany) as an indicator. The acidity of the samples was calculated by using the following equation:

\[ \text{Titratable acidity} = \frac{0.0090 \times \text{volume of NaOH used}}{100 / \text{weight of the sample}}, \text{ (AOAC, 1990)} \]

2.2.4. Determination of fat content

The determination of fat contents of the samples (before and after storage) was carried out gravimetrically according to the method of AOCS (1990) using petroleum ether as solvent for Soxhlet extraction. Two grams of ground samples was accurately weighed, transferred to thimble and extracted with petroleum ether at 40-60 °C for 8 h. After extraction, the solvent was evaporated to dryness in an oven at 105 °C weighed and then the percentage of the oil was calculated.

2.2.5. Total carbohydrates analysis

The content of total carbohydrates of the samples was determined by the phenol sulfuric acid method (Dubois et al., 1956 and Krishnaveni et al., 1984). One gram of the sample (in boiling tube) was hydrolyzed by keeping it in a boiling water bath for 3 h with 5 ml of 2.5 HCl, cooled at room temperature, neutralized with solid sodium carbonate until effervescence ceases, made up to 100 ml and centrifuged. After sample preparation the working standard was pipetted out into a series of test tubes with 0.2, 0.4, 0.6, 0.8, and 1 ml as well as 0.1 and 0.2 from the sample in another two test tubes, then 1 ml of phe-nol and 5 ml of 96% sulfuric acid were added, shaken for 10 min, placed in a water bath at 25–30 °C for 20 min, finally, the color was read at 490 nm using a UV/visible Spectrophotometer (Ultrospec 2100 pro Biochrom Ltd., Cambridge CB 4 OFJ England). The total carbohydrate present in the solution was calculated using the standard graph and the formula

\[ \text{Absorbance} = \frac{x \times 100 \times 1 \text{ mg of glucose in 100 ml of the sample solution contains}}{0.1 \times 100 \text{ mg of glucose}} = \% \text{ of total carbohydrate present.} \]

2.2.6. Fiber analysis

The content of fiber was determined according to (AOAC, 1997) using 3 g of defatted sample transferred to 1 L conical flask. Then 200 ml of 0.2 N sulfuric acid was added and boiled for 30 min, the boiled solution was filtered under suction, the insoluble matter was washed with boiling water till the washing is acid free. 200 ml of 0.313 N NaOH was added, boiled again for 30 min, filtered, washed with boiling water followed by alcohol, 95% ethanol, dried at 100 °C then ashed in a muffle furnace at 550 °C for 3 h, cooled and weighed. The ash weight was subtracted from the weight of the insoluble matter and the difference was expressed as crude fiber percent of the original weight content. LABCONCO corporation Kansas City, MO, USA instrument was used.

2.2.7. Protein analysis

The concentration of protein was determined by Lowry’s method, (Lowry et al., 1951; Wilson and Walker, 2000). Using a set of nine test tubes blank (A), standard casein solution (B–F) and the sample (G–I) add 3 ml of Reagent C {(Reagent C = 100 parts of Reagent A + 1 part of Reagent B)}. Reagent A = 2% Na₂CO₃ + 0.4 NaOH + 0.16% sodium potassium tartarate + 1% sodium dodecyl sulfate (SDS). Reagent B = (4% CuSO₄·5H₂O make up to ml)} and 0.3 ml of Folin–Ciocalteu Reagent, let it stand for 45 min, read absorbance at 660 nm (use tube as blank), and plot the standard curve.
From the standard curve obtained the concentration of the samples was calculated in g/L. UV/visible Spectrophotometer was used (Ultrospec 2100 pro) (Biochrom Ltd., Cambridge CB 4 0FJ England).

2.2.8. Lactose analysis
Lactose as reducing sugar was determined by Asatoor and Kings Method (Asatoor and King, 1954).

The Oggtt sample was diluted to 1:25, 0.2 ml of sample was mixed with 7.6 ml of sodium sulfate–copper sulfate solution plus 0.2 ml of sodium tungstate mixed again then centrifuged, kept in a water bath for 10 min after cooling 3 ml of phosphomolybdic acid was added allowed to stand for 5 min then the absorbance was read at 680 nm using a UV/visible Spectrophotometer (Ultrospec 2100 pro) (Biochrom Ltd., Cambridge CB 4 0FJ England). A standard curve of absorbance against lactose concentration was plotted, and concentration of the samples was calculated in mg/dL.

2.2.9. Ash analysis
The ash content was estimated by incineration with the furnace (Branstead thermolyne DUBUQUE, IA, USA) at 550 °C (AOAC, 1990). Briefly, 2 g of sample was ashed in a muffle furnace at 550 °C for 8 h, cooled in a desiccator and re-weighed to the nearest decimal.

