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Physicochemical, antioxidant, and sensorial properties of peach snacks prepared from different cultivars

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High potentiality of medicinal benefits of peach have increased its demand, however, supply of fresh fruit to meet the demand is challenging as it grows in specific climatic regions and in particular season. Preparation of varieties of processed peach products could be a good option to supply in lean season. Objective of the study was to assess the quality characteristics of peach snacks prepared from 11 different cultivars. We investigated the physicochemical (soluble solid, titratable acidity, hardness and dry yield), antioxidant (DPPH radical scavenging capacity and total phenolics content) and sensorial properties (color, flavor, texture, sweetness and overall acceptance) of peach snacks prepared from 11 peach cultivars. Peach snacks of different cultivars evaluated in this study showed substantial variations in antioxidant capacity, physicochemical and sensorial properties. Some of the samples showed higher physicochemical properties while the others contained better antioxidant capacity or sensory properties. Results of this study reveal that quality peach snacks having different properties could be prepared by drying thin slices of fresh fruits of different cultivars. However, supplementary studies on cost effective techniques of peach snacks preparation and variation in nutritive and medicinal properties of processed products could increase the application of the findings of this experiment.

Key words: Antioxidant, peach snack, physicochemical, sensory property.

INTRODUCTION

Peach (*Prunus persica* L. Batsch) is a cool season fruit that could be cultivated in different parts of the world. It is regarded as an important economic crop and also recommended for its various health benefits (Yang et al., 2011). Peach contains caffeoylquinic acid, one of the bioactive polyphenols with significant antioxidant activity and important beneficial effect in human health (Luo et al., 2008). Antioxidants present in peach scavenge the reactive oxygen species in human blood plasma and thus provide a potential protection against various chronic diseases with dietary consumption of peach (Tsantili et al., 2010).

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As the fruit is grown only in a particular season and specific climatic regions, supply of fresh fruit to a large extent is challenging in spite of its big demand from across the world. On the other hand, some consumers decline to buy fresh fruits as they find the internal quality poor when fruit is consumed fresh (Byrne, 2002). In such a scenario, high quality dried fruits could be a good option to replenish the supply of health benefits of peach during off-season and in those areas where peach is not produced.

High potentiality of medicinal benefit (Manzoor et al., 2012) of some fruits including peach has increased their demand; however, some of the processing related problems have raised concerns among large number of consumers. In order to maintain the quality in some dried fruits, sulfur fumigation is often applied to prevent quality deterioration and fungal attacks (Miller, 1984). However, the hazardous nature of sulfur raises a health risk and food safety concerns (Islam and Hoque, 2013) as the traces of sulfur dioxide remained in food causes asthma or allergic reaction to some people.

Different cultivars of peach have different fruit quality and nutritional composition. Various preferences of consumers have raised the interest in breeding programs worldwide to focus on fruit quality and nutritional composition (Wolfe et al., 2008). Some of them are devoted to produce cultivars with excellent taste, high sugar levels, and balanced sugar/acid ratios (Esti et al., 1997). Other breeding programs are focused to the identification and quantification of phenolic compounds (Cantin et al., 2009). High quality dried fruits could be a good option to replenish the supply of health benefits of peach during off-season and in those areas where peach is not produced.

Very limited studies regarding the potential use of dried peach snacks have been reported. In the context of big scope of dried fruits of peach as fresh fruits are not available year round in the all parts of the world and different quality and nutritional composition of the cultivars, the objective of this study was to evaluate the physicochemical, antioxidant, and organoleptic properties of peach snacks prepared from 11 peach cultivars. This work will benefit the preparation of good quality processed dry peach snacks.

