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# 늙은 호박을 함유한 요구르트의 개발

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# Development of Yogurt Containing Pumpkin

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**ABSTRACT – The healthy yogurt containing pumpkin was developed and evaluated an antioxidant effect of pumpkin in yogurt during storage. For the preparation of pumpkin yogurts, 15, 20 or 25 g of pumpkin level, and 5, 6 or 7 g of sugar level were added to 100 ml milk. There was a trend for more desirable color and texture of pumpkin yogurt at 20 g pumpkin level than 15 or 25 g pumpkin level. Pumpkin yogurt contained 7 g sugar level had a more desirable flavor, texture and overall accetability than those contained 5 or 6 g sugar level. To evaluate antioxidant effect of pumkin in yogurt during stroage, yogurts were prepared by milk alone, with pumpkin, with sugar, and with sugar and pumpkin. The sugar and pumpkin levels in yogurt were 7 g and 20 g per 100 ml milk. The malondialdehyde(MDA) content of yogurt prepared by milk alone were significantly affected by days of storage. During 13 days storage of yogurt, pumpkin and sugar exhibited antioxidant effect.**

**Keywords □ pumpkin yogurt, color, texture, flavor, overall acceptability**

The word Yogurt was originated from the turkish word Jugurt. This product is known as variety of names in different countries. It is traditional food in the Balkan and the Middle East.[1] Yogurt in developed countries is used as dessert, between meal snacks, complete lunches and diet food. Yogurt has been known to prevent chronic constipation, aging, hypertension and cancer.[2] Yogurts are basically divided into three categories (plain, fruit and flavored yogurts). The plain type is the traditional yogurt with its typical sharp nutty flavor. Fruit yogurts are made by addition of fruit, usually in the form of fruit preserves, puree or jam, to yogurt. Flavored yogurts are prepared by adding sugar or other sweetening agents and synthetic flavoring to plain yogurt.[1]

Yogurt was introduced to the Korean consumer in the early 1970's and it has been studied to develop mainly fruit yogurt, rice or soymilk yogurt.[3,4] The consumption of fermented milk in our country was increased from 9,111 M/T in 1975 to 240,911 M/T in 1985.[5] In USA, yogurt consumption was increased from 0.05 kg per person in 1955 to 1.44 kg per person in 1983.[6] This increasing trend is probably due to the increasing economical status.

Food product development by using our agricultural product, such as pumpkin, is important to increase consumption of our agricultural product. The use of pumpkin in food product is only limited in the traditional food.

The objectives of this study were to develop healthy yogurt which was contained pumpkin and evaluate antioxidant effect of pumpkin in yogurt during storage.

## Materials and Methods

### Experimental plan

For the preparation of pumpkin yogurts, 15, 20

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or 25 g of pumpkin puree and 5, 6 or 7 g of sugar were added to 100 ml of milk. These pumpkin yogurt samples were analyzed for sensory evaluation, pH, titratable acidity(TA) and microbiological analysis.

To evaluate antioxidant effect of pumpkin in yogurt during storage, yogurts were prepared with milk alone, with pumpkin, with sugar, and with sugar and pumpkin. The sugar and pumpkin levels in yogurt were 7 g and 20 g per 100 ml of milk, respectively. These yogurt samples were analyzed for MDA, pH and TA during 0, 4, 8 and 13 days of storage periods. Two replications were run for each sample.

### Preparation of pumpkin puree

Pumpkin was purchased from Kyung-Dong local market. It was washed, divided in quarter, and removed skin and seed. The flesh was steamed for 20 min in a steamer. After steaming, the flesh was comminuted in a food processer(Sunbeam Appliance Co., Model No. 14081) for 5 min.

### Preparation of yogurt mixture and method of fermentation

Whole milk was purchased from the market. A batch of 300 ml of milk and each level of sugar and pumpkin was prepared. The mixture was blended in a kitchen type blender(Gold Star Co.) at a medium speed for 4 min, then transferred to a 400 ml stainless steel container for heating. The container with mixture was placed in water bath (85℃) for 15 min with occasional stirring, removed from water bath and cooled to 37℃ in the ice bath. Then 60 mg of Hanmi yogurting powder (Hanmi Pharm. Ltd.) was added to the mixture. The container with mixture was closed with lid and placed into an incubator for 15 hrs at 37℃. After fermentation, the samples were stored in a refrigerator until analyzed.

