Surveying the Effect of Quince seed Mucilage as a Fat Replacer on Texture and Physicochemical Properties of Semi Fat Set Yoghurt

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ABSTRACT: Hydrocolloids or gums are used in the food industries to control and improve the functionality traits of food products such as bulking, gelling agent, syneresis control, and emulsion or suspension stability. Use of hydrocolloids such as guar, xanthan, carrageenan and pectin as fat mimetic in food products had been studied. Quince seed mucilage is a complex of a cellulosic fraction with accompanying with arabinose, a mixture of methylated and unmethylated aldobionic acids and xylose. After extraction, quince seed mucilage before incubation in amounts of 0.03%, 0.05% and 0.1% (w/w) were added to milk. Tests for measuring acidity, syneresis, color and the texture profile analysis test were done for semi fat samples containing quince seed mucilage and semi fat and full fat blank samples. The acidity, color and texture properties: cohesiveness, adhesiveness, stringiness, in semi fat yogurts containing quince seed mucilage had no significant difference with semi fat and full fat blank samples. The amounts of syneresis in samples containing quince seed hydrocolloid were decreased in comparison with semi fat blank samples. In texture properties, the amounts of hardness, gumminess and chewiness in yogurts containing quince seed hydrocolloid were lower than semi fat and full fat blank samples. It seems that negative charge of quince seed mucilage in interaction with positive charge of casein micelles leads to decrease the syneresis but this hydrocolloid did not make a gel to increase hardness, gumminess and springiness in yogurts containing quince seed mucilage.

Keywords: quince seed, mucilage, yogurt, texture, hydrocolloid

INTRODUCTION

Awareness of adverse effects of excessive dietary fat intake is virtually universal. As a result, more and more consumers are making it their goal to reduce overall dietary fat in their diets (Aho,1998 and Bastin, 1997). Consumer acceptance of any food product depends upon taste- the most importance sensory attribute. Although consumers want foods with minimal to no fat or calories, they also want the foods to taste good (Aho,1998).

As a food component, fat contributes key sensory and physiological benefits. Fat also contributes to mouth feel, taste, and aroma/odor. fat also contributes to creaminess, appearance, palatability, texture and lubricity of foods and increases the feeling of satiety during meals. Fat can also carry lipophilic flavor compounds, and stabilize flavor (Leland ,1997).

Fat replacers consist of lipid-, protein-, or carbohydrate-based ingredients may be replaced with fat in low fat food products.
Carbohydrate-based fat replacers or bulking agents replace some of volume lost when fat is omitted. They are simply fillers that give structure and satiety to foods and beverages. Some of these compounds are cellulose, dextrin, maltodextrins, modified food starch and polydextrose, fiber based products such as guar gum, locust bean gum, xanthan gum, gum Arabic, pectins and carrageenan (Giese, 1996).

Food hydrocolloids or gums are added to food systems for numerous reasons, mainly to modify the texture, increase the stability, or reduce the fat or calories of a product. Specifically, food hydrocolloids are used to thickening agent, gel, and control syneresis, stabilize an emulsion or suspension, function as a coating, and bind water finally hydrocolloids effect on rheological properties of food. Use of food hydrocolloids continues to increase with recent development of low-fat and reduced-fat products (Sadar, 2004).

The quince, which grows as a shrub in the wild, is a small tree only about 3-4 m high. The seeds are extensively used, on account of the mucilage of outer surface. Quince seed mucilage affords an additional example of the natural occurrence of methoxyuronic acids. Quince seed mucilage is a complex of a cellulosic fraction with a more readily hydrolyzed polysaccharide. The linkage is not easily broken by the action of dilute acid or alkali at room temperature, but hot dilute acid liberates reducing sugars, cellulose and a gum. Arabinose, a mixture of methylated and unmethylated aldobionic acids and a cellulosic fraction were liberated in the hydrolysis of quince seed gum. Xylose was indentified in the further hydrolysis of the aldobionic acids (Fekri, 2008).

In a research study quince seed mucilage had 4.38% moisture, 95.62% dry weight, 10.9% yield, 8.90% ash and 20.90% protein (Fekri et al., 2008).