MATERIALS AND METHODS

Sample and chemicals

Fruits of 11 peach cultivars namely; Hikawa Hakuho, Yume Fuji, Kunika, Jinmi, Kawanakajima Hakutou, Baekhyang, Changhowon Hwangdo, Wolbongjosaeng, Daemyung, Red Start and Shuho, grown at Cheongdo Peach Experiment Station of Cheongdo-city in Korea, were manually harvested 80-85 days after flowering and transported to the laboratory. Fruits were thoroughly washed with tap water and kept for surface drying at room temperature. Seed was separated from flesh and 5 mm thick slices of flesh were prepared manually using knife. The slices were delivered to quick freezing (−40°C) for 12 h then kept for freeze drying to prepare peach snacks. The freeze-dried snacks were packed into air-tight plastic bags until further analysis. All the chemicals and reagents used in the study were of analytical grade.

Rheological measurement of hardness and weight

Hardness of peach snacks was measured using a rheometer (COMPAC-100, Sun scientific Co., Japan) under the following operational conditions: test type, mastication; probe, 25 mm aluminium cylinder probe; load cell, 2.0 kg and table speed, 60 mm/min. Fresh and dry weight of peach slices were measured to observe the dry yield of peach snacks of different cultivars.

Standard chemical analysis

Titratable acidity (TA) and soluble solid (SS) content of peach snacks of 11 cultivars were analyzed to determine their chemical properties. Peach snacks were ground into flour (60-mesh). Measurement of titratable acidity was carried out by titrating 10 mg of ground peach snack to 100 mL of deionized water and expressed as percentage citric acid. Soluble solid content was determined using a refractometer (RX-5000α, Atago, Tokyo, Japan) and expressed as °Brix.

Determination of total phenolic compounds

Total phenolic compounds in ground peach snacks were analyzed following Folin-Ciocalteu method (Singleton, 1999). The reagents were allowed to react for 60 min at room temperature and absorbance was measured at 750 nm using ELISA microplate reader (Infinite F50, Tecan, Switzerland). Standard calibration curve was drawn using gallic acid and results were expressed as µg/g on a dry weight basis of sample. The values are presented as means of triplicate experiments.

Determination of DPPH radical scavenging activity

Antioxidant capacity of ground peach snack was quantified by 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical method as described by Blois (1958). The DPPH solution was prepared at the concentration of 4×10^{-4} mol/L in methanol. Ground sample (1 g) was extracted in 10 mL of absolute methanol and hot water (100°C) at room temperature for 12 h. The supernatant was centrifuged (1660×*g*) at room temperature for 10 min and filtered through 2-µm syringe filter. A 0.1-mL of sample extract was mixed with 2.9 mL of freshly prepared DPPH solution. The mixture was incubated in the dark at room temperature for 30 min and absorbance (Abs) was measured at 517 nm by ELISA microplate reader (Sunrise basic, Tecan, Austria). The control was prepared without mixing any sample extract, and methanol was used for the baseline correction. Values are presented as means of three replications. The radical scavenging activity was calculated using the following equation:

DPPH radical scavenging activity (%) = (Control Abs − Sample Abs)/Control Abs × 100

Sensory properties evaluation

Sensory properties of peach snacks were evaluated for color, taste (sweetness, astringency), texture, and overall acceptance on 5-scale basis: 1 = very bad, 2 = bad, 3 = moderate, 4 = good, 5 = very good. All the sensory properties were evaluated by 20 volunteer panelists (10 women and 10 men) selected in Kyungpook

Table 1. Physicochemical properties of 11 peach snacks.

Cultivar	Soluble solid (˚Brix)	Titratable acidity (%)	Hardness (Kg/Ø 5 mm)	Dry snack yield (%)
HH	55.5±0.1[j]	0.14±0.02[j]	0.72±0.02[h]	9.5±0.1[g]
YF	65.8±0.2[h]	0.28±0.02[g]	0.49±0.04[j]	9.9±0.1[f]
KK	63.0±0.1[i]	0.37±0.04[f]	0.67±0.01[i]	10.0±0.1[f]
JM	68.6±0.1[g]	1.02±0.05[d]	0.72±0.02[h]	11.0±0.03[e]
KH	69.1±0.2[f]	0.19±0.01[i]	2.62±0.01[a]	12.0±0.02[d]
BH	75.6±0.1[c]	1.59±0.13[c]	1.40±0.03[d]	13.0±0.02[c]
CH	77.0±0.1[b]	0.70±0.23[e]	1.19±0.01[g]	13.6±0.1[b]
WB	72.8±0.2[d]	1.31±0.15[c]	1.22±0.01[f]	13.0±0.1[c]
DM	78.9±0.1[a]	0.23±0.02[h]	1.73±0.02[c]	15.0±0.3[a]
RS	70.0±0.1[e]	5.40±0.16[a]	1.34±0.01[e]	9.2±0.2[g]
SH	70.0±0.1[e]	2.10±0.17[b]	2.03±0.02[b]	12.0±0.1[d]