### Sensory evaluation of yogurt

Each sample for sensory evaluation was coded with a randomly chosen 3-digit number and served to a 25 member inexperienced sensory panel. Eighteen samples consisted of 3 pumpkin levels, 3 sugar levels and 2 replications. Nine samples were served to each panelist per day. The two replications were presented on seperate day. Panelists were asked to rinse their mouth with water between samples. Each sample was evaluated for flavor. color, texture and overall acceptability on an 8 point hedonic scale where 1=dislike extremely and 8=like extremely. A questionaire was distributed to each panelist with the first sample asking for the gender and age of panelist, the preference of yogurt and the frequency of eating yogurt.

### Measurement of pH and TA of yogurt

The samples of yogurt were analyzed for pH and TA by AOAC method.[6,7] Four grams of yogurt was mixed with 4 ml of distilled water and pH of sample was measured by pH meter (Toa Electronics Ltd. Model HM-5ES, Tokyo, Japan). For the determination of TA, 10 g of yogurt was mixed with 15 ml of distilled water and 3 drops of phenolphthalein. The sample was titrated by using 0.1 N NaOH solution to reach end point of pH 8.1. Acidity was calculated as percentage of lactic acid, using the following formula.[6]:

$$\% \text{ lactic acid} = \frac{(ml \text{ NaOH})(N \text{ NaOH})(\text{meq. wt}) \ 100}{\text{g of sample}}$$

### Microbiological analysis of yogurt

The de Mann Rogosa and Sharpe(MRS) agar were used for plating the samples of yogurt.[8] The 0.2 mg of yogurt was transferred to sterile 1.8 ml peptones. Decimal dilutions of the sample were prepared and plated on MRS media. These plates were incubated at 37℃ for 72 hrs.

### MDA analysis of yogurt

The modified distilled method[8] was used for determination of lipid oxidation. Eighty grams of yogurt, 5 ml of 4 N HCl, 10 ml of 0.5% propylgallate(PG), 10 ml of 0.5% ethylenediamine tetraacetic acid(EDTA) and 95 ml of distilled water were mixed in distillation flask. Fifty ml of the distillate were collected in 100 ml graduate cylinder within 15 min and then transferred to a 50 ml erlenme-

**Table 1. Mean (n=6) sensory scores[a] of pumpkin yogurt for each pumpkin and sugar levels**

| | Color | Flavor | Texture | Acceptability |
|---|---|---|---|---|
| **Pumpkin** (g/100 ml milk) | | | | |
| 15 | 5.36 | 5.25 | 5.16 | 5.20 |
| 20 | 5.75 | 5.31 | 5.34 | 5.31 |
| 25 | 5.55 | 5.23 | 5.24 | 5.24 |
| **Sugar** (g/100 ml milk) | | | | |
| 5 | 5.43 | 4.90[b] | 4.76[b] | 4.72[b] |
| 6 | 5.55 | 5.14[b] | 5.14[b] | 5.20[c] |
| 7 | 5.67 | 5.75[c] | 5.84[c] | 5.83[d] |

[a]1=dislike extremely
8=Like extremely
[b,c,d]Means in a column followed by different superscripts are significantly different at the $p<0.05$ level.

yer flask until analyzed for MDA content.

### Statistical analysis

The data were analyzed by analysis of variance to determine any significant differences between treatments. Significance among the means for each test was determined by Duncan's Multiple Range test.

## Results and Discussion

### Sensory evaluation of pumpkin yogurt

Mean sensory scores of pumpkin yogurts are shown in Table 1. There was no significant differences in sensory scores of yogurt prepared by 3 pumpkin levels. However, the mean scores indicate a trend for more desirable color and texture of yogurt at 20 g pumpkin level. Flavor, texture and overall acceptability scores were affected p <0.05) by sugar levels. Yogurt contained 7 g sugar level had a more desirable flavor, texture and overall acceptability than those contained 5 or 6 g sugar level. The interaction of the levels of pumpkin and sugar were not significant for sensory scores of yogurt (Table 2).

The 25-member sensory panel in the present study consisted of 19 females (76%) and 6 males (24%). The majority of panelists (88%) were the age range between 18 and 34 years old. Seventy six percent of panelists preferred flavored yogurt, 16% preferred plain yogurt, and 8% had no preference for either one. The frequency of which panelists consumed yogurt were 56% weekly and 35% monthly. Eight percent of panelists did not indicate how often yogurt were consumed. The panelists were asked if they would buy pumpkin yogurt if it were available in the market, and 38% responded 'yes', 12% 'no', and 50% 'maybe'.

