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ARTICLE

Quality Characteristics, Changes in Physiochemical Properties and Functional Properties of Camembert Cheese Containing Red Ginseng Powder

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Abstract Effects of quality, physicochemical properties and antioxidants in Camembert cheese added with red ginseng powder (RGP) were investigated. Cheese samples were prepared with 0.05%, 0.10%, 0.15% and 0.20% RGP. and then monitored during ripening at 14°C for 28 d. The pH of the RGP amended treatment groups increased during the ripening period relative to the control (p<0.05). Moreover, the 1,2-Diphenyl-1-picrylhydrazyle (DPPH) was highest in the 0.15% RGP group from 21 d to 28 d. $ABTS^+$ radical scavenging activity was increased just like DPPH as the ripening period passed, 0.10% treatment was highest at from 7 d to 21 d. 0.15% RGP was contents of ginsenosides : 10,999.7 ppm. The Free fatty acids (FFA), controls with 0.15% treatment, while the total fat (TF) and monounsaturated fat (MuSF) were higher in the control than the 0.15% RGP group (p<0.05). The total free amino acid (FAA) was increased in the control, and 0.15% RGP, and control was highest at then 0.15% RGP. The samples had average contents of fat and protein were 29% and 18-20% respectively. Additionally, the L* value decreased, while the a* and b* values increased as the amount of RGP added increased. Sensory evaluation revealed that texture and total acceptability were higher in the control group at 12 d. Although the addition of RGP did not exert a better effect on the ripening of the camembert cheese, but the ripening grade was similar to that of the common camembert cheese, and the additional function of the cheese was reinforced. Functional cheese could be developed.

Keywords antioxidant activity, camembert cheese, functional cheese, ginsenoside, red ginseng

Introduction

Recent market research suggests that development of a health functional natural cheese product should be pursued to meet demand for functional, anti-aging and safer foods amid the widespread health-conscious trend of seeking a LOHAS (lifestyle of health and sustainability) for the sustainable growth of both health and environment. One of the most widely known cheeses in the world is Camembert

cheese. Camembert cheese is made by adding *Penicillium candidum* to the curds during production. The mold then gradually grows in the ripening process to form a rind like fine soft hair on the surface. The curd is not cut, but rather put in a frame using a ladle. Ginseng consists of members of the *Panax* genus of the *Araliaceae* family. The roots of ginseng are utilized for their health promoting properties. Ginsengs are divided into three categories depending on the manufacturing or processing methods, fresh ginseng, white ginseng and red ginseng (Kim et al., 2007). Ginsenosides are known to impact the main medicinal effects of ginseng. These compounds are divided into panaxadiol (PD) and panaxatriol (PT) according to their structural characteristics (Sanata et al., 1974). The PD type is known to calm the central nervous system, while the PT type reduces cholesterol (Sanata et al., 1974; Choi. 1991). Ginsenosides included in red ginseng are distinguished into many different types according to the hydroxyl (-OH) locations and sugar binding. Of them, those with the largest contents are Rg1 (protopanaxatriol type) and Rb1 (protopanaxadiol type) (Lee et al., 2009). Studies have investigated the acidic polysaccharide, peptide, phenol, polyacetylenes, oil components and other physiologically active ingredients of ginseng. Additionally, water/fat solubility fractionation studies and investigations of the antioxidant activity of phenol compounds, anti-cancer function of polyacetylene types, and functional characteristics of the original red ginseng aroma ingredient have been conducted (Park et al., 2003). Ginsenosides are known to restrain the growth of some pathogenic microorganisms (Kwak. 2006), as well as lactobacillus and phyto-pathogenic molds (Nam. 1979; Cho et al., 1986). New effects of red ginseng such as anti-allergic function, memory improvement, and impotence improvement have also been reported. Furthermore, these studies have suggested that observed effects could be a result of G-Rg3, G-Rf and G-Rh2, which are only found in red ginseng (Bae et al., 2005; Jang et al., 2008). Therefore, the present study was conducted to develop a farmstead cheese making standard process for production of artisan cheese with added red ginseng which have proved its medicinal effects, physiologically active function through the long history of Korean tradition.

Materials and Methods

Red ginseng powder (RGP)

Red ginseng powder (RGP) was obtained from Dongwon F&B Co., Ltd. (Seongnam, Korea). The contents of ginsenosides in the RGP are shown in Table 1.

Table 1. Contents of ginsenosides in red ginseng powder (RGP)

Ginsenoside	RGP (mg/g)
Rg1+Rb1	15
Rh1+Rg3	15
CK+F2	2.0

CK, compound K (20-O-β-D-glucopyranosyl-20(S) protopanaxadiol).

Manufacture of camembert cheese containing RGP

Camembert cheese was prepared using the method described by Mark et al. (2008). In all cases the raw milk (20 L); pH: 6.8; protein: 3.2 ± 0.1%, fat: 4.1 ± 0.1%; somatic cell number: 45×10^3, total bacterial number: 4.0×10^3) was pasteurized at 63°C for 30 min, then cooled to 33°C, RGP (0.05, 0.10, 0.15 and 0.20% / raw milk) was added to the milk so that the red ginseng powder could be evenly distributed to the cheese. The pasteurized milk was poured into a cheese vat set to

33°C, and mixed starter (R-707 DVS, *Lactococcus lactis* subsp. *lactis*, *Lactococcus lactis* subsp. *cremoris* : 3 g / 100 kg, Chr. Hansen Inc., *P. candidum* : 0.03 g / 100 kg, Chr. Hansen Inc., Denmark) with the addition of 0.02% CaCl2(30 mL/100 kg; CALCIO, Dupont-Danisco, Denmark) to milk. After 60 min, 0.025% rennet (25 mL / 100 kg; 290 Halal Calf Rennet, Chr. Hansen Inc., Denmark) added to each cheese vat and stood for 40 min. After coagulating, the curds were cut to 15 mm, and stirred at 33°C for 15 min. Next, the curd and whey mixture was allowed to stand for 20 min, after that the whey was removed by the curds and whey were placed into the moulds. In this study, cylindrical Camembert cheese blocks (diameter = 150 mm and height = 30 mm) were manufactured and salted in 20% (w/w) brine for 15 min / 200 g. Next, the cheese was dried for 2 days to allow surface formation in the refrigerator at 4°C, and stood , sprayed with *P. candidum* dispersion solution at the room temperature(18-20°C) for 4-5 d, until the cheese surface covered with full-grown mold flora, after that ripened for 28 d at 13°C-14°C and 90-95% relative humidity (R/H), the cheeses were turning over and over periodically during ripening. Both the control and Camembert cheese contained RGP with different concentrations (0.05, 0.10, 0.15 and 0.20% / raw milk) were made in duplicates.

