Effect of Different Concentrations of Aqueous Ginger Extract on Some Physical and Sensory Properties of Yoghurt

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Abstract

The present study was designed to determine the effect of using the aqueous ginger extract on the physical and sensory properties of yoghurt. In club to see the issue of different concentrations of the aqueous ginger extract on yoghurt properties, manufactured from cow's milk, first the milk was divided into five treatments and was considered as the control treatment (T1). Aqueous ginger extract at the concentrations of (1, 3, 6, and 9) ml.100 ml⁻¹ milk as (T2, T3, T4, and T5) treatments, respectively were added to the samples and incubated at 42°C until the milk coagulated. The produced samples were then examined for pH, Titratable acidity and coagulation time during the incubation period. In addition, the sensory evaluations of the product samples were done. The results indicated that there was a decreased in pH value for plain yoghurt and yoghurt with aqueous ginger extract during the incubation time, as the aqueous ginger extract increased the pH value decreased in comparison with titratable acidity which reported an increased as the aqueous ginger extract increased. In addition, the coagulation time of the treatments (T2, T3, T4, and T5) was decreased with increasing in ginger concentrations in comparison to control treatment (T1) which was coagulated in standard time 3.15 hours. For the sensory evaluation test, the results indicated that T1 has higher flavor score compared to other treatments. However, as the aqueous ginger extract increased the flavor score decreased.
While the yoghurts with aqueous ginger extract have higher texture and acidity scores compared to the control treatment.

Keywords: aqueous ginger extract, yoghurt, sensory evaluation.
Introduction

Ginger (*Zingiber officinale*) is the underground rhizome of plant *Zingiber Officinale* belonging to the family Zingibeaceae, which is applied as a spice and as a preserver. It is regarded as a common part of a diet worldwide (8, 17). Ginger has been employed in traditional Chinese and Indian medicine for over 25 centuries (5). Yield and oil characteristic and content in ginger is not uniform and can change with the cultivar and environmental factors (9, 20). The primary components of ginger are gingerols, shogaols, zingerone and parasol. 6-gingerol and 6-shogaol are also the major gingerols and shogaols present in the ginger. All these compounds have antioxidant and anti-inflammatory, anticancer, antiemetic effect and can protect heart from blood clotting (14). The active ingredients in ginger are thought to be in its volatile oils, which cover about 1-3% of its weight (16). Bisapoline, zingiberene, and zingiberol are the major active constituents in ginger oil (21).

Yoghurt is a fermented milk product which is widely practiced worldwide. More than 73% of the yoghurt that was manufactured in 2001 was produced in Europe alone. In addition, Yoghurt is a milk product widely consumed as functional food due to its full sensory and nutritional attributes, and beneficial effects on human health (19). Many studies have been done by using ginger in dairy products. Hailu and others (10) reported that soft unripened cheese can be made from camel milk by coagulating it using ginger crude extract. Also, *Abd El-Aziz* and others (2) reported that adding a ginger extract to the soft cheese can accelerate the ripening period of it, caused an increase in cohesiveness and a decrease in firmness, which gives more softness and smoothness along storage. Cheese with ginger extract was characterized by enhanced
growth of *Lactococcus* strains, flavor compounds and showed antioxidant activity. Thus, the purpose of this work was to look into the feasibility of using different concentrations of the aqueous ginger extract on the physical and sensory properties of yoghurt.

**Materials and Methods**

**Materials**

Fresh Cow’s milk was purchased from the local market of Al- Najaf province. The fresh rhizomes of ginger were bought from Baghdad market, Iraq. Yoghurt culture containing *Lactobacillus bulgaricus* and *streptococcus thermophilus* were obtained from Chris- Hansen Company, Denmark.

**Methods**

**Preparation of Aqueous Ginger Extract**

Fresh ginger was washed for any contamination, peeled, and crushed finely; sun dried, then ground using a coffee grinder. 30 gm of the powder was put in a beaker and 120 ml of distill water was added. The mixture was mixed using magnetic stirrer for 30 minutes, then it filtered using cotton. The ginger extract was centrifuged at 5000×g for 30 minutes. Then the extract was added at (1, 3, 6, and 9) ml/100 ml milk.