### pH and TA of pumpkin yogurt

The pH and TA of pumpkin yogurts are shown in Table 3. There were no significant differences in pH and TA of yogurt prepared by 3 pumpkin and 3 sugar levels. Connolly[10] and Kroger[11] advised that the final pH of yogurt are between 4.00 and 4.44 and lactic acid content range from 0.8 to 0.9%. However, Deeth and Tamime[12] mentioned that yogurt should contain 0.6~1.1% lactic acid. Yogurt milk becomes solid at an acidity of

**Table 2. Mean (n=2) sensory scores[a] of pumpkin yogurt for pumpkin and sugar combination**

| Pumpkin[b] | 15 | | | 20 | | | 25 | | |
|---|---|---|---|---|---|---|---|---|---|
| Sugar[b] | 5 | 6 | 7 | 5 | 6 | 7 | 5 | 6 | 7 |
| Color | 5.08 | 5.50 | 5.50 | 5.60 | 5.76 | 5.88 | 5.60 | 5.40 | 5.64 |
| Falvor | 4.90 | 5.00 | 5.84 | 4.92 | 5.26 | 5.76 | 4.88 | 5.16 | 5.66 |
| Texture | 4.76 | 4.88 | 5.84 | 4.86 | 5.36 | 5.80 | 4.66 | 5.18 | 5.88 |
| Acceptability | 4.70 | 5.06 | 5.84 | 4.82 | 5.32 | 5.80 | 4.64 | 5.22 | 5.86 |

[a]1=dislike extremely, 2=like extremely.
[b]g/100 ml milk

**Table 3. Mean (n=6) pH and TA* of pumpkin yogurt for each pumpkin and sugar levels**

| | pH | TA |
|---|---|---|
| **Pumpkin** (g/100 ml milk) | | |
| 15 | 3.98 | 1.07 |
| 20 | 4.05 | 1.10 |
| 25 | 4.07 | 1.13 |
| **Sugar** (g/100 ml milk) | | |
| 5 | 4.02 | 1.08 |
| 6 | 4.03 | 1.10 |
| 7 | 4.05 | 1.12 |

*% lactic acid

about 0.6% lactic acid content.[13] The TA of pumpkin yogurt generally agreed with those reported by Deeth and Tamime.[12]

### Microbial content of pumpkin yogurt

Logarithmic microbial counts of pumpkin yogurt for each pumpkin and sugar levels are shown in Table 4. There were no significant differences in microbial counts of yogurt prepared by 3 pumpkin and 3 sugar levels. The ranges of microbial count were from 7.43 log CFU/g to 7.72 log CFU/g. It agreed with the result of Kroger[11] which showed 7.41 to 9.62 log CFU/g in fresh yogurt.

### pH and TA of yogurt in each treatment during storage

The pH of yogurt in each treatment as a function of days of storage at 4℃ are shown in Fig. 1. No significant differences were shown in the pH of yogurt in each treatment during 13 days of storage. The TA of yogurt in each treatment as a function of days of storage at 4℃ are shown in Fig. 2. The TA of yogurt prepared with milk alone were significantly affected by days of storage(X) where $Y=0.01442X+1.13237$($r=0.9567$). Also, the TA of yogurt prepared with milk and sugar are significantly affected by days of storage (X) were $Y=0.01482X+0.93235$($r=0.9917$). No significant differences were shown in the TA of yogurt prepared with milk and sugar; sugar and pumpkin during storage.

### MDA content of yogurt in each treatment during storage

The MDA content of yogurt in each treatment as a function of days of storage at 4℃ are shown in Fig. 3. The MDA content of yogurt prepared with milk alone were significantly affected by days of storage(X) where $Y=0.0002488X+0.0004973$($r=0.9818$). The MDA content of yogurt prepared with milk and sugar; milk and pumpkin; milk, sugar and pumpkin were not affected by days of storage. Fresh yogurt prepared with milk, sugar and pumpkin had $1.12\times10^{-3}$ mg MDA/kg sample and yogurt prepared with milk alone had $0.29\times10^{-3}$ mg MDA/kg sample. During 13 days of storage of yogurt, pumpkin and sugar exhibited antioxi-

**Table 4. Mean (n=6) logarithmic microbial counts of pumpkin yogurt for each pumpkin and sugar levels**

| | Log CFU/g |
|---|---|
| **Pumpkin** (g/100 ml milk) | |
| 15 | 7.48 |
| 20 | 7.67 |
| 25 | 7.70 |
| **Sugar** (g/100 ml milk) | |
| 5 | 7.43 |
| 6 | 7.69 |
| 7 | 7.72 |