Measuring changes in the pH and viable cell count of the cheese

The changes in the pH during the cheese ripening process were measured every day for 28 d using a pH meter (Istek Co. Model 720p, Korea). To accomplish this, the cheese sample was mixed with saline at a 2:1 ratio (v/w) and then homogenized for 2 min at 20,000 rpm with a homogenizer (M. Zipperer GmbH, Germany), after which the pH of the solution was measured. Changes in the viable cell counts of lactic acid bacteria (LAB) during cheese ripening were evaluated by collecting cheese samples every 7 d and then mixing them with sterile saline solution at a ratio of 2:1 (40 mL saline:20 g cheese). The samples were subsequently homogenized three times for 2 min each at 20,000 rpm with a homogenizer (M. Zipper GmbH, Germany). The viable cell counts were determined by standard plate count agar methods (Richardson, 1985). Serially diluted aliquots of the samples were subsequently plated on BCP agar (Eiken Chemical Co., Ltd., Japan) and YM agar (Difco Ltd., France), after which they were incubated for 48 h at 37°C. Plates containing 30-300 colonies were counted, and the results presented as the log of the viable counts in CFU/g.

Antioxidant activity by radical (DPPH) inhibition assay

The DPPH radical scavenging activity assays were conducted according to a modified version of the method described by Blois (1958) and Apostolidis (2007). Briefly, 3 mL of 60 μM DPPH in ethanol were amended with 250 μL of each homogenized water extract, after which the decrease in absorbance was monitored at 517 nm until a constant reading was obtained. The readings were then compared with those of the controls, which contained 250 μL of water instead of the extract. The% inhibition was subsequently calculated as follows:

% inhibition = [(control - extract)/control)] × 100

$ABTS^+$ radical scavenging activity

The modified method described by Erel (2004) was applied to evaluate $ABTS^+$ radical scavenging activity. Before analyzing the samples, 6 mM ABTS (2,2'-azinbis-(3-ethyl-benzothiazoline-6-sulfonic acid) was reacted with 2.45 mM potassium persulfate to form $ABTS^+$ after 14 h in the dark. $ABTS^+$ had an absorbance of 0.70 ± 0.02 at 734 nm when diluted $ABTS^+$ in ethanol. A 20 μL aliquot of the sample was then added to 3.0 mL of diluted $ABTS^+$ solution. In addition, a blank consisting of ethanol instead of sample was analyzed for comparison. The $ABTS^+$ radical scavenging activity of

samples was determined based on the absorbance measured with a UV spectrometer at 734 nm as follows:
$ABTS^+$ radical scavenging activity (%) = [(ABS control - ABS sample)/ABS control] × 100

Total phenolic content

The total phenolic content was determined by modified version of the assay described by Shetty et al. (1995). Briefly, 1.0 mL of homogenized (M. Zipper GmbH, Germany) water extract was transferred into a test tube and mixed with 1.0 mL of 95% ethanol and 5.0 mL of distilled water. To each sample, 0.5 mL of 50% (v/v) Folin-Ciocalteu reagent was supplemented and mixed. After 5 min, 1.0 mL of 5% Na_2CO_3 was added to the reaction mixture and allowed to stand for 60 min. The absorbance was then read at 725 nm (Spectrophotometer, Optizen 1412V, Korea), converted to total phenolics and expressed in microgram equivalents of gallic acid per gram (g) of sample. Standard curves were established using various concentrations of gallic acid (Sigma-Aldrich, USA) in water ($y = 0.0743 x - 0.0199$, $R^2 = 0.995$).

Ginsenosides analysis

Ginsenosides analysis was conducted using a modified version of the method described by Wang et al. (2005). The ginsenosides was analyzed by the 0.15% sample, which is the average sample point of the added RGP, except for the control. After took the cheese sample (10 g) to the funnel, n-Hexane (100 mL) and 70% methanol (100 mL) were added, after which the samples was subjected to shaking extraction for three hours. Next, the sample was filtered through (Whatman No. 1 filter paper. After fixing it until the layer was completely separated, the lower layer was moved to a round-bottom flask. After decompressing /concentrating it in water and then dissolving the concentrate in methanol (3.0 mL), methanol (5 mL) was injected to the Sep-Pak C18 Cartridge (Phenomenes, Inc., USA). The sample was then washed by injecting DW (5.0 mL) again, after which the sample solution was injected into the cartridge. After washing with DW (5.0 mL), methanol (5.0 mL) was injected again, which was used as a sample solution. This sample solution was then used for HPLC analysis after being filtered through a 0.45 μm membrane filter (Toyo Roshi Kaisha, Ltd., Japan). The HPLC conditions for the analysis of ginsenosides are method based on Kim et al. (2007). A Hitachi HPLC system (Japan) consisted of a chromatographic pump (e-2695), autosampler (L-7200) and UV-VIS detector (2489) was employed for the HPLC analysis of ginsenoside. The Waters Atlantis column (4.6 mm ID x 150 mm, 5 ㎛ particle size) and a binary solvent system of (A) deionized water (B) acetonitrile with flow rate of 1.0 mL /min was used for separation. The solvent gradient condition was 80% A and 20% B initially, raised to 20% B at 5 min, 40% B at 30 min, 60% B at 45 min, 90% B at 55 min, 90% B at 65 min, 65% at 50 min, 100% B at 51 min and maintained until 61 min. The column temperature was maintained at 35°C and the detection was wavelength at 203 nm.

