EFFECT OF SOYA AND WHEY PROTEINS ON THE SENSORY AND PHYSICOCHEMICAL PROPERTIES OF SET YOGHURT

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ABSTRACT

Recently, a focus on the utilization of whey and soya proteins has been receiving significant attention due to their nutritional value and their potential to enhance the functional characteristics of the dairy products. Set yoghurt was manufactured from standardized (4% fat) buffalo milk alone (control), or fortified with whey protein concentrate (WPC), soya protein concentrate (SPC) or their combination (MIX) and stored at 5±2 °C for 10 days. Sensory properties of the resultant yoghurt were evaluated one day after manufacturing. All treatments were analyzed when fresh and during storage period for pH-value, titratable acidity(TA) and syneresis. The pH-values and titratable acidity(TA) of yoghurt samples showed that both soya and whey proteins did not alter the rate of acid production in yoghurt. Acidity of samples treated with WPC during storage was significantly (P<0.05) higher, compared to control. Also, the addition of whey proteins and soya proteins or their combination resulted in reduction in the syneresis of yoghurt samples by about 17-25%, when compared with control at zero time. Fortification with soya proteins lowered appearance, taste and odor scores by 25, 37 and 35%, respectively, compared with the control. This negative effect of soya proteins on the sensory properties of yoghurt (SPC treatment) was improved when combined with whey protein in the MIX treatment. Therefore, it is recommended to add whey proteins to improve sensory and syneresis properties of soya yoghurt.

Keywords: Yoghurt, Soy Proteins, Whey proteins, Sensory Evaluation, Syneresis.

INTRODUCTION

It is well known, that soybean is an important source of plant proteins. It has several unique properties, such as high nutritional value, good functional properties in food technology and low cost (Walsh et al., 2010). It received a significant attention from not only the food industry, but also the consumers. Therefore, its demand to be used as a replacer of animal proteins in different food and dairy products have been increased.

Nowadays, the demand of soya-based yoghurt, or soya yoghurt, has increased in the marketplace, especially, among vegetarians and consumers who prefer plant-origin foods. The components of soya are reported to be useful to human health because of their potential to reduce the risk of cancer, heart disease, osteoporosis and high blood cholesterol levels (Kovalenko and Briggs, 2002). Due to its beany smell and astringent taste, which considered
as off-flavor, soya yoghurt is not widely accepted by consumers. There are several studies have been conducted to produce soya yoghurt with acceptable flavor (Yang and Li, 2010). Earlier study found that fortification of low fat yoghurt with soya proteins (from 1.0 to 4.0% level) can produce more acceptable yoghurts (Zanhi and Jideani, 2012).

Not only soya proteins, but also whey proteins have been added to yoghurt to improve its characteristics. Whey proteins; which is produced as a by-product of the cheese manufacture; represents about 20% of milk proteins. In addition to their high potential nutritional value, they also show an improvement in the functional properties of food and dairy products that in turn excessively modify the product quality attributes (Eissa and Khan, 2006). Many studies have been carried out in an attempt to improve the physical, textural and rheological properties of yoghurt fortified with whey proteins (Cheng et al., 2000; Gonzalez-Martinez et al., 2002; Aziznia et al., 2008; Landge, 2009).

Sensory properties have a large effect on the consumers’ acceptability of any new products. Thus, the aim of the present study was to evaluate the effect of addition of soya, whey proteins or their combination on the sensory and physicochemical properties of yoghurt made from buffalo milk.

**MATERIALS AND METHODS**

Fresh buffalo’s milk was obtained from the farm of Fac. of Agric., Cairo Univ., Egypt. Starter culture (Lactobacillus delbrueckii ssp. bulgaricus and Streptococcus thermophilus) was obtained from the stock cultures of Dairy Microbiology Lab., Fac. of Agric., Cairo Univ., Egypt. Whey protein concentrate (WPC) 80%- Fedex Co., USA- was purchased from Light Food Co., Cairo, Egypt. Soya protein concentrate (SPC) 60%- was purchased from Nantong Sun – Green Bio – Tech. Co., China.

Fresh buffalo’s milk was standardized to ~4.0% fat using skim milk. The modified milk was heated to 85°C for 10 min and cooled to 42°C. Then divided into 4 equal portions. The first portion was set as a control without any addition. The second and third portions were fortified with either whey proteins (WPC) or soya proteins (SPC). The last portion was fortified with a mixture of both of them (MIX). Depending on the previous studies (Zanhi and Jideani (2012) & Delikanli and Ozcan, 2014), who found that both whey and soya proteins could be added with different levels. In the present study, the level of addition of both whey and soya proteins had been chosen to be 2.26gm/100ml. All yoghurt milk were inoculated with 2.0% of mixed starter culture (1:1), dispensed into plastic cups (100 ml) and incubated at 42°C until coagulation was formed (Barrantes et al., 1994). The yoghurt samples were stored at 5±2°C and analyzed one day after manufacture as fresh samples (zero time) and after 3, 7 and 10 days of storage. Three replicates were analyzed from each treatment.

