

## Quality Bread as Influenced by Sweet Pumpkin Powder

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### Abstract

Physicochemical properties of bread as influenced by the addition of sweet pumpkin powder (SPP) were investigated. Freeze-dried sweet pumpkin was ground, sieved through a laboratory sieve and a fraction with particles less than 250  $\mu\text{m}$  was used. Amount of SPP added to the bread was found to affect the bread quality significantly ( $p < 0.05$ ). Loaf volume and weight of the control were significantly higher than others ( $p < 0.05$ ) and decreased significantly ( $p < 0.05$ ) with the addition of SPP. In other words, the enrichment of product with SPP decreased bread volume and weight without significant changes in the moisture content. There were distinctive color changes with the addition of the powder: L- and a-values were reduced but b-value was significantly increased ( $p < 0.05$ ). The hardness, springiness, and gumminess of bread were found to increase with the addition of the powder. Consumer test indicated that bread contained with 3% SPP had the highest overall acceptability score while 1 or 5% addition produced an acceptable quality for the bread.

**Key words:** sweet pumpkin powder, breadmaking, quality, consumer test

### INTRODUCTION

For several thousand years, bread has been one of the major constituents of human diet and is one of the most important elements in Korean diet. Wheat is by far the most important cereal in breadmaking. In wheat bread-baking, flour, water, salt and yeast are mixed into a viscoelastic dough, which is fermented and baked. During all steps of breadbaking, complex chemical, biochemical, and physical transformations occur, which is affected by the various flour constituents. In addition, many substances are nowadays used to influence the structural and physicochemical characteristics of the flour constituents in order to optimize their functionality in breadmaking. Incorporation of various functional additives has been considered to maintaining and enhancing bread quality.

Meanwhile, the demands for wheat-based products with value-added are growing rapidly in the past few decades as consumer realizes that eating foods with health benefits is better than taking supplements. For example, improvement in the quality of breads and the creation of new products to satisfy expanding consumer's demands were examined with rice bran (1), apple fiber (2), peanut hull (3), sunflower hull (4), freeze-dried old pumpkin powder (5), Korean persimmon (6), *Paecilomyces japonica* and *Cordyceps militaris* powder (7), and green tea powder (8). Recently, effects of dietary fibers as a

powder form in breadmaking were also tested and examined (9-12).

A pumpkin is a squash fruit, usually orange in colour when ripe. Pumpkins grow as a gourd from a trailing vine of the genus *Cucurbita Cucurbitaceae*. *Cucurbita* varieties include *Cucurbita pepo*, *Cucurbita maxima*, *Cucurbita mixta* or *Cucurbita moschata*; all plants native to the western hemisphere. Pumpkins are a popular food, with their insides commonly eaten cooked and the seeds can be roasted as a snack. Pumpkins have good shelf life. Pumpkins are relatively low in total solids, usually ranging between 7% and 10% (13), but are rich in carotene, pectin, mineral salts, vitamins, and other substances beneficial to health (14-16). Even though incorporation of SPP to a standard wheat bread formulation would improve color as well as the nutrition value of bread, the breadmaking properties, consistency, and overall sensory acceptability of bread are still in question, which will be explored in this study.

### MATERIALS AND METHODS

#### Preparation of raw material

Bread flour (strong flour, 1st grade; CJ Corp., Yangsan, Gyeongnam, Korea), raw yeast (Ottogi Ltd., Ansan, Gyeonggi, Korea), yeastfood (Sunlim Food Co., Seoul, Korea), salt (CJ Corp., Sinan, Jeonnam, Korea), sugar

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(CJ Corp., Incheon, Korea), skim milk powder (Seoul Milk Coop., Yangju, Gyeonggi, Korea), and butter (Seoul Milk Coop., Yongin, Gyeonggi, Korea) were purchased from a local market. All samples were stored at room temperature until used. SPP was prepared from fresh pumpkins by removing the seeds, finely macerating the remaining pulp and freeze-dried using a vacuum freeze dryer (EYELA vacuum Freeze dryer, FDU-1100, Tokyo Rikakikai Co., Ltd., Japan). Freeze-dried sample was ground using an analytical mill (model M20, IKA Works, Inc., Wilmington, NC, USA) at maximum speed for 5 min and sieved using a strainer to obtain uniform particle size (c. 100 mesh) before use.