Free fatty acids (FFA) analysis

The total fat was extracted according to the method described by Folch et al. (1957) and the analytical method for food ingredients grade (Ministry of Food and Drug Safety, 2016). Briefly, after putting cheese (1.0 g) in a Mojonnier tube and then adding pyrogallol (antioxidant, about 100 mg), internal standard solution (triundecanoin ($C_{11:0}$), 2.0 mL) was added. Next, ethanol (2.0 mL) was added and the sample was blended until completely mixed. After adding deionized water (4.0 mL) and ammonium hydroxide (2.0 mL) (58% (w/w)), the sample was stirred, sealed in the Mojonnier tube, and allowed to decompose for 20 min while stirring in a water bath(70°C-80°C). Next, 12 M hydrochloric acid solution (10 mL) was added and the sample was allowed to decompose for 20 min. To make it easy to separate the solution when extracting

ether, the bottom part of the Mojonnier tube was filled with ethanol and then mixed slowly. Diethyl ether (25 mL) was then added to the solvent, shaking extraction was conducted for five minutes. Acetic petroleum ether (25 mL) was then added, after which shaking extraction was conducted for another five minutes. Next, the layers were separated by allowing the sample to stand for more than one hour, after which the moisture was removed with Na_2SO_4. The ether was then slowly evaporated under a nitrogen stream while the samples were held in a water bath (35°C-40°C). After melting the extracted fat with chloroform (2.0 mL) and diethyl ether (2.0 mL), it was moved to a 15 mL glass test tube, then subjected to nitrogen enrichment in a water bath (40°C). Next, 7.0% trifluoroborane methanol solution (2.0 mL) and toluene(1.0 mL) were added, after which the sample was mixed by light shaking. The tube was then sealed and heated in an oven (100°C) for 45 min. The sample was subsequently rapidly cooled to room temperature, after which it was amended with DW (5.0 mL), hexane (1.0 mL) and acetic sodium sulfate (about 1.0 g), shaken and fixed. The separated supernatant was then removed and placed in a vial containing acetic sodium sulfate (about 1.0 g), after which it was dehydrated and used as the test solution.

The extracted and dehydrated hexane was transferred to a vial for analysis. Separation and quantification of the fatty acid methyl esters was conducted using a gas chromatograph (GC, Agilent 7890A, Agilent Technologies, Korea) equipped with a flame ionization detector automatic sample injector G4513A and a SP™ 2560 fused silica capillary column (100 mm, 0.25 mm i.d., 0.2 μm film thickness, Supleco). Helium was applied as the carrier gas at a linear flow of 1.0 mL/min and the injection volume was 1.0 mL. The oven temperature was initially held at 140°C for 5 min, then increased by 4.0°C/min to 240°C, where it was held for 10 min. The injector (split mode) and detector temperatures were maintained at 260°C. The fatty acid methyl ester (FAME) in the total lipids were identified by comparison of the retention times with those of a standard FAME mixture (Supleco TM 37 Composition FAME Mix, Catalogue number 47885-UP, Lot number, LB-95903. Sigma-Aldrich Inc., USA). Fatty acids were expressed as a percentage of total fatty acids identified and grouped as follows: SFA, MUFA and PUFA. Finally, the PUFA/SFA to n-6/n03 ratios were calculated.

Free amino acid (FAA) analysis

The free amino acid analysis of the Camembert cheese was extracted using an AccQ · Tag Reagent Kit according to the manufacturer's instructions (Waters; Milford, MA, USA). Those are shown in Table 2.

Table 2. HPLC operating conditions for free amino acids analysis in cheese

Items	Conditions		
Mobile phase	A: aqueous buffer, Waters AcccQ-Tag Eluent A B: 60% acetonitrile		
Column	Nova-PAK™C_{18}, 4 μm		
Column temperature	37°C		
Flow rate	1 mL/min		
Detector	Excitation wavelength: 250 nm Emission wavelength: 395 nm		
Time (min)	Flow rate	A (%)	B (%)
Initial	1.0	100	0
0.5	1.0	98	2

Table 2. HPLC operating conditions for free amino acids analysis in cheese (continued)

Time (min)	Flow rate	A (%)	B (%)
15	1.0	93	7
19	1.0	90	10
32	1.0	67	33
33	1.0	67	33
34	1.0	0	100
37	1.0	0	100
38	1.0	100	0
64	1.0	100	0
65	1.0	0	100
100	1.0	0	100

Chemical composition analysis

The chemical composition was measured based on when the mold spores are applied to the cheese surface as a whole. Petri dishes (90 mm × 15 mm) were filled with cheese, after which the fat, protein, moisture, salinity, and total solid contents were measured using a FoodScan™ dairy analyzer (Hillerød Inc., Denmark).

Measurement of cheese color

The cheese color was measured based on when the mold spores are applied to the cheese surface as a whole. Color analysis was conducted based on the method described by Perkins-Veazie et al. (2001). Color values were compared the control and the RGP supplemented Camembert cheese using a Color Meter ZE 2000 (Nippon Denshoku Co. Ltd., Japan). after calibrating its original value with a standard plate (L = 96.88, a = -0.16 and b = -0.29). Measured L*, a* and b* values were used as indicators of lightness (white-black), redness(+)/green(-) and yellowness, respectively. All samples were measured five times.

Sensory evaluation

Sensory evaluation was conducted using a total of 11 panelists from the Department of Animal Science and Technology at Sunchon National University were included. The cheese used for the test was ripened for 14 d, 21 d and 28 d, after which samples were evaluated for the following sensory characteristics: pungent, buttery, moldy, sweaty, sweet, sour, salty, bitter, burning, texture and total acceptability using a 9 point hedonic scale ranging from 1 (dislike extremely) to 9 (like extremely). Samples (15 g) were given to the panelists on a white plastic plate.

Statistical analysis

All experimental data were analyzed in accordance with the General Linear Model (GLM) procedure established by the Statistics Analysis Systems Institute employing polynomial analysis (Version 9.1; SAS Ins. Inc., Cary, NC, USA). Data are presented as the means ± standard deviation from three replicates but color (n=5), chemical composition (n=4) and sensory value data were n=13. Differences between means were identified by Duncan's multiple range test. A $p<$ 0.05 was considered to indicate significance.

Results and Discussion

Changes in the pH and viable cell count of the cheese

The changes in the pH values and viable cell count observed during the ripening procedure are shown in Table 3. The changes in pH during the ripening of Camembert added with RGP increased as the ripening period progressed. The pH values of the experimental group ranged from 4.84-4.92 on d 0, then gradually increased to 5.91-6.21 when ripening ended on d 28. *Penicillium camemberti* as a metabolizes lactate and produces ammonia by proteolysis generating a pH gradient from the surface to the core of the Camembert cheese that is responsible for the softening of the cheese, and changes in cheese pH significantly affect the texture of the final product (Daniela et al., 2011). Other cheeses are ripened for more than 6 months undergoes increasing pH owing to increases in nitrogen inside the cheese due to proteolysis by lactic acid bacteria (LAB). An increase in pH during ripening can be caused by decarboxylation and deamination of amino acids in cheese (Bachmann, 1999). The LAB and yeast count in the experimental group was log 7.30-9.39 CFU/g during the ripening period, gradually increasing in all RGPs as ripening progressed (p<0.05). The number of LAB in the control and 0.05% RGP was higher than in other groups during ripening. These findings indicate that adding RGP to the cheese did not adversely affect the LAB and yeast count. All experimental groups were increased with similar to a growth curve of general microorganism, and then gradually increased during the ripening period (p< 0.05). Fleet (1990) reported that yeast is naturally produced when producing camembert cheese or blue cheese. In this study, yeast was not inoculated and the result showed yeast count similar to that of Fleet (1990). Yeast is an important part of the micro-flora of the surface-ripened cheeses. The most important species of yeasts isolated from Camembert (Lenoir, 1984) participate in the ripening process of other surface-ripened cheeses such as *K. lacis, K. marxianus, D. hansenii* and their imperfect forms,