The pH value was measured in yoghurt samples using a digital pH-meter PHM92 (MeterLab TM, Radiometer Analytical S.A., France). Titratable acidity of yoghurt samples was measured as described by Ling (1963). For
syneresis measurements, an amount of 25 g of the yoghurt sample was placed into centrifuge tube and centrifuged at 1290 xg for 20 min (Sigma Laborzentri Fugen, 2 K15, Germany) as described by Aguilera & Kessler (1989). The weight fraction of the supernatant liquid was used as an index of whey syneresis (ml/100g yoghurt).

For sensory evaluation, the set yoghurt samples were assessed by a panel (10 persons) from the Department Staff. The assessed properties were: Appearance (20 points), body and texture (30 points), taste (30 points) and odor (20 points) with a total acceptance of 100 points.

Data were statistically analyzed by one-way ANOVA using general linear model of SPSS, and significant differences ($P \leq 0.05$) between treatments were determined by Tukey test (SPSS software, ver. 16.0, SPSS Inc., USA, 2001).

RESULTS AND DISCUSSION

Table (1) showed some chemical and physiochemical properties of yoghurt fortified with whey proteins, soya proteins or their mixture. As it could be noticed from pH-values, there was no significant difference among all yoghurt samples ($P>0.05$). The pH-values showed a gradual reduction during storage period in all yoghurt samples. Opposite trend was found in (TA) of all yoghurt samples, but there were also no significant difference between all samples, except that fortified with WPC. These results of pH-values and titratable acidity(TA) of yoghurt samples showed that both soy and whey proteins did not alter the rate acid development in yoghurt by the starter culture. These results are in agreement with those found by Zanhi and Jideani (2012), who found that fortification of yoghurt with soya protein did not affect pH-value or TA of yoghurt. On the other hand, it could be observed that the acidity of WPC samples during storage was significantly ($P<0.05$) higher (0.75±0.01 to 0.72±0.02%, when compared with control (0.59±0.01 to 0.60±0.02%). This increment in the titratable acidity of WPC yoghurt might be attributed to the increase in the ratio of citrates and phosphates, when concentration of milk solids increased as a result of the addition of whey proteins (Yeganehzad et al., 2007).

The results of syneresis are illustrated in Table (1). Addition of whey proteins, soya proteins or their combination reduced the syneresis of yoghurt samples by about 17-25%, when compared with control yoghurt at zero time. In contrast, all yoghurt treatments showed an increment in syneresis during storage, but WPC, SPC and MIX still showed lower values than control yoghurt. This could imply that the addition of soya, whey proteins or their combination resulted in better absorption of free water within the yoghurt matrix and to decrease syneresis (Cais-Sokolinska et al., 2002). Also, it was cleared that whey proteins was better than soya proteins in holding free water, in which WPC treatment gave less syneresis during storage. This finding was attributed to the reduction in the ratios of casein to whey proteins that increased the gel strength of the resultant yoghurt and reduced drainage of whey (Puvanenthiran et al., 2002). Similarly, soya proteins showed less
effectiveness in binding free water molecules in previous study (Osundahunsi et al., 2007). The ability of the added proteins to reduce syneresis might indicate a shift in the structure of the resultant yoghurt from compact structure to larger aggregates with casein micelles that give a more rigid gel structure (Zanhi and Jideani, 2012).

Table (1): Effect of addition of soya and whey proteins on the pH, titratable acidity (TA), total solids (TS) and syneresis of set yoghurt.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fresh</th>
<th>Storage (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>pH-value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>4.97±0.06”</td>
<td>4.57±0.06”</td>
</tr>
<tr>
<td>WPC</td>
<td>4.90±0.10”</td>
<td>4.37±0.06”</td>
</tr>
<tr>
<td>SPC</td>
<td>4.83±0.06”</td>
<td>4.30±0.10”</td>
</tr>
<tr>
<td>MIX</td>
<td>4.93±0.06”</td>
<td>4.43±0.06”</td>
</tr>
<tr>
<td>Titratable acidity (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>0.54±0.01”</td>
<td>0.59±0.01”</td>
</tr>
<tr>
<td>WPC</td>
<td>0.63±0.02”</td>
<td>0.75±0.01”</td>
</tr>
<tr>
<td>SPC</td>
<td>0.63±0.01”</td>
<td>0.68±0.01”</td>
</tr>
<tr>
<td>MIX</td>
<td>0.59±0.02”</td>
<td>0.67±0.01”</td>
</tr>
<tr>
<td>Syneresis (ml)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>8.00±1.00”</td>
<td>8.33±2.08”</td>
</tr>
<tr>
<td>WPC</td>
<td>6.00±1.00”</td>
<td>6.00±2.65”</td>
</tr>
<tr>
<td>SPC</td>
<td>6.33±1.53”</td>
<td>7.67±2.52”</td>
</tr>
<tr>
<td>MIX</td>
<td>6.67±1.53”</td>
<td>7.00±2.65”</td>
</tr>
</tbody>
</table>

Means are means ± standard deviation. Means with different superscripts are significantly differ (P < 0.05).