### Breadmaking

Bread was baked according to the straight dough method (17,18). The recipe for the dough is listed in Table 1. The control dough was made with 300 g of wheat flour. The levels of added freeze-dried SPP were 1, 3, and 5% in wheat flour. The doughs were optimally mixed and then, placed in a thermostatically controlled proofing oven for 70 min at 27°C, and 80% relative humidity. Then, the dough was divided into 170 g pieces followed by rounding and molding, and then placed in a baking pan for 15 min. The doughs were kneaded again for 1 min, and replaced in the proofing oven for a further 50 min at 38°C, and 85% relative humidity. Loaves were baked at 200°C for 20 min.

### Moisture content, weight, and specific volume

Moisture content and weight of sample were measured after cooling down to room temperature for 2 hrs, using a dry oven at 105°C overnight and using chemical balance, respectively. Loaf volume was measured by rapeseeds displacement method (19). All measurements were done in triplicate.

### Surface color

Surface color at the middle of each crumb was measured with a Chromameter (model CR-200, Minolta Co., Osaka, Japan) calibrated with a white tile ( $Y=94.2$ ,  $x=0.3131$ , and  $y=0.3201$ ).  $L$  (lightness),  $a$  (greenness [-] to redness [+]), and  $b$  (blueness [-] to yellowness [+]) values were recorded. All measurements were done in triplicate.

### Textural properties

Textural characteristics were evaluated by 30% compression of individual sample (3×3×3 cm) with a computer-controlled Advanced Universal Testing System (model LRXPlus, Lloyd Instrument Limited, Fareham, Hampshire, UK) at room temperature with a 1.2-cm diameter stainless steel cylinder probe. A 100-Newton (N) load cell was used, and the crosshead speed was 60

**Table 1.** Baking formula based on wheat flour weight (unit: g)

Composition	Sample			
	Control	SPP1 <sup>1)</sup>	SPP3 <sup>2)</sup>	SPP5 <sup>3)</sup>
Wheat powder	300	297	291	285
Pumpkin powder	–	3	9	15
Sugar	18	18	18	18
Salt	6	6	6	6
Water	189	189	189	189
Yeast	6	6	6	6
Yeast food	0.6	0.6	0.6	0.6
Butter	12	12	12	12
Powdered skim milk	9	9	9	9
Total	540.6	540.6	540.6	540.6

<sup>1)</sup>1% sweet pumpkin powder. <sup>2)</sup>3% sweet pumpkin powder.  
<sup>3)</sup>5% sweet pumpkin powder.

mm/min. Nine samples for each replication were tested, and their mean values were compared.

### Consumer test

Each sample was also evaluated by 31 consumer panelists. Four samples were presented in random order and were asked to evaluate the consumer attributes of color, flavor, taste, texture, and overall acceptability. A 5-point hedonic scale, wherein 5=like extremely, 4=like moderately, 3=neither like or dislike, 2=dislike moderately, and 1=dislike extremely, was used. The test was done in duplicate.

### Statistical analysis

The statistical analysis was done using the SAS Statistical Analysis System for Windows v8.1 (SAS Inst. Inc., Cary, N.C., USA). The means were compared with Duncan's multiple range test at  $\alpha=0.05$ .

## RESULTS AND DISCUSSION

### Bread quality evaluation

The bread formula used in this study contained SPP. The scope of this work was to increase the functionality of bread by adding SPP while maintaining good bread quality. Moisture content and ash of freeze-dried SPP were  $5.03 \pm 0.01\%$  and  $4.87 \pm 0.03\%$ , respectively, which are similar to the previous result of freeze-dried old pumpkin powder (5). The amount of SPP was increased from 1, 3, 5% of the wheat flour and breads with those blends are called SPP1, SPP3 and SPP5 (Table 1). The effect of the pumpkin supplementation on bread characteristics, moisture content, loaf volume, and loaf weight is summarized in Table 2. Moisture content, measured 2 hrs after baking, showed no significant differences between the control and the three different treatments ( $p<0.05$ ).

**Table 2.** Effect of sweet pumpkin powder on loaf weight, volume, and moisture content

Parameter	Sample			
	Control	SPP1 <sup>1)</sup>	SPP3 <sup>2)</sup>	SPP5 <sup>3)</sup>
Moisture (%)	42.5 ± 0.1 <sup>a4)</sup>	41.2 ± 1.2 <sup>a</sup>	42.8 ± 1.5 <sup>a</sup>	41.2 ± 0.7 <sup>a</sup>
Loaf volume (mL)	1,803 ± 7 <sup>a</sup>	1,773 ± 10 <sup>b</sup>	1,725 ± 13 <sup>c</sup>	1,696 ± 7 <sup>d</sup>
Loaf weight (g)	480 ± 1 <sup>a</sup>	480 ± 2 <sup>ab</sup>	476 ± 3 <sup>bc</sup>	475 ± 2 <sup>c</sup>

<sup>1)</sup>1% sweet pumpkin powder. <sup>2)</sup>3% sweet pumpkin powder. <sup>3)</sup>5% sweet pumpkin powder.