HH, Hikawa Hakuho; YF, Yume Fuji; KK, Kunika; JM, Jinmi; KH, Kawanakajima Hakutou; BH, Baekhyang; CH, Changhowon Hwangdo; WB, Wolbongjosaeng; DM, Daemyung; RS, Red Start; SH, Shuho. Values are means±SD of three replications. The values followed by different superscript within a column indicate significant difference (p<0.05).

National University, Daegu, Korea. The values are the average of 10 evaluations for each sensory property.

Statistical analysis

Data were analyzed using the statistic version 4.0 package (Analytical Software, AZ, USA) to generate one-way or two-way analysis of variance (ANOVA) when needed and the significant differences between means were identified using the Tukey's mean test (p<0.05).

RESULTS

Peach snacks of different cultivars evaluated in this study showed substantial variations in antioxidant capacity, physicochemical, and sensorial properties as mentioned by other authors (Byrne et al., 1991; Cantín et al., 2009a; 2009b).

Physicochemical properties

SS contents of peach snacks of different cultivars were significantly different except Red Start and Shuho. Daemyung (78.9±0.1 ˚Brix) cultivar showed the highest SS content whereas that of Hikawa Hakuho (55.5±0.1 ˚Brix) was the lowest. With respect to TA, considerable variations among cultivars were found, with the lowest value for Hikawa Hakuho (0.14±0.02% of citric acid) and the highest value for Red Start (5.40±0.16% of citric acid) (Table 1). The highest hardness value was observed in Kawanakajima Hakutou (2.62±0.01 Kg/Ø 5 mm) followed by Shuho (2.03±0.02 Kg/Ø 5 mm). Cultivar Yume Fuji (0.49±0.04 Kg/Ø 5 mm) contained the lowest hardness value. Dry snacks yield was the highest in Daemyung (15.0±0.3%) and the lowest in Hikawa Hakuho (9.5±0.1%) and Red Start (9.2±0.2%) (Table 1). In general, dry snack yield was higher in cultivars with higher SS content except for Red Start (70.0±0.1 ˚Brix and 9.2±0.2% dry yield) which had equal SS value to Shuho (70.0±0.1 ˚Brix) but significantly low dry yield (12.0±0.1%).

Antioxidant capacity

Total phenolic compounds and DPPH radical scavenging activity were considered to evaluate the antioxidant capacity of peach snacks of different cultivars. Peach snacks of some of the cultivars showed variability in their antioxidant capacity in hot water extract and methanol extract (Table 2). Total phenolic content of Hikawa Hakuho (1.44±0.05 µg GAE/mg on a dry basis) was the highest in hot water extract whereas Wolbongjosaeng (1.41±0.02 µg GAE/mg on a dry basis) showed the lowest value. On the other hand, Hikawa Hakuho (1.52±0.07 µg GAE/mg on a dry basis) was found to possess the lowest and Kunika (3.12±0.07 µg GAE/mg on a dry basis) the highest value in methanolic extract. The DPPH radical scavenging capacity was the highest in Changhowon Hwangdo (11.00±0.37%) and Red Start (10.50±0.50%) and the lowest in Yume Fuji (3.50±0.31%) as the extraction was carried out in hot water whereas the highest value for the same was found in Red Start (19.00±0.60%) and the lowest in Baekhyang (8.00±0.36%) when the extraction was made in methanol.