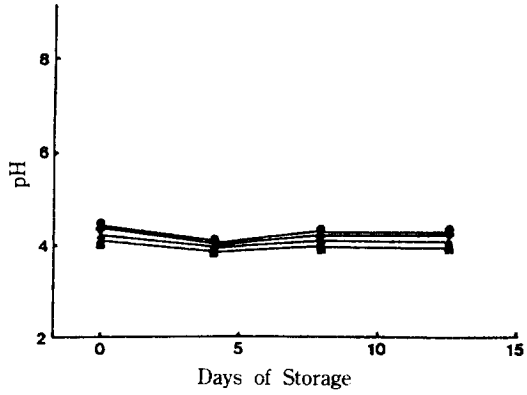


**Fig. 1. pH of yogurt in each treatment as a function of days of storage at 4℃.**
■—■: Milk
◆—◆: Milk+Pumpkin
▲—▲: Milk+Sugar
●—●: Milk+Pumpkin+Sugar

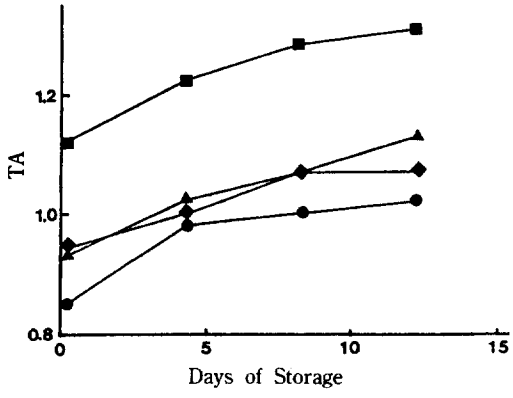


**Fig. 2. TA (% lactic acid) of yogurt in each treatment as a function of days of storage at 4℃.**

■—■: Milk
Significantly affected by days of storage (X) where, Y=0.01442X+1.13237 (R=0.9567)
◆—◆: Milk+Pumpkin
▲—▲: Milk+Sugar
Significantly affected by days of storage (X) where, Y=0.01482X+0.93235 (R=0.9972)
●—●: Milk+Pumpkin+Sugar

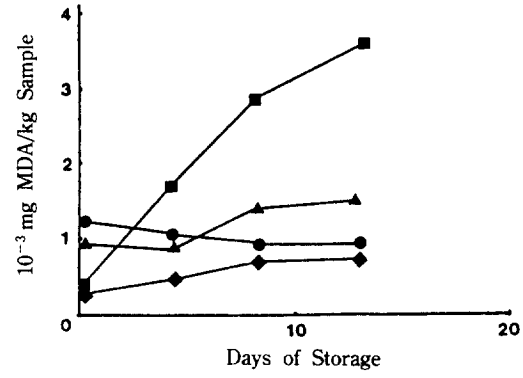


**Fig. 3. MDA content of yogurt in each treatment as a function of days of storage at 4℃.**

■—■: Milk
Significantly affected by days of storage (X) where, Y=0.0002488X+0.0004973 (R=0.9818)
◆—◆: Milk+Pumpkin
▲—▲: Milk+Sugar
●—●: Milk+Pumpkin+Sugar

dant effect. The MDA of yogurt prepared with milk alone were significantly increased by days of storage. Rao and Reddy (1984)[14] showed that fermentation of whole milk by lactobacillus and streptococcus resulted in a significant increase in the levels of saturated fatty acids and oleic acid with a concomitant decrease in the levels of linoleic and linolenic acid. Therefore the use of pumpkin as an ingredient to prepare yogurt increases oxidative stability of yogurt during storage. Yogurt containing 20 g and 7 g of pumpkin and sugar level per 100 ml milk showed desirable flavor, texture and overall acceptability.

## 국문요약

건강식품으로서 늙은호박을 함유한 요구르트를 개발하고 요구르트를 저장하는 동안 늙은호박의 항산화작용을 측정하였다. 우유 100 ml에 15, 20 또는 25 g의 늙은호박과 5, 6 또는 7 g의 설탕을 첨가한 요구르트를 제조하여 관능검사를 하였다. 늙은 호박을 20 g 함유한 요구르트가 좋은 색과 질감을 가졌고 설탕을 7 g 함유한 요구르트가 좋은 맛과 그리고 전반적으로 좋은 선호도를 가지는 것으로 나타났다. 요구르트를 저장하는 동안 늙은호박의 항산화작용을 측정하기 위하여, 우유; 우유와 늙은호박; 우유와 설탕; 우유와 설탕과 늙은 호박으로 요구르트를 제조하였는데 우유 100 ml에 설탕과 늙은호박의 함량은 7 g과 20 g으로 하였다. 요구르트를 저장하는 동안 MDA의 양은 우유만으로 제조한 요구르트에서는 현저하게 증가한 반면 늙은호박과(또는) 설탕을 첨가한 요구르트에서는 변화가 나타나지 않았다.

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