Sensory evaluation of WPC, SPC and MIX yoghurts were elucidated in Table (2) and Fig. (1). It could be observed that the highest sensory scores for appearance, taste and odor were given to MIX yoghurt treatments. While, the lowest sensory scores for appearance, taste and odor were given to SPC yoghurt treatments. Fortification with soya proteins lowered appearance, taste and odor by 25, 37 and 35%, respectively, compared with control. A beany smell and astringent taste was noticed in yoghurt containing soya proteins which affected negatively the flavor (taste and odor) acceptability of SPC yoghurt. This astringent taste or off-flavor which is normally associated with soy foods could be due to the interaction between polyphenolics from soy with mucoprotein in mouth (Rehman et al., 2007). Therefore, it is recommended to extract phenolics from soy before preparing soy protein concentrate when added to yoghurt (Zanhi and Jideani, 2012). Previous report showed also that addition of whey proteins to yoghurt developed better physical and sensory properties (Delikanli & Ozcan, 2014).
Table (2): Effect of adding soya and whey proteins on the sensory evaluation of set yoghurt.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Appearance (20)</th>
<th>Body &amp; Texture (30)</th>
<th>Taste (30)</th>
<th>Odor (20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>17.40±1.35^a</td>
<td>26.00±1.70^a</td>
<td>27.20±1.40^a</td>
<td>18.60±1.07^a</td>
</tr>
<tr>
<td>WPC</td>
<td>17.70±2.06^a</td>
<td>26.10±2.38^a</td>
<td>27.00±2.16^a</td>
<td>18.40±1.71^a</td>
</tr>
<tr>
<td>SPC</td>
<td>13.10±2.69^b</td>
<td>26.30±1.42^a</td>
<td>17.20±4.89^b</td>
<td>12.00±3.43^b</td>
</tr>
<tr>
<td>MIX</td>
<td>18.80±1.48^a</td>
<td>28.10±1.29^a</td>
<td>28.00±1.33^a</td>
<td>18.90±1.10^a</td>
</tr>
</tbody>
</table>

Values are means ± standard deviation.
Means with different superscripts are significantly differ ($P < 0.05$).

Production of soya yoghurt had been showed minimal improvement in syneresis and also showed unacceptable flavor. Making a mixture of whey proteins and soy proteins resulted in a remarkable improvement in sensory and functional properties of yoghurt product.

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تأثير بروتينات الشرش وبروتينات الصويا على الصفات الحساسية الفيروكيميائية للزبادي

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شهدت الأونة الأخيرة تعدد الدراسات التي تناولت زيادة استخدام بروتينات الشرش وبروتينات الصويا في منتجات الألبان وذلك لما لهما من أهمية غذائية عالية وكفاءتها على تحسين الصفات الفيروكيميائية للكميات المنتجة. تم تصنيع منتج زبادي باستخدام بروتينات جاموسية معنفة مع 6% من بروتينات (كروتول) أو باضافة مركز بروتينات الشرش أو مركز بروتينات الصويا أو مزيج منهما حيث تم تجزئة الزبادي الناتج على 5 % لمدة 30 يومًا. تم تقدير الخواص الحساسية للزيت النباتي في اليوم الثاني للتوزيع. وتم تصدر رقم ال pH والمحمولة والمواد الكلية وفيض الانحلال والشرب في اليوم الثاني للتصنيع وخلال التخزين على درجة 700. أظهرت نتائج رقم ال pH، والمحمولة أن إضافة كل من بروتينات الشرش والصويا لم تؤثر على معدل تكم اللمحة في الزبادي. أدى إضافتي بروتينات الشرش إلى ارتفاع معياري في حموضة الزبادي الناتج بالمقارنة مع المنتجات. كذلك أدت إضافة كل من بروتينات الشرش وبروتينات الصويا أو مزيج منهما إلى انخفاض انحلال الشرب في الزبادي النباتي بمعادل 20-25% بالمقارنة مع المنتجات. أدى إضافتي بروتينات الصويا إلى انخفاض قيمة التقييم الحسني للزبادي حيث انخفضت في المظهر والسماقة والرائحة بمعادل 30-35% على النحو التالي. أدى إضافتي بروتينات الشرش إلى معدل هذا التأثير السبيتي لبروتينات الصويا. ولذلك فإنه يوصي بإضافة بروتينات الشرش لتحسين الصفات الحساسية لزيت الزيت الهي بروتينات الصويا.