<sup>4)</sup>Means (± standard deviation) with different letters within the same column are significantly different according to Duncan's multiple range test (p<0.05).

Since SPP dilute the viscoelastic properties of gluten, addition of SSP in breadmaking reduces loaf volume of breads. Accordingly, increasing SPP contents led to smaller loaf volumes while the control bread had the largest loaf volume. The addition of 5% SPP promoted the greatest volume reduction (5.1%). The loaf weight data showed that samples of SPP3 and SPP5 exhibited similar loaf weights with significantly lower than the control and SPP1 (p<0.05). Previous report (5) showed that the weight of bread tend to increase with increase in fibers quantity, while, at the same time, volume of bread as well as crumb quality tend to decrease with the increase in fiber quantity. Also it reported that the decrease in volume might be explained by a weakening of gluten matrix, which is losing the ability to retain gases created during fermentation in the presence of fibers (20,21). Insufficient formation of gluten network can be improved by adding gluten enhancing material such as vital gluten. Our data showed the decreased loaf volume which was similar to the previous findings with Korean persimmon (6), *Paecilomyces japonica* and *Cordyceps militaris* powder (7), and green tea powder (8), but in the case of loaf weight, it decreased with increasing the amount of SPP.

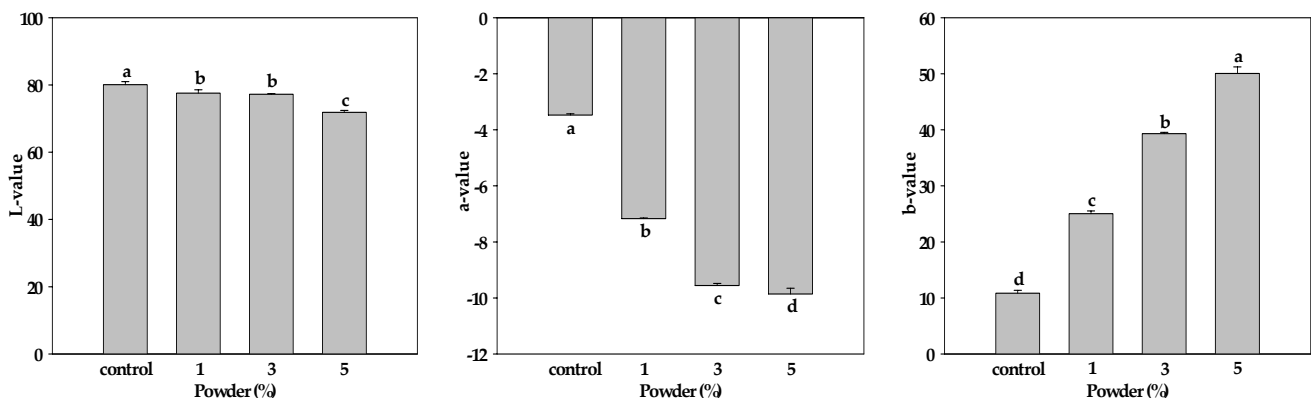
### Color change

Color is an important characteristic of bread because this, together with texture and flavor, contributes to con-

sumer preferences. The SPP used in the present study was a fine and yellow color in appearance. Therefore, it is expected that bread with SPP had different color from the control. The use of SPP caused an increase in darkness of bread crumb. Comparison of bread color between the control and bread with three levels of SPP is listed in Fig. 1. With an increase in SPP in bread, a decrease in brightness was apparent among the three samples. For bread with more amount of SPP, the L- and a-values were reduced, but the b-value increased significantly (p<0.05). This means the decreased brightness and increased green and yellow colors. Moon et al. (5) showed similar findings. In general, the L-, a-, and b-values were all significantly different among the control and the breads with SPP at the three levels (p<0.05).