Sensory characteristics

Sensorial characteristics of peach snacks varied slightly among cultivars (Table 3). The highest and lowest values

Table 2. Total phenolic content and DPPH radical scavenging activity of 11 peach snacks in hot water and methanol extracts.

Cultivar	Total phenolics (μg GAE/mg on a dry basis)		DPPH (% on a dry basis)	
	HWE	ME	HWE	ME
HH	1.44±0.05[a]	1.52±0.07[f]	9.00±0.21[b]	14.50±0.12[cd]
YF	1.42±0.06[c]	1.90±0.08[e]	3.50±0.31[g]	13.50±0.31[d]
KK	1.42±0.03[c]	3.12±0.07[a]	6.00±0.26[f]	18.00±0.26[b]
JM	1.42±0.04[c]	2.61±0.06[c]	7.00±0.31[e]	9.00±0.31[g]
KH	1.42±0.03[c]	2.84±0.05[b]	7.00±0.28[e]	11.00±0.31[f]
BH	1.43±0.02[b]	2.32±0.04[d]	8.50±0.25[c]	8.00±0.36[h]
CH	1.42±0.03[c]	2.06±0.03[e]	11.00±0.37[a]	15.00±0.40[c]
WB	1.41±0.02[d]	2.29±0.05[d]	9.50±0.41[b]	14.00±0.50[d]
DM	1.42±0.04[c]	2.37±0.06[d]	7.00±0.51[e]	14.50±0.52[cd]
RS	1.43±0.05[b]	2.02±0.05[e]	10.50±0.50[a]	19.00±0.60[a]
SH	1.42±0.02[c]	2.59±0.04[c]	8.00±0.21[d]	12.50±0.55[e]

[1]HH, Hikawa Hakuho; YF, Yume Fuji; KK, Kunika; JM, Jinmi; KH, Kawanakajima Hakutou; BH, Baekhyang; CH, Changhowon Hwangdo; WB, Wolbongjosaeng; DM, Daemyung; RS, Red Start; SH, Shuho. GAE = Gallic acid equivalent; HWE = hot water extract; ME = methanol extract. Values are means±SD of three replications. The values followed by different superscript within a column indicate significant difference (p<0.05).

Table 3. Sensory characteristics of 11 peach snacks.

Cultivar	Color	Flavor	Texture	Sweetness	Overall acceptance
HH	3.9±0.2[b]	3.6±0.1[a]	4.1±0.2[a]	3.7±0.2[ab]	3.7±0.1[c]
YF	4.5±0.1[a]	3.6±0.2[a]	4.0±0.1[a]	3.7±0.1[b]	4.9±0.1[a]
KK	2.7±0.1[c]	2.8±0.1[b]	3.5±0.1[b]	3.8±0.1[ab]	3.5±0.2[cd]
JM	3.1±0.3[c]	3.3±0.2[ab]	3.9±0.2[a]	4.1±0.2[a]	4.0±0.1[b]
KH	3.8±0.1[b]	3.4±0.1[a]	4.1±0.1[a]	4.0±0.1[a]	4.1±0.2[b]
BH	2.7±0.2[c]	3.6±0.2[a]	3.8±0.2[ab]	3.0±0.1[c]	3.4±0.2[cd]
CH	4.6±0.1[a]	3.5±0.1[a]	4.0±0.1[a]	3.9±0.2[ab]	3.2±0.1[d]
WB	2.6±0.2[c]	2.3±0.2[c]	2.2±0.1[c]	2.2±0.3[d]	2.2±0.2[e]
DM	2.8±0.1[c]	3.0±0.1[b]	2.4±0.3[c]	2.3±0.2[d]	2.1±0.3[e]
RS	2.0±0.3[d]	2.1±0.1[c]	2.0±0.2[c]	1.5±0.1[e]	1.9±0.2[ef]
SH	2.0±0.3[d]	1.7±0.2[d]	1.6±0.1[d]	1.7±0.2[e]	1.6±0.1[f]

