

Quality of Yackwa as Influenced by Xylitol Addition

Hai-Jung Chung

Department Food Science & Nutrition, Daejin University, Kyunggi 487-711, Korea

ABSTRACT Yackwa was prepared by substituting syrup with xylitol (0, 10, 20, and 30%) and the quality characteristics were evaluated. Volume and specific volume were higher in Yackwa prepared with xylitol than the control. Crude fat content of xylitol-containing Yackwa were significantly higher than that of control ($p < 0.05$), but moisture content was not different among treatments. Incorporation of xylitol in Yackwa lowered the redness and yellowness values ($p < 0.05$). Instrumental hardness results showed that the addition of xylitol decreased the hardness of Yackwa. Sensory evaluation revealed no significant difference in overall desirability between control- and xylitol-containing groups. Therefore, Yackwa made with up to 30% xylitol in place of syrup is as acceptable as control Yackwa without depressing sensory quality.

KEYWORDS: Yackwa, xylitol, quality

INTRODUCTION

Yackwa is a Korean traditional fried snack made from wheat flour, sesame oil, honey and other ingredients. Yackwa is an important traditional snack food due to its unique texture and flavor. Its popularity among all age groups has produced a gradual increase in consumption recently.

Public interest in well-being and health has triggered the introduction of diverse functional ingredients in food products, including Yackwa. Many attempts have been made to improve the functional properties and nutritive value of Yackwa by modifying the basic formulation. Herb (Gwon and Moon, 2007), cellulose (Cha and Song, 2006), black rice (Lee, 2006), green tea powder (Yun and Kim, 2005), red ginseng powder (Hyun and Kim 2005) and chitosan (Kim and Chung, 2000) have been incorporated into Yackwa formulations and the quality characteristics investigated.

Xylitol, a pentahydroxy sugar alcohol, is a natural functional sweetener that is widely used as a sugar substitute for diabetes, because insulin is not needed to regulate its metabolism (Kwon et al 2006). Xylitol is as sweet as sucrose and, hence, can replace sucrose on a weight-to-

weight basis. It dissolves readily in water and gives a pleasant cool sensation due to the negative heat of solution (Winkelhausen and Kuzmanova 1998). It also serves as a humectant to decrease water activity as well as improving the shelf-life of foods. In this study, xylitol was added to replace a part of syrup in the preparation of Yackwa and the quality characteristics were investigated.

MATERIALS AND METHODS

Materials

Wheat flour (CJ Co., Korea), corn syrup (Singsong, Korea), soju (Doosan, Korea), corn oil (Chungjungwon, Korea), xylitol (Danisco, Finland) and salt (Chungjungwon, Korea) were purchased from a local market.

Preparation of Yackwa

The ingredients used in the formulations are shown in Table 1. The levels of xylitol (0, 10, 20, and 30%) were determined in a preliminary study. Wheat flour and corn oil were mixed and sifted. Syrup, xylitol, soju and salt were mixed and added to the sifted flour and kneaded for 30 s. The dough was wrapped in plastic wrap and refrigerated for 30 min until set. The firm dough was sheeted to a thickness of 5 mm-thick and cut in 40×40 mm and fried at 160°C for 4 min in corn oil. The finished product (Yackwa) was drained for 30 min and cooled to room temperature before analysis.

Weight, volume and specific volume measurements

Yackwa weight was determined with a precision scale

*Corresponding author
Tel: +82-31-539-1861
Fax: +82-31-539-1860
E-mail: haijung@daejin.ac.kr

(Mettler GB 3002, Switzerland). Volume was measured using an established seed displacement method and specific volume was obtained from the ratio of volume (mL) to weight (g).

Moisture and crude fat content determinations

Moisture and crude fat contents of Yackwa were determined according to the method of the Association of Official Analytical Chemists (AOAC, 1995).

Color measurement

Yackwa surface color was measured using a colorimeter (JX 777, Juki, Japan) calibrated with a white standard plate ($L=+98.5$, $a=+0.07$, $b=-0.40$). Hunter L (lightness), a (redness), b (yellowness) values were measured from five different points per sample, and three samples were tested for each treatment. An average of these readings was calculated.

Instrumental hardness evaluation

Yackwa hardness was measured using a rheometer (Compac-100, Sun Scientific, Japan) equipped with a 10 kg load cell in compression mode with a 5 mm-diameter cylindrical aluminum plunger at a table speed of 120 mm/min. An average of three values from different points per sample was taken and three samples were selected at random for each treatment.

Sensory evaluation

Yackwa was placed on a plastic dish coded by a three-digit random number and offered to eight panelists who were in lighted individual booths. Surface color, sweetness, hardness, crispness and greasiness were evaluated using a nine-point scale where 1=none, 5=moderate, and 9=intense.

Statistical analysis

Data are expressed as mean±standard deviation of at least triplicate measurements. Analysis of variance (ANOVA) was applied to study the differences among the samples using SAS version 8.12 software. The comparisons of mean values were performed by Duncan's multiple range test with significance set at $p<0.05$.