### Textural characteristics

Hardness is commonly used as an index to determine bread quality. The change in hardness is frequently accompanied with the loss of resilience during storage (22). The hardness, springness, and gumminess of bread were found to increase with the increased SPP concentration (Table 3). Moon et al. (5) also showed the results of the increased hardness and gumminess with increased freeze-dried old pumpkin powder. There was no significant correlation between SPP addition and cohesiveness, adhesiveness (p>0.05). Other researchers found similar results: the inverse relation between bread vol-

**Fig. 1.** Effect of sweet pumpkin powder on the L-, a-, and b-values of bread.

**Table 3.** Textural properties of breads added with freeze-dried sweet pumpkin powders

Attributes	Sample			
	Control	SPP1 <sup>1)</sup>	SPP3 <sup>2)</sup>	SPP5 <sup>3)</sup>
Hardness (kg <sub>f</sub> )	0.0434 ± 0.0067 <sup>b4)</sup>	0.0444 ± 0.0047 <sup>b</sup>	0.0526 ± 0.0023 <sup>ab</sup>	0.0580 ± 0.0056 <sup>a</sup>
Cohesiveness	0.5878 ± 0.0093 <sup>a</sup>	0.5816 ± 0.0436 <sup>a</sup>	0.5731 ± 0.0412 <sup>a</sup>	0.5611 ± 0.0078 <sup>a</sup>
Springiness (mm)	7.19 ± 0.44 <sup>b</sup>	7.60 ± 0.010 <sup>ab</sup>	7.51 ± 0.17 <sup>ab</sup>	7.83 ± 0.17 <sup>a</sup>
Gumminess (g <sub>f</sub> )	22.9 ± 1.9 <sup>b</sup>	25.7 ± 1.6 <sup>b</sup>	31.9 ± 1.2 <sup>a</sup>	33.8 ± 1.6 <sup>a</sup>
Adhesiveness (kg <sub>f</sub> .mm)	-0.0005 ± 0.0006 <sup>a</sup>	-0.0007 ± 0.0001 <sup>a</sup>	-0.0011 ± 0.0003 <sup>a</sup>	-0.0012 ± 0.0003 <sup>a</sup>

<sup>1)</sup>1% sweet pumpkin powder. <sup>2)</sup>3% sweet pumpkin powder. <sup>3)</sup>5% sweet pumpkin powder.

<sup>4)</sup>Means (± standard deviation) with different letters within the same row are significantly different according to Duncan's multiple range test (p<0.05).

ume and firmness, with increasing amount of SPP lead to decreasing loaf volume and increasing hardness value (5,11,12).

### Consumer test

Thirty-one consumer panelists evaluated 4 samples for the consumer attributes of color, flavor, taste, texture, and overall acceptability. The overall bread quality perceived with SPP is presented in Table 4 and Fig. 2. There were significant differences among samples added with

**Table 4.** Sensory evaluation of breads added with freeze-dried sweet pumpkin powders

Attributes	Sample			
	Control	SPP1 <sup>1)</sup>	SPP3 <sup>2)</sup>	SPP5 <sup>3)</sup>
Color	3.26 <sup>b4)</sup>	3.58 <sup>b</sup>	4.03 <sup>a</sup>	3.68 <sup>ab</sup>
Flavor	3.06 <sup>a</sup>	3.16 <sup>a</sup>	3.29 <sup>a</sup>	3.16 <sup>a</sup>
Texture	3.00 <sup>b</sup>	3.26 <sup>b</sup>	3.71 <sup>a</sup>	3.03 <sup>b</sup>
Taste	2.90 <sup>b</sup>	3.13 <sup>b</sup>	3.71 <sup>a</sup>	3.03 <sup>b</sup>
Overall acceptability	2.94 <sup>b</sup>	3.16 <sup>b</sup>	3.68 <sup>a</sup>	3.13 <sup>b</sup>

<sup>1)</sup>1% sweet pumpkin powder. <sup>2)</sup>3% sweet pumpkin powder.

<sup>3)</sup>5% sweet pumpkin powder.

<sup>4)</sup>Means with different letters within column are significantly different according to Duncan's multiple range test (p<0.05).

different amounts of SPP except for flavor attribute (p<0.05). It is clearly showed that color of the crumb was the attribute with the most significant difference, whereas the flavor was the one with the least difference among the four bread variants. Texture and taste attributes also showed considerable differences among variants with their ranges smaller than that of color. SPP3 received the highest scores for all the attributes tested. For example, color, flavor, taste, texture, and overall acceptability had received the highest scores of 4.03, 3.29, 3.71, 3.71, and 3.68, respectively. Moon et al. (5) reported similar results with freeze-dried old pumpkin powders.

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**Fig. 2.** Spider chart (QDA, Quantitative Descriptive Analysis) of consumer test results of bread as influenced by sweet pumpkin powder.

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