[1)]HH, Hikawa Hakuho; YF, Yume Fuji; KK, Kunika; JM, Jinmi; KH, Kawanakajima Hakutou; BH, Baekhyang; CH, Changhowon Hwangdo; WB, Wolbongjosaeng; DM, Daemyung; RS, Red Start; SH, Shuho. Values are the means±SD of triplicate experiments (n=10) based on 5-point scores (very poor, 1; poor, 2; fair, 3; good, 4; very good, 5). The values followed by different superscript within a column indicate significant difference (p<0.05).

for color were found in Yume Fuji (4.5±0.1), Changhowon Hwangdo (4.6±0.1), Red Start (2.0±0.3) and Shuho (2.0±0.3), respectively. The flavor value was the highest for Hikawa Hakuho (3.6±0.1), Yume Fuji (3.6±0.2), Kawanakajima Hakutou (3.4±0.1), Baekhyang (3.6±0.2) and Changhowon Hwangdo (3.5±0.1) and the lowest for Shuho (1.7±0.2). Hikawa Hakuho (4.1±0.2), Yume Fuji (4.0±0.1), Jinmi (3.9±0.2), Kawanakajima Hakutou (4.1±0.1), and Changhowon Hwangdo (4.0±0.1) had the highest and Shuho (1.6±0.1) had the lowest values for texture. The highest sweetness value was obtained for Jinmi (4.1±0.2) and Kawanakajima Hakutou (4.0±0.1) while the lowest for Red Start (1.5±0.1) and Shuho (1.7±0.2). Finally, the highest overall acceptance scores were for Yume Fuji (4.9±0.1) and the lowest for Shuho (1.6±0.1).

DISCUSSION

Significant differences in SS content were found in the dried peach snacks made of different cultivars. These variations enrich the scope of preparing varieties of snacks from them since SS content is a key quality trait in peaches and nectarines as it is reported that consumer acceptance and satisfaction are related to these traits. However, this relationship varies with cultivar as no standard SS content satisfies consumer, moreover, is affected by other quality traits, such as TA (Crisosto and Crisosto, 2005).

A large number of reports showed a beneficial effect of phenol antioxidants on heart disease and cancer. Phenolic content found in these peach snacks are higher than those previously reported (Gil et al., 2002; Celia et al., 2009) which might be due to the difference in the nature of sample: dry fruit sample was used in the present study instead of fresh one as did in previous studies. However, the proportion of variation in antioxidant capacities between hot water and methanol among different cultivars were not clearly understood.

Differences in overall acceptance of peach snacks in the present study could be considered to prepare highly acceptable product as statistics showed that many food products, even when developed from a sound scientific point of view, encounter poor market acceptance (Hilliam, 1998). Approximately 75% of newly launched food products suffer from poor liking and are withdrawn from the food market during their first two years (Menrad, 2003).

The variation in physicochemical, antioxidative, and sensorial traits of different peach snacks might be due to the genotypic variation among cultivars as pomological characteristics of fruits are strongly affected by the genotypes and environments (Moghaddama et al., 2013; Mratinic et al., 2011).

In conclusion, high potentiality of medicinal benefits of peach have increased its demand, however, supply of fresh fruit to meet the demand is challenging as it grows in specific climatic regions and in particular season. Preparation of varieties of processed peach products could be a good option to supply in lean season. This study, portrayed that peach snacks having different physicochemical, sensorial, and antioxidant properties could be prepared by drying thin slices of fresh fruits of different cultivars. However, further study on cost effective techniques of peach snacks preparation could increase the application of the findings of this experiment.

Conflict of interests

The authors did not declare any conflict of interest.

REFERENCES

Blois MS (1958). Antioxidant determinations by the use of a stable free radical. Nature 181:1199-1200.

Byrne DH (2002). Peach breeding trends: a worldwide perspective. Acta Hortic. 592:49-59.