2.2.10. Calculation of the energy value
The theoretical energy value of the milk was calculated using the values of physiological energy deferred by (Peterson and Turner, 1938) according to the formula:

\[ E = 93.12f + 53.58p + 39.87l + 49.80a + 35.86w \]

where \( E \) is cal/kg of milk and \( f, p, l, a, \) and \( w \) are the percentages of fat, protein, lactose, ash and water, respectively.

2.2.11. Mineral analysis
A microwave Equipment milestone Ethos plus (2000) was used for digestion then, Inductive Coupled Plasma with optical emission spectroscopy (ICP–OES) was used for the measurement of mineral concentrations. Approximately, 0.50 g sample was weighed into a PTFE vessel and 2 mL of concentrated HNO₃, 0.5 ml of concentrated HCl, 2 mL of 30% H₂O₂ and 5.5 mL of H₂O were added. Samples were digested simultaneously with the optimized microwave digestion system. After digestion, the solution was transferred into a volumetric flask and made up to 25 mL with ultra-pure water. Concentrations of mineral elements in Oggtt were determined with ICP–OES.

2.2.12. Statistical analysis
Each sample was analyzed in triplicate and the data were assessed by One way analysis of variance (ANOVA) using SAS (version 9.1.3 SAS institute Inc., Cary, USA), with probability (\( P \leq 0.05 \)) level of significance all data presented as average of triplicate ± SD.

3. Results and discussion
The moisture content of Oggtt samples increased significantly (\( P \leq 0.05 \)), from 7% ± 0.2 before storage to 10% ± 0.2 after storage (Table 1, Fig. 1). This increase is within the range obtained by Al-Ruqaie et al., 1987; and EL-Erian (1979). This increase in moisture content may be due to the gain of moisture/water from the internal atmosphere of the refrigerator during storage period.

3.1. pH
The pH of Oggtt samples decreased non-significantly (\( P \leq 0.05 \)), from 4.32% ± 0.4 before storage to 4% ± 0.01

Table 1 Various components and parameters of Oggtt in percentage before and after storage.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Before storage*</th>
<th>After storage*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>7 ± 0.2a</td>
<td>10 ± 0.2a</td>
</tr>
<tr>
<td>pH</td>
<td>4.32 ± 0.04a</td>
<td>4 ± 0.01a</td>
</tr>
<tr>
<td>Titrable acidity</td>
<td>0.45 ± 0.19a</td>
<td>0.39 ± 0.01a</td>
</tr>
<tr>
<td>Fat</td>
<td>5 ± 0</td>
<td>5 ± 0</td>
</tr>
<tr>
<td>Total carbohydrate</td>
<td>35.5 ± 1.8a</td>
<td>33.8 ± 1.3a</td>
</tr>
<tr>
<td>Fiber</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
</tr>
<tr>
<td>Protein</td>
<td>16.0 ± 3a</td>
<td>16.1 ± 1.9a</td>
</tr>
<tr>
<td>Lactose</td>
<td>2.8 ± 4.5a</td>
<td>2.9 ± 3.7a</td>
</tr>
<tr>
<td>Total Ash</td>
<td>8 ± 1.7a</td>
<td>7.6 ± 0.1a</td>
</tr>
<tr>
<td>Energy (kcal/kg)</td>
<td>2851 ± 2.4</td>
<td>2859 ± 1.5</td>
</tr>
</tbody>
</table>

* Mean ± S.D.

a Significantly (\( P \leq 0.05 \)) different.

x Non-significantly different at (\( P \leq 0.05 \)).

Table 2 Element concentrations in mg/kg (ppm) before and after storage at 4 °C of Oggtt samples.

<table>
<thead>
<tr>
<th>Element</th>
<th>Before storage*</th>
<th>After storage*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>118 ± 6a</td>
<td>114.9 ± 6.51a</td>
</tr>
<tr>
<td>K</td>
<td>185.8 ± 8.1a</td>
<td>188.8 ± 6.4a</td>
</tr>
<tr>
<td>Mg</td>
<td>10.5 ± 0.6a</td>
<td>12.3 ± 2.57a</td>
</tr>
<tr>
<td>Mn</td>
<td>0.02 ± 0.013a</td>
<td>0.02 ± 0.012a</td>
</tr>
<tr>
<td>Zn</td>
<td>0.83 ± 0.057a</td>
<td>0.86 ± 0.12a</td>
</tr>
<tr>
<td>Fe</td>
<td>0.8 ± 0.26a</td>
<td>0.80 ± 0.26a</td>
</tr>
</tbody>
</table>

* Mean ± S.D.

x Non-significantly different at (\( P \leq 0.05 \)).
after storage (Table 1, Fig. 1) which was similar to that reported by Abdulrahman et al. (1997). This may be attributed to moisture content increase, which in turn dilutes the acidity of the samples.