Table 3. Change in pH, lactic acid bacteria and yeast counts of the Camembert cheese contained with RGP

		Ripening period (d)				
		0*	7	14	21	28
pH	Con.	4.84 ± 0.01^{bcE}	5.55 ± 0.01^{aD}	6.01 ± 0.01^{abA}	5.75 ± 0.01^{cC}	5.91 ± 0.03^{cB}
	0.05%	4.92 ± 0.01^{abD}	5.40 ± 0.02^{bC}	5.89 ± 0.09^{bB}	6.06 ± 0.02^{bA}	6.18 ± 0.02^{aA}
	0.10%	4.81 ± 0.04^{cC}	5.17 ± 0.03^{cdB}	6.01 ± 0.04^{abA}	5.99 ± 0.01^{bA}	6.00 ± 0.02^{bA}
	0.15%	4.91 ± 0.03^{abD}	5.19 ± 0.02^{cC}	5.59 ± 0.06^{cB}	5.83 ± 0.06^{cA}	5.96 ± 0.03^{bcA}
	0.20%	4.92 ± 0.02^{aD}	5.11 ± 0.03^{dC}	6.09 ± 0.03^{aB}	6.17 ± 0.01^{aA}	6.21 ± 0.01^{aA}
LAB	Con.	7.00 ± 0.01^{cC}	9.32 ± 0.06^{abA}	9.38 ± 0.01^{aA}	9.17 ± 0.01^{aAB}	8.96 ± 0.16^{aB}
	0.05%	7.10 ± 0.06^{cC}	9.39 ± 0.03^{aA}	9.38 ± 0.03^{aA}	9.28 ± 0.05^{aA}	8.62 ± 0.05^{bB}
	0.10%	7.93 ± 0.46^{abB}	8.75 ± 0.06^{cA}	8.44 ± 0.06^{dAB}	9.13 ± 0.01^{aA}	8.83 ± 0.07^{abA}
	0.15%	7.27 ± 0.08^{bcC}	9.12 ± 0.01^{bA}	9.14 ± 0.01^{bA}	8.69 ± 0.11^{bB}	8.60 ± 0.11^{bB}
	0.20%	8.17 ± 0.02^{aB}	8.88 ± 0.11^{cA}	8.57 ± 0.04^{cA}	7.40 ± 0.20^{cC}	7.30 ± 0.06^{cC}
Yeast	Con.	6.73 ± 0.12^{nsC}	8.07 ± 0.14^{bB}	8.31 ± 0.03^{nsAB}	8.25 ± 0.01^{abcAB}	8.38 ± 0.03^{aA}
	0.05%	6.43 ± 0.18^{B}	8.19 ± 0.01^{abA}	8.20 ± 0.07^{A}	8.15 ± 0.01^{bcA}	8.32 ± 0.02^{aA}
	0.10%	6.50 ± 0.15^{B}	8.19 ± 0.01^{abA}	7.98 ± 0.37^{A}	8.44 ± 0.07^{aA}	7.73 ± 0.20^{bA}
	0.15%	6.37 ± 0.22^{C}	8.42 ± 0.05^{aA}	7.92 ± 0.21^{B}	8.28 ± 0.02^{abAB}	8.36 ± 0.01^{aAB}
	0.20%	6.53 ± 0.12^{C}	7.53 ± 0.13^{cB}	8.18 ± 0.18^{A}	8.01 ± 0.15^{cA}	8.33 ± 0.03^{aA}

RGP: red ginseng powder.
CFU: colony-forming units.
*0 day means the sample obtained at 48 hours after cheese making.
The data are presented as the means ± S.D. (n=3). $^{ns; NS}$: not significant. $^{a-e}$ Different letters in the same column indicate significant differences between cheeses (p<0.05). $^{A-E}$ Different letters in the same row indicate significant differences between weeks of ripening (p<0.05).

S. cerevisiae, G. candidum, C. catenulate and *Y. lipolyica*. *D. hansenii* constitutes a major part of the surface microbiota of red smear cheeses (Besancon et al., 1992; Elikases-Lechner & Ginzinger, 1995). In addition, *D. hansenii* has the capability to metabolize lactose, to utilize multiple organic carbon and nitrogen sources and to generate an alcoholic, acidic and cheese flavor (Valdes-Stauber et al., 1997; Viljoen et al., 1995; Welthagen et al., 1998).

Antioxidant activity

The changes in the antioxidant activity observed during the ripening procedure are shown in Table 4. The DPPH activity of the 0.15% RGP and 0.20% RGP increased as the ripening period progressed, but that of control, 0.05% RGP and 0.10% RGP decreased at 21 d to 28 d (p<0.05). Moreover, the antioxidant activity of the 0.15% RGP was highest at 21 d to 28 d. Similar results were observed for the ABT, although the highest value was observed in the 0.10% RGP treatment from 7 d to 21 d. The TP value also increased as the ripening period progressed, with the 0.2% treatment having the highest value at 0 d and 7 d, and no significant differences being observed from 14 d to 28 d. Phenolic phytochemicals are secondary metabolites of plant origin that constitute an important part of both human and animal diets (Shetty et al., 2005).

Total ginsenosides

The total ginsenosides observed procedure are shown in Table 5. The total ginsenosides of the cheese added with 0.15% RGP was 10,999.7 ± 314.03. Additionally, Rs1 (20s) and Protopanxatriol (20s) were the ginsenosides present in greatest abundance.