Byrne DH, Nikolic AN, Burns EE (1991). Variability in sugars, acids, firmness, and color characteristics of 12 peach genotypes. J. Am. Soc. Hortic. Sci. 116(6):1004-1006.

Cantín CM, Gogorcena Y, Moreno MA (2009a). Analysis of phenotypic variation of sugar profile in different peach and nectarine [*Prunus persica* (L.) Batsch] breeding progenies. J. Sci. Food Agric. 89:1909-1917.

Cantín CM, Moreno MA, Gogorcena Y (2009b). Evaluation of the antioxidant capacity, phenolic compounds, and vitamin C content of different peach and nectarine [*Prunus persica* (L.) Batsch] breeding progenies. J. Agric. Food Chem. 57:4586-4592.

Crisosto CH, Crisosto GM (2005). Relationship between ripe soluble solids concentration (RSSC) and consumer acceptance of high and low acid melting flesh peach nectarine (*Prunus persica* (L.) Batsch) cultivars. Postharvest Biol. Technol. 38: 239-246.

Esti M, Messica MC, Sinesio F, Nicotra A, Conte L, Notte EL, Palleschi G (1997). Quality evaluation of peaches and nectarines by electrochemical and multivariate analyses. Relationships between analytical measurements and sensory attributes. Food Chem. 60:659-666.

Gil MI, Tomás-Barberan FA, Hess-Pierce B, Kader AA (2002). Antioxidant capacities, phenolic compounds, carotenoids, and vitamin C content of nectarine, peach, and plum cultivars from California. J. Agric. Food Chem. 50(17):4976-4982.

Hilliam M (1998). The market for functional foods. Dairy J. 8: 349-353.

Islam GMR, Hoque MM (2013). Food safety regulation in Bangladesh, chemical hazard and some perception to overcome the dilemma. Int. Food Res. J. 20(1):47-58.

Luo J, Butelli E, Hill L, Parr A, Niggeweg R, Bailey P, Weisshaar B, Martin C (2008). AtMYB12 regulates caffeoylquinic acid and flavonol synthesis in tomato: expression in fruit results in very high levels of both types of polyphenol. Plant J. 56:316-326.

Manzoor M, Anwar F, Mahmood Z, Rashid U, Ashraf M (2012). Variation in minerals, phenolics and antioxidant activity of peel and pulp of different varieties of peach (Prunus persica L.) fruit from Pakistan. Molecules 17:6491-6506.

Menrad K (2003). Market and marketing of functional food in Europe. J. Food Eng. 56:181-188.

Miller EP (1984). Oriental persimmons (*Diospyros kaki*) in Florida. Proc. Fla. Sta. Hort. Soc. 97:310-344.

Moghaddama EG, Moghaddamb HA, Piric S (2013). Genetic variation of selected Siah Mashhad sweet cherry genotypes grown under Mashhad environmental conditions in Iran. Crop Breed. J. 3(1):45-51.

Mratinic E, Popovski B, Miloševic T, Popovska M (2011). Analysis of morphological and pomological characteristics of apricot germplasm in FYR Macedonia. J. Agric. Sci. Technol. 13:1121-1134.

Singleton VL, Orthofer R, Lamuela-Raventos RM (1999). Analysis of total phenols and other oxidation substrates and antioxidants bymeans of Folin-Ciocalteu reagent. Methods Enzymol. 299:152-178.

Tsantili E, Shin Y, Nock JF, Watkins CB (2010). Antioxidant concentrations during chilling injury development in peaches. Postharvest Biol. Technol. 57:27-34.

Wolfe KL, Kang X, He X, Dong M, Zhang Q, Liu RH (2008). Cellular antioxidant activity of common fruits. J. Agric. Food Chem. 56:8418-8426.

Yang Z, Ma Y, Chen L, Xie R, Zhang X, Zhang B, Lu M, Wu S, Gilissen LJWJ, van Ree R, Gao Z (2011). Differential transcript abundance and genotypic variation of four putative allergen-encoding gene families in melting peach. Tree Genet. Genomes 7(5):903-916.