3.2. Titratable acidity

The titratable acidity content of Oggtt samples decreased significantly ($P \leq 0.05$), from 0.45% ± 0.19 before storage to 0.39% ± 0.01 after storage (Table 1, Fig. 1). These results are in agreement with those reported by Amal and Soherm (2010) (Table 3) which may be due to the variation in duration of fermentation period, method of production and type of milk in each study.

3.3. Fat content determination

The Oggtt samples have 5% fat content in both cases before and after storage (Table 1, Fig. 1). These values are lower than those reported by Al-Ruqaie et al. (1987). This is likely due to lactation stage and feeding source of the animal or season (Raynal et al., 2008). In relation to the daily energy in food ratio, lipids represent 15–30% of the daily required energy for the adults (WHO, 1990). Another fat content result on fermented dairy product was found to be in a range of 3.1–7.4% Abdulrahman et al. (1997); these results are in agreement with the Oggtt samples obtained in this study. The lipids are excellent energizing food; they contribute by 50% of the energy, Guo (2003).

3.4. Carbohydrate determination

The carbohydrate content of Oggtt decreased non-significantly ($P \leq 0.05$), from 35.5% ± 1.8 before storage to 33.8% ± 1.3 after storage (Table 1, Fig. 1) in close agreement with the values obtained by Al-Ruqaie et al. (1987) (Table 3), but higher than those results obtained by Park (2011) in yogurt (Table 3). Carbohydrates (glucose) are considered as fuel for all organisms which contribute to about 55–75% (WHO, 1990) of energy required by the organisms.

3.5. Protein determination

The protein content of the samples increased non-significantly ($P \leq 0.05$), from 16% ± 3.0 before storage to 16.1% ± 1.9 after storage (Table 1, Fig. 1). The results of this study were higher than the values reported by Al-Ruqaie et al., 1987 and Sawaya et al. (1984a,b) (Table 3), which may be due to temperature and duration during the process of production (denaturation). These values are within the same range with those obtained by El Mayda (2007), Hilali et al. (2010) in cheese (Table 3). Protein contributes in formation of hormones and enzymes which control a variety of body functions such as growth and repair of the body cells as well as a high energy resource for the body Mau et al. (1999).

3.6. Lactose determination

The lactose contents of Oggtt samples increased non-significantly ($P \leq 0.05$), from 2.8% ± 4.5 before storage to 2.9% ± 3.7 after storage (Table 1, Fig. 1). These are below
values obtained by Alrousan (2009) (Table 3) on raw goat milk. Human who are lactose-intolerant can consume fermented products of milk without side effects, because lactose in milk is converted into glucose and galactose, and partially fermented to lactic acid by bacteria.

3.7. Total ash determination

Total ash of Oggtt sample decreased non-significantly (P ≤ 0.05) from 8% ± 1.7 before storage to 7.6% ± 0.1 after storage (Table 1, Fig. 1). These results indicate that Oggtt is rich in energy and many people used it as energizing food. It is recognized that, the metabolism of proteins is affected by the energy contribution.

3.8. Energy value

The energy value of Oggtt samples ranged from 2851 ± kcal/kg before storage to 2859 ± kcal/kg after storage (Table 1, Fig. 1). These values indicate that Oggtt is rich in energy and many people used it as energizing food. It is recognized that, the metabolism of proteins is affected by the energy contribution.

3.9. Stability of Oggtt samples

Moisture content of Oggtt samples increased during the storage by 35.3% which explains the reduction in titratable acidity content of Oggtt samples which, reflected in the pH reduction by 6.9% that may be due to the production of lactic acid by lactic acid bacteria which had an effect for lowering the pH value (Kuipers et al., 2000; and Shah, 2007), that may lead to optimum pH encouraging lactic acid bacteria growth by Rivera-Espinoza and Gllardo-Navarro (2010). Similar results were reported by Herrero and Requena (2006), Agata et al. (2011).

4. Conclusion

- Cold storage period for Oggtt samples showed statistically significant increase in moisture content and a simultaneous decline in titratable acidity which, reflects oggtt as a stable source of good nutritive food.
- It is therefore necessary to encourage Oggtt production and promote its consumption by people for its good nutritive value rather than its taste.

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