Table 4. Changes in DPPH radical scavenging activity, ABTS radical scavenging activity, and total phenolic acid concentration of the Camembert cheese contained with RGP

E[1)]		Ripening period (d)				
		0	7	14	21	28
A	Con.	13.3 ± 0.1^{dC}	39.3 ± 0.8^{bB}	66.1 ± 5.4^{aA}	60.5 ± 2.9^{bA}	33.0 ± 5.1^{cB}
	0.05%	15.6 ± 0.5^{cD}	52.3 ± 3.1^{aBC}	66.0 ± 8.2^{aAB}	79.3 ± 3.1^{aA}	41.9 ± 8.6^{cC}
	0.10%	25.2 ± 0.8^{aD}	36.5 ± 1.4^{bC}	49.1 ± 0.5^{bB}	59.2 ± 0.9^{bA}	45.7 ± 1.5^{cB}
	0.15%	20.6 ± 0.6^{bD}	42.6 ± 6.9^{abC}	54.9 ± 0.6^{abB}	80.9 ± 1.8^{aA}	82.7 ± 1.8^{aA}
	0.20%	20.5 ± 0.5^{bC}	38.7 ± 0.9^{bB}	65.1 ± 2.3^{aA}	64.7 ± 2.9^{bA}	64.7 ± 0.5^{bA}
B	Con.	16.09 ± 0.05^{eE}	17.09 ± 0.05^{eD}	32.71 ± 0.05^{eC}	42.59 ± 0.05^{eB}	57.68 ± 0.05^{dA}
	0.05%	23.59 ± 0.09^{dE}	42.93 ± 0.05^{cD}	52.19 ± 0.05^{cC}	59.26 ± 0.09^{dB}	62.22 ± 0.09^{cA}
	0.10%	24.25 ± 0.05^{cE}	53.10 ± 0.05^{aD}	54.87 ± 0.08^{aC}	69.53 ± 0.09^{aB}	73.25 ± 0.05^{bA}
	0.15%	25.93 ± 0.08^{bE}	33.04 ± 0.05^{dD}	50.23 ± 0.05^{dC}	66.09 ± 0.05^{bB}	73.11 ± 0.05^{bA}
	0.20%	28.12 ± 0.05^{aE}	45.31 ± 0.05^{bD}	53.34 ± 0.05^{bC}	63.22 ± 0.05^{cB}	76.93 ± 0.08^{aA}
C	Con.	29.66 ± 6.0^{bD}	70.94 ± 1.0^{abC}	87.56 ± 5.4^{nsB}	98.80 ± 3.0^{nsAB}	109.80 ± 1.9^{nsA}
	0.05%	35.87 ± 6.9^{bC}	74.32 ± 4.3^{aB}	84.39 ± 0.8^{B}	107.03 ± 7.4^{A}	118.44 ± 8.2^{A}
	0.10%	45.00 ± 3.5^{abD}	62.80 ± 3.2^{bC}	80.40 ± 6.5^{B}	101.00 ± 6.2^{A}	114.12 ± 7.0^{A}
	0.15%	39.25 ± 4.2^{bD}	71.10 ± 1.5^{abC}	85.87 ± 6.1^{BC}	98.44 ± 3.8^{B}	120.10 ± 7.9^{A}
	0.20%	60.10 ± 1.3^{aC}	74.12 ± 2.2^{aB}	81.62 ± 3.6^{B}	98.24 ± 3.7^{A}	107.90 ± 3.8^{A}

RGP: red ginseng powder.
[1)]A-DPPH radical scavenging activity (%), B-ABTS radical scavenging (%), C-total phenolic acid concentration (mg/g).
[2]: Concentration of sample, T1: Control, T2: 0.05%, T3: 0.10%, T4: 0.15%, T5: 0.20% with supplemented RGP.
The data are presented as the means ± S.D. (n=3). $^{ns; NS}$: not significant. $^{a-e}$ Different letters in the same column indicate significant differences between cheeses (p<0.05). $^{A-E}$ Different letters in the same row indicate significant differences between weeks of ripening (p<0.05).

Table 5. Ginsenosides compounds of the Camembert cheese contained with 0.15% RGP (Units: ppm)

Rg1	Rf	Rs1 (20s)	Rh1 (20r)
428.82 ± 46.29	309.52 ± 17.99	1,292.69 ± 39.69	384.78 ± 38.25
Rb1	Rc	Rb2	Rd
240.46 ± 34.47	866.30 ± 113.90	120.10 ± 12.74	332.10 ± 54.74
Protopanxatriol (20S)	Rg3 (20s)	Rg3 (20r)	Compound K
5,635.33 ± 79.52	384.05 ± 12.61	226.79 ± 1.46	516.53 ± 55.03
Rh2 (20S)	Rh2 (20r)	Total content	
117.19 ± 12.88	145.01 ± 24.57	10,999.7 ± 314.7	

The data are presented as the means S.D. ± (n=3).

Total free fatty acids contents during ripening

The changes in total free fatty acids contents during ripening are shown in Table 6. Controls, C14:0, C15:0, C16:0, C17:0, C18:0, C14:1 and C18:1n-9,Cis, increased with ripening, while C4:0, C6:0, C8:0, C10:0, C12:0, C18:1n-9,trans, C18:2n-6, trans and C16:1 were increased at 14 d, then decreased. In the 0.15% treatment, C6:0, C8:0, C10:0, C18:1n-9,trans and C18:2n-6,trans decreased as the ripening period progressed, while C14:0, C15:0, C16:0, C17:0, C18:0, C14:1, C16:1 and C18:1n-9,Cis increased. When the control was compared with the 0.15% RGP, the saturated fat (SF) was not significant at 0 d and 28 d. The TF and MuSF was higher in the control than the 0.15% RGP, while the opposite was true for C14:1 and C16:1.

Table 6. Changes in free fatty acids profiles of the Camembert cheese contained with RGP during ripening