RESULTS AND DISCUSSION

Weight, volume and specific volume of Yackwa

Results of weight, volume and specific volume of Yackwa are presented in Table 2. Weight of control Yackwa was 17.4 g and those of xylitol added groups were 17.8-18.4 g. Volume of control Yackwa was 20.3 mL and those of xylitol Yackwa ranged from 21.7-23.3 mL, indicating that volume increased with increasing proportion of xylitol. There were no significant differences in specific volume of Yackwa between control (1.17 mL/g) and 10% group (1.18 mL/g).

Table 1. Formulations of Yackwa added with xylitol

Ingredients	Group ¹⁾			
	Y-0	Y-10	Y-20	Y-30
Flour	100 g	100 g	100 g	100 g
Corn syrup	30 g	27 g	24 g	21 g
Xylitol	-	3 g	6 g	9 g
Soju	13.5 mL	14 mL	14.5 mL	15 mL
Corn oil	15 mL	15 mL	15 mL	15 mL
Salt	0.6 g	0.6 g	0.6 g	0.6 g

¹⁾Y-0: syrup:xylitol=10:0

Y-10: syrup:xylitol=9:1

Y-20: syrup:xylitol=8:2

Y-30: syrup:xylitol=7:3

Table 2. Weight, volume and specific volume of Yackwa added with xylitol

Group	Weight (g)	Volume (mL)	Specific volume (mL/g)
Y-0 ¹⁾	17.4±0.19 ^{a2)}	20.3±1.15 ^a	1.17±0.08 ^a
Y-10	18.4±0.32 ^b	21.7±1.53 ^{ab}	1.18±0.07 ^a
Y-20	17.8±0.29 ^a	23.0±1.00 ^b	1.29±0.05 ^b
Y-30	17.8±0.42 ^a	23.3±0.58 ^b	1.32±0.06 ^b

¹⁾See the legend of Table 1.

Each value is mean±standard deviation(SD).

²⁾Means with different letters within a column are significantly different from each other at $\alpha=0.05$ as determined by Duncan's multiple range test.

However, significant differences were found with 20% (1.29 mL/g) and 30% (1.32 mL/g) xylitol.

Moisture and crude fat content of Yackwa

Results of moisture and crude fat contents of Yackwa are shown in Table 3. Moisture content of control was 7.64% and that of Yackwa containing 10, 20, and 30% xylitol ranged from 8.39-9.88%, and no significant differences were observed between the control and the three different treatments. Crude fat content of control Yackwa was 30.03% and increased as the xylitol content increased, resulting in the highest value of 34.44% for Yackwa containing 30% xylitol. Han et al (1994) reported lower moisture content (6.37-6.47%) and crude fat content (19.5-21.77%). Kim et al (2003) reported moisture content as 5.66-6.31% and fat content as 41.90-43.84% for Yackwa prepared with Dansam.

Color of Yackwa

The results of Hunter L, a, b value are shown in Table 4. The L (lightness) value of control Yackwa was 53.02 and those of xylitol containing groups were 50.31-52.86; no significant differences among the groups were evident. Hunter a (redness) value of control Yackwa was 11.16 and decreased with increasing xylitol level (7.06-8.83). Hunter b

Table 3. Moisture and crude fat content of Yackwa added with xylitol (unit : %)

Group	Y-0 ¹⁾	Y-10	Y-20	Y-30
Moisture	7.64±0.01 ^{a2)}	8.97±0.21 ^a	9.88±0.01 ^a	8.39±1.93 ^a
Crude fat	29.96±0.87 ^a	31.94±1.03 ^b	34.26±0.28 ^c	34.44±2.11 ^c

¹⁾See the legend of Table 1.

Each value is mean±standard deviation (SD).

²⁾Means with different letters within a row are significantly different from each other at $\alpha=0.05$ as determined by Duncan's multiple range test.

Table 4. Hunter L, a, b value of Yackwa added with xylitol

Group	L	a	b
Y-0 ¹⁾	53.02±3.48 ^{a2)}	11.16±1.97 ^b	29.28±2.00 ^b
Y-10	51.23±4.21 ^a	8.83±2.38 ^a	25.20±2.94 ^a
Y-20	52.86±3.58 ^a	7.82±2.21 ^a	25.68±0.71 ^a
Y-30	50.31±3.47 ^a	7.06±2.70 ^a	24.00±2.22 ^a

¹⁾See the legend of Table 2.

Each value is mean±SD.

²⁾Means with different letters within a column are significantly different from each other at $p<0.05$ as determined by Duncan's multiple range test.

(yellowness) value of control Yackwa was 29.28 and those of xylitol containing groups ranged from 24.00-25.68. Thus, it would be expected that control Yackwa would be more reddish and yellowish than the xylitol-containing preparations. Yun and Kim (2005) reported lowered L and b values with the addition of green tea powder to Yackwa. Lee (2006) reported that the L and b values were lowered as the substitution level of black rice flour increased. From these findings, it is suggested that the incorporation of different ingredients into Yackwa is manifest as different color profiles.