**Yoghurt Making**

The yoghurt was made according to Kosikowiski (13) as follows: The milk was heated at 85°C for 30 minutes. Then the milk was cooled to 42°C. The milk was inoculated with the starter cultures. Then the milk was divided into five Containers. Different concentrations of aqueous ginger extract (0, 1, 3, 6, and 9) ml/100 ml milk were added respectively to the containers and mixed so that aqueous ginger was dissolved. Subsequently, all the containers were placed in the incubator at 42°C. About every 30 minutes, the acidity and pH tests were performed until the milk coagulation. Then, the samples were brought out of the incubator.
and transferred to a refrigerator and stored at 5°C.

Physical Properties Determination
1- Determination of Titratable Acidity

Titratable acidity (as % lactic acid) of yoghurt was measured according the AOAC titration method 947.05 using 0.1 M NaOH and phenolphthalein as indicator (4).

2- pH Determination

The pH value was determined according to Kosikowiski (13) by using pH – meter.

3- Sensory evaluation of the Yoghurt

Sensory evaluation of plain and aqueous ginger extract yoghurts was done. Participants were randomly selected and identified themselves as students and faculty of Food Science, Al – Kufa University. Each panelist received five samples of yoghurt (T1, T2, T3, T4, and T5) to taste, evaluate and comment on sensory characteristics on each serving, using sensory evaluation sheet (15).

Result and Discussion

1- Effect of Aqueous Ginger extract on the pH value and Titratable Acidity of the Yoghurt

The changes in the pH value of the plain yoghurt (no aqueous ginger extract)(control) (T1), yoghurt with 1ml aqueous ginger extract (T2), yoghurt with 3 ml aqueous ginger extract (T3), yoghurt with 6 ml aqueous ginger extract (T4), and yoghurt with 9 ml aqueous ginger extract (T5) is shown in Table (1). There was a decreased in pH value for plain yoghurt and yoghurt with aqueous ginger extract during the incubation time. In addition, the control treatment (T1) showed a slight decrease in pH value compared with T2, T3, T4, and T5 which noted a clear decrease in pH value during the incubation time. Whereas the pH value for the T1 was 6.36, 6.20, 5.90, 5.61, and 5.10 after 30, 60, 90, 120, and 150 minutes respectively, compared to the T2 6.31, 6.11, 5.71, 5.33, and 4.80, and for T3 6.28, 6.02, 5.56, 5.18, and 4.60, and for T4 6.22,
5.95, 5.39, 4.88 and 4.29, and for T5 6.17, 5.89, 5.20, and 4.58 after 30, 60, 90, 120, and 150 minutes respectively. This decline in the pH value due to convert the lactose to the lactic acid because the activity of starter culture (11).

**Table (1) Effect of Using Different Concentrations of Aqueous Ginger Extract on the pH Value of the Yoghurt**

<table>
<thead>
<tr>
<th>Test Treatment</th>
<th>Coagulation Time (min)</th>
<th>30</th>
<th>60</th>
<th>90</th>
<th>120</th>
<th>150</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td></td>
<td>6.36</td>
<td>6.20</td>
<td>5.90</td>
<td>5.61</td>
<td>5.10</td>
</tr>
<tr>
<td>T2</td>
<td></td>
<td>6.31</td>
<td>6.11</td>
<td>5.71</td>
<td>5.33</td>
<td>4.80</td>
</tr>
<tr>
<td>T3</td>
<td></td>
<td>6.28</td>
<td>6.02</td>
<td>5.56</td>
<td>5.18</td>
<td>4.60</td>
</tr>
<tr>
<td>T4</td>
<td></td>
<td>6.22</td>
<td>5.95</td>
<td>5.39</td>
<td>4.88</td>
<td>4.29</td>
</tr>
<tr>
<td>T5</td>
<td></td>
<td>6.17</td>
<td>5.89</td>
<td>5.20</td>
<td>4.58</td>
<td>-</td>
</tr>
</tbody>
</table>