(mg/g)	Control			RGP (0.15%) added		
	0 d	14 d	28 d	0 d	14 d	28 d
C4:0	6.50 ± 0.11^{bB}	8.36 ± 0.43^{aA}	6.56 ± 0.72^{bB}	6.36 ± 0.23^{nsB}	7.00 ± 0.50^{AB}	7.70 ± 0.75^{AB}
C6:0	1.40 ± 0.11^{bB}	1.90 ± 0.10^{aA}	1.43 ± 0.13^{bB}	1.63 ± 0.03^{aB}	1.36 ± 0.03^{bB}	1.43 ± 0.03^{bB}
C8:0	1.63 ± 0.03^{cD}	2.00 ± 0.00^{aA}	1.90 ± 0.00^{bB}	1.80 ± 0.00^{aC}	1.76 ± 0.03^{aC}	1.50 ± 0.05^{bE}
C10:0	4.46 ± 0.03^{cC}	5.40 ± 0.00^{aA}	5.23 ± 0.03^{bA}	4.83 ± 0.03^{abB}	4.96 ± 0.08^{aB}	4.53 ± 0.12^{bC}
C12:0	9.63 ± 0.08^{cC}	11.43 ± 0.03^{aA}	11.16 ± 0.03^{bA}	10.26 ± 0.06^{nsB}	10.60 ± 0.23^{B}	10.53 ± 0.23^{B}
C14:0	17.40 ± 0.15^{bC}	18.36 ± 0.03^{bB}	19.66 ± 0.51^{aA}	17.23 ± 0.12^{bC}	18.23 ± 0.12^{aB}	18.50 ± 0.15^{aB}
C15:0	0.86 ± 0.03^{bC}	1.10 ± 0.00^{aB}	1.03 ± 0.03^{aB}	1.00 ± 0.00^{bBC}	0.96 ± 0.03^{bBC}	2.53 ± 0.08^{aA}
C16:0	39.9 ± 0.43^{bC}	40.63 ± 0.73^{bC}	46.80 ± 0.15^{aA}	40.23 ± 0.37^{bC}	43.93 ± 0.98^{aB}	45.70 ± 0.58^{aAB}
C17:0	1.90 ± 0.05^{bB}	2.03 ± 0.03^{bB}	2.23 ± 0.06^{aB}	1.93 ± 0.03^{bB}	2.20 ± 0.05^{bB}	4.10 ± 0.51^{aA}
C18:0	6.63 ± 0.12^{cD}	7.66 ± 0.06^{bB}	8.60 ± 0.15^{aA}	6.63 ± 0.17^{cD}	7.20 ± 0.11^{bC}	8.70 ± 0.10^{aA}
SF	90.33 ± 0.56^{cC}	98.9.30 ± 0.35^{bB}	104.63 ± 0.38^{aA}	91.93 ± 0.47^{cC}	98.23 ± 1.18^{bB}	105.23 ± 1.31^{aA}
C18:1n-9,trans	8.43 ± 0.08^{cC}	10.03 ± 0.03^{aA}	9.83 ± 0.03^{bA}	9.00 ± 0.05^{aB}	9.33 ± 0.20^{aB}	7.10 ± 0.15^{bD}
C18:2n-6,trans	0.10 ± 0.00^{bB}	0.13 ± 0.03^{aB}	0.20 ± 0.00^{bA}	0.20 ± 0.00^{aA}	0.10 ± 0.00^{bB}	0.10 ± 0.00^{bB}
TF	8.53 ± 0.08^{bC}	10.16 ± 0.06^{aA}	10.06 ± 0.06^{aA}	9.13 ± 0.03^{aB}	9.43 ± 0.20^{aB}	7.20 ± 0.15^{bD}
C14:1	1.23 ± 0.03^{bE}	1.50 ± 0.00^{aB}	1.43 ± 0.03^{aBC}	1.30 ± 0.00^{bDE}	1.36 ± 0.03^{bCD}	1.96 ± 0.03^{aA}
C16:1	0.50 ± 0.00^{bB}	0.60 ± 0.00^{aA}	0.53 ± 0.03^{bB}	0.50 ± 0.00^{bB}	0.50 ± 0.00^{bB}	0.63 ± 0.03^{aA}
C18:1n-9,Cis	21.16 ± 0.31^{bB}	22.43 ± 0.37^{abB}	23.90 ± 0.76^{aA}	13.20 ± 0.15^{cE}	14.73 ± 0.44^{bD}	17.23 ± 0.37^{aC}
MuSF	22.90 ± 0.31^{bB}	24.53 ± 0.63^{aA}	25.86 ± 0.74^{aA}	15.00 ± 0.15^{cE}	16.60 ± 0.41^{bD}	19.83 ± 0.42^{aC}

The data are presented as the means ± S.D. (n=3). $^{ns; NS}$: not significant. $^{a-e}$ Different letters in the same column indicate significant differences between cheeses (p<0.05). $^{A-E}$ Different letters in the same row indicate significant differences between weeks of ripening (p<0.05).

Total free amino acid contents during ripening

The changes in the total amino acid contests during the ripening procedure are shown in Table 7. The FAA increased in the control and 0.15% RGP as the ripening period progressed, with the control having higher values throughout the ripening. The tendency for levels of nitrogen compounds to increase during the ripening of cheese has also been noted by Bergamini et al. (2006) and Tejada et al. (2008). Lactic acid bacteria were involved in protein degradation during the ripening of cheese, and 0.15% RGP showed lower lactic acid bacteria counts from 7 to 28 days of ripening than the control. Therefore, total amino acid value was lower than that of the control.

Table 7. Changes in free amino acids content of the Camembert cheese contained with RGP during ripening