Uses of gums in numerous foods were studied and showed guar gum and Arabic gum caused to improve the viscosity and texture of frozen yoghurt (Rezaei et al., 2011). Xanthan gum and carageenan in yoghurt led to decrease the syneresis during storage time (Hematyar, 2012). Use of xanthan gum in reduced fat cheddar cheese had positive effect on economic aspects like increase in cheese yield, besides acceptable textural properties. Electronic nose for evaluation of volatile flavor compounds showed a positive effect of xanthan gum on flavor release in low-fat cheese (Nateghi et al., 2012). Addition of barely beta glucan, guar gum and inuline as fat replacers in low fat stirred yoghurt led to increase firmness of the product, improve yield of yoghurt, decrease syneresis and overall improved acceptability in terms of sensory attributes (Brennan and Tudorica, 2008).

In this study the effects of quince seed mucilage on the texture properties, acidity, syneresis and color of semi fat set yoghurt had been studied. These properties had been compared with semi fat and full fat set yoghurt without quince seed mucilage and the ability of quince seed mucilage as a fat replacer in yoghurt had been survived.

MATERIALS AND METHODS

Mucilage extraction

Quince seeds were purchased in a local market of Isfahan (Iran). The seed were manually cleaned to remove all foreign matter such as dust, stone, and chaffs. The seeds were soaked in distilled water at a water/seed ratio of 30:1 at room temperature. After 24 hours quince seeds separated from solution contain mucilage and the mixture was subjected to ethanol precipitation (97% ethanol/mixture ratio of 3:1). The precipitate was removed using rotary evaporator. The mucilage then was dried in conventional oven (overnight at 40° C).

Yoghurt manufacture

yoghurts were manufactured using semi fat (2.5% fat) homogenized milk prepared from Pak Pey dairy factory (Shahre Kord, Iran) and quince seed mucilage powder as amounts of 0.03%, 0.05% and 0.1% (w/w) were added. Semi fat and full fat (4.2% fat) milks without quince seed mucilage were used to manufacture yoghurt samples as testifiers. 0.02 (w/w) of non fat milk powder were added to all samples. The mixtures were heated up to 85° C for 10mins, then cooled to 45° C, inoculated with 0.02% (w/w) of the frozen sturter culture and incubated at 45° C for 4 hours. Consumed starter culture was consists of Streptococcus thermophilus and Lactobacillus delbrueckii ssp bolgaricus manufacture of DSM company, nom CY-220 (Australia).

Acidity measurement

Acidity of samples was measured according to Dornic method.

Yoghurt syneresis

To investigate susceptibility to syneresis, samples of 4-5 g were centrifuged at 2500 rpm for 10mins at room temperature. After centrifuged, the serum phase was poured off and remaining material weighted. The difference in weight of samples before and after centrifuge recorded as syneresis (%).
Texture test

TPA test was performed on intact yoghurt samples using a Brook field texture analyzer- CT- III (Middleboro, MA, USA). Texture Profile Analysis (TPA) test was performed by two sequential compression tests and a rest phase of 30 second between them. The probe number TA25/1000 with speed of 1mm/s was used. Target distance was 2 mm. from this test hardness, adhesiveness, cohesiveness, springiness, gumminess and chewiness values can be obtained.

Color parameters

to measurement of color parameters pictures of samples were taken in controlled condition with a 16.2 mega pixels digital camera (Sony Cyber-shot, Japan). These pictures were analyzed with image pro plus program, version 6.

Data obtained from tests were analyzed with SPSS statistical program No 19.

RESULTS AND DISCUSSION

Results

Results of syneresis test are shown in Figure 1. These results showed quince seed mucilage in all of treatments caused to decrease of yoghurt samples compared to semi fat yoghurt without quince seed mucilage.

![Figure 1. Results of syneresis test in yoghurt samples](image)

The decrease in syneresis in samples containing 0.1% of quince seed mucilage were double to triple time lower than semi fat blank sample and was comparable with full fat yoghurt sample.

Acidity test measurements are shown in Figure 2. These results showed a slight decrease in acidity of yoghurts containing quince seed mucilage compare with semi fat and full fat blank samples.