Table (2) showed the effect of using different concentrations of the aqueous ginger extract on the titratable acidity. The results pointed out an increased in the percentage of titratable acidity for all treatments (T1, T2, T3, T4, and T5) during incubation time. The Plain Yoghurt (T1) showed a slight increase in titratable acidity compared with T2, T3, T4, and T5 which showed a clear increase in titratable acidity during incubation time. Whereas the titratable acidity of the T1 was 0.234, 0.259, 0.331, 0.529, and 0.690 after 30, 60, 90, 120 and 150 minutes of incubation at 42 °C respectively, while for T2
0.241, 0.284, 0.390, 0.597, and 0.800 and for T3 0.253, 0.298, 0.511, 0.820, and 1.030, and for T4 0.266, 0.318, 0.583, 0.932, and 1.171, and for T5 0.270, 0.365, 0.712, and 1.050 after 30, 60, 90, 120, and 150 minutes respectively. The formation of organic acids (citric, acetic, pyruvic and lactic acid) during fermentation acts as natural preservatives. This results in a pH decrease to around 4.3 where further fermentation is inhibited due to the inhibition of β-galactosidase activity (6). The differences in the pH value and Tittratable acidity for the control treatment and yoghurt with aqueous ginger extract might be due to the ginger extract added to the yoghurt.

Lactic Acid Bacteria (LAB) used during yoghurt fermentation is described by their high request for essential growth factors like peptides and amino acids. However, milk does not have sufficient free amino acids and peptides to lead the growth of LAB. Thus, these LAB possesses a complex system of proteinases and peptidases, which enable them to use milk casein as a source of amino acids and nitrogen (18). Huang and others (12) indicated that ginger extract has a proteolytic property of protease enzymes which was used to coagulate cow milk. All the above statements can be an indication of the effect of ginger extract to promote the LAB growth and thus increased the titratable acidity and decreased the pH value which may be due to the ginger protease which could have provided the essential growth factors such as peptidase and amino acids to promote the growth of the Lactobacillus strains (3).

2- Effect of Aqueous Ginger Extract on the Coagulation Time

The effect of different concentrations of the aqueous ginger extract on the coagulation time was reported in Table (3). The results showed that as the aqueous ginger extract increased the coagulation time decreased. This result was expected since the yoghurt with aqueous ginger
extract reached the pH value and titratable acidity for coagulation in less incubation time compared to the control treatment. Whereas the coagulation time for T1 was 3.15 hours, which was within the standard time for coagulation the yoghurt. However, T2 coagulated in 2.55 hours, T3 2.30 hours, T4 2.10 hours and T5 2.00 hours from the time of adding the starter culture and this might be ascribable to the ginger protease which could have provided the essential growth factors to promote the growth of the Lactobacillus strains (3).

Table (2) Effect of Using Different Concentrations of Aqueous Ginger Extract on the % Titratable Acidity Percentage of the Yoghurt

<table>
<thead>
<tr>
<th>Test</th>
<th>Coagulation Time (min)</th>
<th>%Titratable Acidity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>0.234</td>
<td>0.259</td>
</tr>
<tr>
<td>T2</td>
<td>0.241</td>
<td>0.284</td>
</tr>
<tr>
<td>T3</td>
<td>0.253</td>
<td>0.298</td>
</tr>
<tr>
<td>T4</td>
<td>0.266</td>
<td>0.318</td>
</tr>
<tr>
<td>T5</td>
<td>0.270</td>
<td>0.365</td>
</tr>
</tbody>
</table>

Abd El-Aziz and others (2) reported that adding ginger extract to the soft cheese can accelerate the ripening period of it. Ginger extract-fortified cheese was characterized by promoting growth.
of *Lactococcus* strains, flavour compounds and presented antioxidant activity. Also, Abd El-Aziz and others (1) mentioned that the Egyptian white brined cheese made by adding the aqueous ginger extract to brine solution could be more suited for improving the physicochemical properties of the cheese.

**Table (3) Effect of Using Different Concentrations of Aqueous Ginger Extract on the Coagulation Time of the Yoghurt**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Time of Coagulation (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>3.15</td>
</tr>
<tr>
<td>T2</td>
<td>2.55</td>
</tr>
<tr>
<td>T3</td>
<td>2.30</td>
</tr>
<tr>
<td>T4</td>
<td>2.10</td>
</tr>
<tr>
<td>T5</td>
<td>2.00</td>
</tr>
</tbody>
</table>