FAAs (mg/kg)	Control			RGP (0.15%) added		
	0 d	14 d	28 d	0 d	14 d	28 d
ASP	43.1 ± 2.1^{bCD}	47.7 ± 1.9^{bBC}	56.6 ± 1.6^{aA}	36.0 ± 0.9^{bE}	40.3 ± 1.9^{bDE}	50.8 ± 1.6^{aB}
SER	52.7 ± 1.9^{bBC}	57.8 ± 1.6^{bB}	65.6 ± 1.0^{aA}	45.8 ± 0.9^{bD}	48.3 ± 1.9^{abCD}	53.9 ± 2.0^{aB}
GLU	129.9 ± 6.4^{bBC}	144.14 ± 5.6^{bB}	171.0 ± 4.5^{aA}	108.6 ± 2.4^{bD}	120.3 ± 4.6^{bCD}	144.8 ± 4.3^{aB}
GLY	24.2 ± 0.5^{bBC}	25.3 ± 0.5^{bB}	30.6 ± 0.5^{aA}	21.5 ± 0.3^{bC}	23.8 ± 1.7^{abBC}	26.4 ± 0.9^{aB}
HIS	16.4 ± 0.6^{bBC}	17.5 ± 0.1^{bB}	20.8 ± 0.3^{aA}	14.3 ± 0.1^{bD}	15.2 ± 0.7^{bCD}	16.9 ± 0.5^{aB}
ARG	19.1 ± 1.1^{nsA}	20.6 ± 0.2^{A}	20.6 ± 0.4^{A}	16.0 ± 0.3^{bC}	16.9 ± 0.7^{abBC}	19.0 ± 0.9^{aAB}
THR	29.8 ± 1.0^{cBC}	33.3 ± 1.1^{bB}	38.3 ± 0.5^{aA}	25.8 ± 0.2^{bD}	27.2 ± 1.3^{bCD}	31.8 ± 1.8^{aB}
ALA	31.8 ± 0.9^{bC}	33.6 ± 0.3^{bbC}	40.6 ± 0.6^{aA}	27.6 ± 0.5^{bD}	30.3 ± 1.6^{bCD}	35.9 ± 1.8^{aB}
PRO	91.0 ± 3.3^{bb}	99.8 ± 1.2^{bbC}	120.2 ± 3.1^{aA}	77.6 ± 1.3^{bD}	99.0 ± 3.7^{abC}	108.6 ± 8.5^{aAB}
TYR	35.1 ± 0.4^{cCD}	38.0 ± 0.2^{bAB}	40.8 ± 1.2^{aA}	31.2 ± 0.1^{bE}	32.3 ± 0.6^{bDE}	36.9 ± 1.7^{abC}
VAL	46.0 ± 1.8^{cCD}	50.9 ± 0.7^{bb}	60.2 ± 0.9^{aA}	40.6 ± 0.7^{bE}	43.6 ± 1.9^{abDE}	49.2 ± 2.1^{abC}
MET	18.4 ± 0.7^{bbC}	19.8 ± 0.3^{bb}	22.7 ± 0.3^{aA}	15.9 ± 0.3^{bD}	17.0 ± 0.8^{bCD}	19.7 ± 0.5^{aB}
LYS	48.5 ± 2.6^{bbC}	52.7 ± 1.2^{bb}	65.0 ± 1.3^{aA}	42.4 ± 1.0^{bC}	46.5 ± 1.8^{abbC}	53.7 ± 3.8^{aB}
ILE	34.0 ± 1.4^{cbC}	37.2 ± 0.3^{bb}	44.8 ± 0.6^{aA}	29.7 ± 0.4^{bD}	32.2 ± 1.1^{abCD}	35.6 ± 1.8^{abC}
LEU	67.7 ± 2.9^{cBC}	74.3 ± 0.7^{bb}	84.8 ± 1.2^{aA}	57.8 ± 1.1^{bD}	62.8 ± 2.8^{bCD}	71.7 ± 2.9^{aB}
PHE	30.7 ± 0.4^{bb}	33.4 ± 0.4^{bb}	37.9 ± 0.6^{aA}	26.3 ± 0.3^{bC}	27.7 ± 1.2^{bC}	31.4 ± 1.3^{aB}
Total	834.8 ± 30.9^{bC}	913.9 ± 21.2^{bb}	1096.1 ± 22.6^{aA}	730.9 ± 13.8^{cD}	833.5 ± 13.6^{bC}	941.3 ± 16.1^{aB}

The data are presented as the means ± S.D. (n=3). $^{ns; NS}$: not significant. $^{a-e}$ Different letters in the same column indicate significant differences between cheeses (p<0.05). $^{A-E}$ Different letters in the same row indicate significant differences between weeks of ripening (p<0.05).

Chemical composition analysis

The general ingredients of Camembert cheese added with RGP shown in Table 8. The content of RGP varied depending on the amount of milk, which did not have a large impact on the general ingredients of the final product. The fat and protein comprised 29% and 18-20% of the final product, respectively, In the results of batch, there were no significant differences of the experimental group (p<0.05).

Table 8. Chemical composition of the Camembert cheese[1)] contained with RGP (Units: %)

	Fat	Moisture	Protein	Salt	Total solid
Control	29.85 ± 0.06^{ab}	47.03 ± 0.05^{b}	20.58 ± 0.05^{a}	1.75 ± 0.01^{b}	52.97 ± 0.05^{a}
0.05%	29.92 ± 0.03^{a}	47.47 ± 0.02^{a}	20.21 ± 0.04^{b}	1.72 ± 0.01^{b}	52.53 ± 0.02^{b}
0.10%	29.45 ± 0.18^{cd}	47.51 ± 0.13^{a}	19.24 ± 0.11^{d}	1.74 ± 0.01^{b}	52.49 ± 0.13^{b}
0.15%	29.13 ± 0.11^{d}	47.43 ± 0.03^{a}	19.64 ± 0.07^{c}	1.81 ± 0.02^{a}	52.07 ± 0.15^{c}
0.20%	29.57 ± 0.07^{bc}	47.41 ± 0.18^{a}	18.71 ± 0.08^{e}	1.63 ± 0.02^{c}	49.84 ± 0.13^{d}

RGP : red ginseng powder.
[1)]The cheese samples used for the test had been ripened for 14 d.
The data are presented as the means ± S.D. (n=3). Mean values followed by different superscript letters in each a column are significantly different (p<0.05).

Measurement of cheese color

The color of Camembert cheese added with RGP shown in Table 9. The result showed that the L* value decreased significantly with increasing concentration of RGP in cheese, while the a* and b* values increased significantly increased (p<0.05).

Table 9. Color of Camembert cheese[1)] contained with RGP

	Color attribute		
	L*	a*	b*
Control	65.93 ± 0.04[a]	-2.97 ± 0.01[e]	8.26 ± 0.02[d]
0.05%	62.67 ± 0.01[b]	-2.32 ± 0.01[d]	8.24 ± 0.02[d]
0.10%	62.80 ± 0.15[b]	-1.76 ± 0.01[c]	9.10 ± 0.01[c]
0.15%	60.91 ± 0.03[c]	-1.59 ± 0.01[b]	10.78 ± 0.01[b]
0.20%	60.49 ± 0.03[d]	-1.36 ± 0.01[a]	11.04 ± 0.01[a]

RGP: red ginseng powder.
[1)]The cheese samples used for the test had been ripened for 14 d.
The data are presented as the means ± S.D. (n=3). Mean values followed by different superscript letters in each a column are significantly different (p<0.05).

Sensory evaluation

The sensory evaluation of Camembert cheese added with RGP shown in Table 10. The buttery, moldy, sweaty and salty characteristics did not differ among experimental groups, but the pungent, sour, bitter and burning characteristics were higher in the treatment group than the control. Conversely, the sweetness, texture and total acceptability were higher in the control than the treatment groups at 12 d. buttery, moldy, sweet, sour and salty were no significant difference, and just like 14 d, texture and total acceptability were higher at control than experimental groups. The results observed at 28 d were identical to those observed at 7 d and 14 d.