Hardness of Yackwa

Hardness values of Yackwa stored at room temperature for 30 days are shown in Fig. 1. Initial hardness value of control Yackwa was 75.1 kg/cm² and those of xylitol added groups ranged from 3 4.1-54.2 kg/cm². The lowest value was observed for Yackwa containing 30% xylitol. Similar results were obtained by Mun (2003) where the addition of garlic juice instead of ginger juice to Yackwa lowered the

hardness value. Dissimilar results were obtained by Gwon and Moon (2007), who reported that the addition of herbs such as rosemary, thyme, oregano and ginger increased texture hardness. Yun and Kim (2005) reported that Yackwa prepared with 6 and 8% of green tea powder displayed lower hardness values. Presently, after 30 days of storage at room temperature, hardness of control Yackwa was 84.1 kg/cm², while xylitol-containing Yackwa displayed hardness values of 48.4-77.7 kg/cm². Addition of xylitol significantly retarded the texture hardening ($p<0.05$). Hardness is an important aspect of Yackwa quality and affects shelf life and consumer acceptance. Kim et al (2004) reported that the addition of 0.05 and 0.1% gellan gum or 0.1 and 0.5% xanthan gum significantly decreased the hardness of Yackwa by 32-63% after 4 weeks of storage.

Sensory evaluation

Table 5 shows the results of sensory evaluation of Yackwa. No differences in surface color between the control and xylitol-containing Yackwa were evident. Moreover, there were no significant differences in sweetness between the control and Yackwa formulated with 10% xylitol. However, significant differences were found with Yackwa containing 20 and 30% xylitol ($p<0.05$). Hardness was significantly affected by the addition of xylitol ($p<0.05$). Yackwa became softer as the xylitol level increased, which is in agreement the texture data shown in Fig. 1. The crispness score was highest in Yackwa containing 30% xylitol, followed by 20% and 10% xylitol ($p<0.05$). Greasiness score was highest in the 30% xylitol samples, but there were no remarkable differences among the other samples. Overall desirability score was highest in Yackwa containing 20% xylitol, but no significant differences were

Table 5. Sensory characteristics of Yackwa added with xylitol

Group	Surface color	Sweetness	Hardness	Crispness	Greasiness	Overall desirability
Y-0 ¹⁾	5.50±1.22 ^{a2)}	3.89±1.15 ^a	5.64±0.93 ^c	5.71±0.83 ^a	5.29±0.99 ^a	5.71±0.83 ^a
Y-10	6.14±0.86 ^a	3.92±1.30 ^a	5.36±0.93 ^c	6.29±0.91 ^a	5.36±1.28 ^a	5.93±1.00 ^a
Y-20	6.36±0.75 ^a	4.90±1.41 ^b	4.64±0.75 ^b	6.57±0.94 ^b	5.29±1.14 ^a	6.21±1.01 ^a
Y-30	6.00±1.17 ^a	4.96±1.24 ^b	3.71±0.73 ^a	6.79±0.89 ^b	6.36±0.93 ^b	5.57±1.22 ^a

¹⁾See the legend of Table 2.

Each value is mean±SD.

²⁾Means with different letters within a column are significantly different from each other at $\alpha=0.05$ as determined by Duncan's multiple range test.

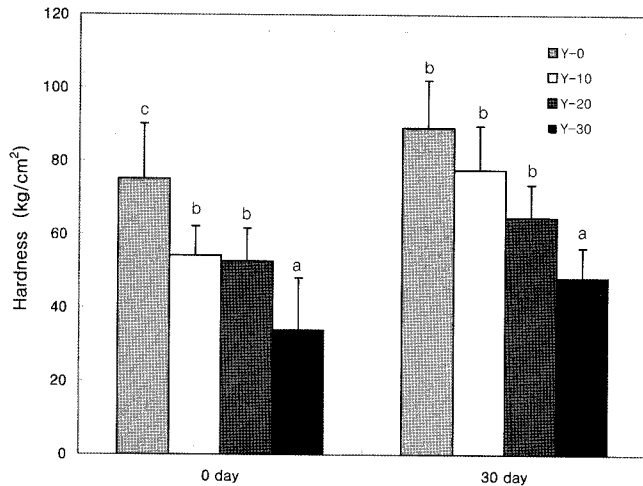


Fig. 1. Changes in hardness of Yackwa added with xylitol during storage at room temperature for 30 days. Y-0 syrup:xylitol=10:0, Y-10 syrup:xylitol=9:1, Y-20 syrup:xylitol=8:2, Y-30 syrup:xylitol=7:3. Different letters above each treatment represent significant difference at $p < 0.05$.

observed among the other treatments. Therefore, Yackwa with up to 30% xylitol in place of syrup is as acceptable as control Yackwa without diminishing sensory quality.

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