3- Sensory Evaluation of the Yoghurt

The effect of different concentrations of aqueous ginger extract on the sensory evaluation of the yoghurt is presented in Table (4). For the flavor score, T1 gets the highest flavor score compared to T2, T3, T4, and T5. However, as the aqueous ginger extract increased the flavor score decreased this might be due to the Gingerols, zingerone and shogaols which were responsible for the sharpness taste in ginger (7). For the texture score, the sensory evaluation results indicated that T2, T3, T4, and T5 get higher texture score compared to T1. This might be due to the protease in ginger which could have promoted the growth of the Lactobacillus strains and gives a good texture. For the acidity score, T2, T3, T4,
and T5 get higher acidity score compared to the control treatment (T1). This result was expected since the yoghurt with ginger extract has higher titratable acidity compared to control treatment. In addition the sensory evaluation test showed that all yoghurts did not have any discoloration except T5 which gave a brown color to the yoghurt due to the high concentration of the aqueous ginger extract. However, all treatments get full score of the can shape. Abd El-Aziz and others (2) reported that cheese with ginger extract get the highest scores for flavour, texture and overall acceptability in both pickled and un-pickled cheese compared to the control.

**Table (4) Sensory Evaluation of the Yoghurt**

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Flavor (45)</th>
<th>Texture (30)</th>
<th>Acidity (10)</th>
<th>Appearance (10)</th>
<th>Can Shape (5)</th>
<th>Total</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>41</td>
<td>23</td>
<td>7</td>
<td>9</td>
<td>5</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>40</td>
<td>24</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>38</td>
<td>24</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>T4</td>
<td>31</td>
<td>26</td>
<td>9</td>
<td>9</td>
<td>5</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>T5</td>
<td>25</td>
<td>28</td>
<td>9</td>
<td>8</td>
<td>5</td>
<td>75</td>
<td>Sharp tastes of ginger and brown color</td>
</tr>
</tbody>
</table>
Conclusion

According to the results of this study and the nutritional health properties of ginger as well as simple extraction, addition of the aqueous ginger extract to the yoghurt could be decreased the yoghurt fermentation time and will lead to increased production plant capacity and will result in cost savings during the manufacturing process. For that I recommend to add 1ml of aqueous ginger extract / 100 ml milk which gave the highest total evaluation score compared to the other treatments.

References

7- Connell, D.W., and M.D, Sutherland. 1969. A re-examination of gingerol, shogaol, and zingerone, the pungent principles of ginger.
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تأثير تراكيز مختلفة من مستخلص الزنجبيل المائي على بعض صفات اللبن الفيزيائية والحسية

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المستخلص

تم 시행 الدراسةINGLE Hunt لمعرفة تأثير استخدام تراكيز مختلفة من المستخلص المائي للزنجبيل على
الصفات الفيزيائية والحسية لل لبن المنضوع من حليب البقر. اولاء قسم الحليب إلى خمسة عاملات وهي
معاملة المقارنة (T1) ومعاملات المستخلص المائي للزنجبيل بتراكيز (1، 3، 6 و 9) مل. 100 مل حليب
(في التتابع اضيفت الى النماذج وحضنت على درجة حرارة 42 م. لحين التخثر تم تقدير قيم الحموضة
pH والحوضة التسجيحية ووقت التخثر خلال فترة الحضن
اضافة الى التقييم الحسي للمسلامادرتتنبحة الحببتلتة حصول انخفاض قيم رقم
الحموضة pH لمعاملة السيطرة والمعاملات المضافة لها المستخلص المائي للزنجبيل خلال فترة
الحضن، كما زاد تركيز المستخلص المائي للزنجبيل انخفضت قيم رقم الحموضة مقارنة بنسبة
المنوية للحموضة التسجيحية والتي زادت بزيادة نسبة اضافة المستخلص المائي للزنجبيل. أظهرت
فحص وقت التخثر الى أن هناك تأثير واضح للمستخلص المائي للزنجبيل على تقليب وقت التخثر
المعاملات T2، T3، T4، T5 بالمقارنة مع معاملة السيطرة والتي تخثرت ضمن الوقت القياسي
(3.15) ساعة. أما بالنسبة الى اختيار التقييم الحسي أشارت النتائج الى ان معاملة السيطرة أعطت
نسبة افضل مقارنة ببقية المعاملات حيث كما زادت نسبة المستخلص المائي للزنجبيل قلت درجة
تقليب المنتوج بينما حصل اللبن المضاف له المستخلص المائي للزنجبيل على درجة تقييم حسي أعلى
لصنفي النسجة والحموضة مقارنة مع معاملة السيطرة.

الكلمات المفتاحية: المستخلص المائي للزنجبيل، اللبن، التقييم الحسي.