![Figure 2. Results of acidity test in yoghurt samples](image)

Data of texture profile analysis tests are shown in table 1. According to these results, hardness, gumminess and chewiness of yoghurts containing quince seed mucilage were significantly decreased compared to semi fat
and full fat blank samples. The properties of adhesiveness, cohesiveness, springiness and stringiness in yoghurts containing quince seed mucilage had not significant different with semi fat and full fat blank samples.

Table 1. results of TPA test in yoghurt samples

<table>
<thead>
<tr>
<th>day</th>
<th>Treatment of 0.03%</th>
<th>Treatment of 0.05%</th>
<th>Treatment of 0.1%</th>
<th>Blank sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>hardnes</td>
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<td>1.08&lt;sup&gt;a&lt;/sup&gt;</td>
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</tr>
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<td>1.11&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>2.10&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.55&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>1.47&lt;sup&gt;a&lt;/sup&gt;</td>
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</tr>
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<td>2.51&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>0.54&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.56&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>1.11&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.02&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Treatments are semi fat yoghurts containing quince seed mucilage
 ** a,b,… show the homogeneous groups after means comparing (p<0.05)

From data listed in table 2, it could be noticed that L value (which reflect the whiteness of samples), A value (which reflect the blue and red color), and B value (which reflect the yellowish color) had no significant difference.

Table 2. Color parameters in yoghurt samples

<table>
<thead>
<tr>
<th>treatment</th>
<th>A</th>
<th>B</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment of 0.03%</td>
<td>-12.76</td>
<td>11.11</td>
<td>77.52</td>
</tr>
<tr>
<td>Treatment of 0.05%</td>
<td>-12.56</td>
<td>10.90</td>
<td>77.35</td>
</tr>
<tr>
<td>Treatment of 0.1%</td>
<td>-12.17</td>
<td>11.58</td>
<td>78.38</td>
</tr>
<tr>
<td>Blank sample</td>
<td>-12.49</td>
<td>11.60</td>
<td>79.17</td>
</tr>
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</table>
Discussion

Yoghurts have been attributed nutraceutical, therapeutic and probiotic effects. They are increasingly popular due to their nutritional and potentially therapeutic characteristics. Yoghurt may have two primary defects: variation in viscosity and/or expulsion of serum (syneresis) (Hematyar et al., 2012).

It has been demonstrated that the structure of the hydrocolloid, including the type and number, in distribution of side unites, determines its characteristics and behavior in solution. Moreover, the net charges on the polymeric side chains also play an important role in their functionality. In general, hydrocolloids have a sugar back bone that contains protruding substituent such as esters, sulfates, or additional sugars (Sadar, 2004). The quince seed mucilage is a hydrocolloid consists of arabinose, xylose and methylated and unmethylated aldobionic acids (Fekri et al., 2008). Methyl groups cause a negative electrostatic charge in this polysaccharide.

Results of Kruif and Kresher study on the polysaccharide and protein interaction showed carageenan, a polysaccharide with negative electrostatic charge, can be mixed with casein micelles at high temperature. On cooling the mixture one observes a sudden increase in the apparent size of the casein micelles. This is explained by the fact that carageenan under goes a coil to helix transition at about 47° C. as a result of the helix formation the charge density along the carageenan chain increases and electrostatic interactions are strong enough for adsorption. A similar behavior is observed with pectin, a polysaccharide with negative electrostatic charge, and casein micelles mixtures (Fekri, 2008). So it can be concluded that the results obtained from syneresis test in yoghurts containing quince seed mucilage has a similar behavior as carageenan and pectin with casein micelles that caused an improvement of casein micelles association, increase the serum phase preservation and decrease the syneresis. But it is probable that the quince seed mucilage didn’t lead to increase the gelling because hardness and gumminess properties in yoghurts containing quince seed mucilage decreased in compare with semi fat and full fat yoghurts without quince seed mucilage. According to results of this study addition of quince seed mucilage to yoghurt caused to increase of thickening and decrease of syneresis and did not change the color and acidity, adhesiveness, cohesiveness and springiness. Quince seed mucilage mixture in semi fat yoghurt can develop bulking and appearance of full fat yoghurt. So use of this hydrocolloid as a fat replacer in food stuffs can be study more.

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