Table 10. Sensory evaluation of the Camembert cheese contained with RGP

R	T	Con.	0.05%	0.10%	0.15%	0.20%
14 (d)	Pungent	1.6 ± 0.2[b]	3.6 ± 0.5[ab]	3.7 ± 0.8[ab]	4.4 ± 0.7[a]	5.8 ± 1.0[a]
	Buttery	4.2 ± 0.6[ns]	4.5 ± 0.6	3.1 ± 0.7	4.1 ± 0.6	2.6 ± 0.8
	Moldy	4.2 ± 0.7[ns]	5.3 ± 0.5	4.8 ± 0.8	5.8 ± 0.7	4.6 ± 1.2
	Sweaty	3.8 ± 0.6[ns]	3.0 ± 0.4	5.0 ± 0.7	5.1 ± 0.6	4.5 ± 0.6
	Sweet	4.4 ± 0.5[a]	2.2 ± 0.4[b]	2.0 ± 0.2[b]	2.2 ± 0.5[b]	2.0 ± 0.6[b]
	Sour	2.6 ± 0.6[b]	2.8 ± 0.7[b]	5.5 ± 0.8[a]	5.2 ± 0.7[a]	5.3 ± 0.8[a]
	Salty	3.5 ± 0.5[ns]	3.8 ± 0.6	4.7 ± 0.7	4.8 ± 0.4	4.1 ± 0.8
	Bitter	1.7 ± 0.3[c]	6.1 ± 0.7[b]	6.1 ± 0.5[b]	8.1 ± 0.3[a]	8.5 ± 0.3[a]
	Burning	1.2 ± 0.1[b]	4.0 ± 0.8[a]	5.8 ± 0.7[a]	4.1 ± 0.9[a]	4.8 ± 0.7[a]
	Texture	5.4 ± 0.4[a]	5.8 ± 0.7[a]	4.4 ± 0.4[ab]	4.3 ± 0.5[ab]	2.8 ± 0.7[b]
	Total acceptability	7.1 ± 0.5[a]	3.8 ± 0.5[b]	2.2 ± 0.4[bc]	2.3 ± 0.6[bc]	1.8 ± 0.5[c]

Table 10. Sensory evaluation of the Camembert cheese contained with RGP (continued)

R	T	Con.	0.05%	0.10%	0.15%	0.20%
21 (d)	Pungent	1.3 ± 0.3^{b}	4.2 ± 0.6^{a}	4.6 ± 0.5^{a}	4.7 ± 0.8^{a}	4.5 ± 0.8^{a}
	Buttery	4.9 ± 0.5^{ns}	3.3 ± 0.6	4.1 ± 0.7	4.6 ± 0.7	4.0 ± 0.7
	Moldy	3.9 ± 0.8^{ns}	4.6 ± 0.6	4.1 ± 0.6	4.0 ± 0.8	6.1 ± 0.8
	Sweaty	2.9 ± 0.8^{b}	5.3 ± 0.5^{a}	5.0 ± 0.8^{ab}	3.7 ± 0.7^{ab}	5.5 ± 0.8^{a}
	Sweet	2.9 ± 0.5^{ns}	2.4 ± 0.6	3.0 ± 0.6	3.7 ± 0.7	3.1 ± 0.6
	Sour	2.4 ± 0.6^{ns}	3.3 ± 0.6	4.1 ± 0.6	3.9 ± 0.8	4.7 ± 0.9
	Salty	3.5 ± 0.7^{ns}	3.5 ± 0.5	4.2 ± 0.5	4.9 ± 0.7	5.1 ± 0.6
	Bitter	2.4 ± 0.6^{b}	6.1 ± 0.7^{a}	7.1 ± 0.6^{a}	6.7 ± 0.7^{a}	7.2 ± 0.7^{a}
	Burning	1.4 ± 0.4^{b}	4.7 ± 0.6^{a}	5.3 ± 0.5^{a}	5.0 ± 0.7^{a}	6.1 ± 0.7^{a}
	Texture	6.5 ± 0.4^{a}	4.5 ± 0.5^{bc}	5.5 ± 0.5^{ab}	5.8 ± 0.7^{ab}	3.8 ± 0.5^{c}
	Total acceptability	7.2 ± 0.4^{a}	4.0 ± 0.4^{b}	4.8 ± 0.4^{b}	5.0 ± 0.8^{b}	3.5 ± 0.8^{b}
R	T	Con.	0.05%	0.10%	0.15%	0.20%
28 (d)	Pungent	3.5 ± 0.6^{ns}	3.8 ± 0.7	4.8 ± 0.7	5.6 ± 0.5	5.4 ± 0.7
	Buttery	5.8 ± 0.4^{a}	3.6 ± 0.5^{b}	3.2 ± 0.3^{b}	3.7 ± 0.6^{b}	3.7 ± 0.6^{b}
	Moldy	3.8 ± 0.7^{ns}	4.8 ± 0.5	4.6 ± 0.6	5.4 ± 0.7	5.3 ± 0.6
	Sweaty	4.2 ± 0.6^{b}	5.4 ± 0.4^{ab}	5.6 ± 0.6^{ab}	6.4 ± 0.6^{ab}	5.4 ± 0.8^{a}
	Sweet	4.4 ± 0.6^{ns}	3.7 ± 0.7	2.7 ± 0.5	2.8 ± 0.5	2.5 ± 0.6
	Sour	2.7 ± 0.5^{ns}	5.1 ± 0.6	3.7 ± 0.7	5.1 ± 0.7	4.4 ± 0.7
	Salty	4.7 ± 0.6^{ns}	5.0 ± 0.4	4.8 ± 0.7	4.2 ± 0.7	4.7 ± 0.9
	Bitter	4.3 ± 0.6^{ns}	6.5 ± 0.2	5.1 ± 1.1	5.8 ± 0.8	6.5 ± 1.1
	Burning	2.1 ± 0.4^{b}	3.7 ± 0.6^{ab}	3.5 ± 0.6^{ab}	3.8 ± 0.7^{ab}	4.2 ± 0.7^{a}
	Texture	6.3 ± 0.6^{a}	5.0 ± 0.7^{ab}	4.7 ± 0.6^{ab}	5.5 ± 0.7^{ab}	3.4 ± 1.0^{b}
	Total acceptability	6.5 ± 0.5^{a}	3.6 ± 0.3^{b}	2.4 ± 0.5^{b}	2.1 ± 0.5^{b}	2.2 ± 0.5^{b}

RGP: red ginseng powder.
R: means ripening period.
T: means kind of sensory perception.
^{ns}: not significant.
The data are presented as the means ± S.D. (n=11). Mean values followed by different superscript letters in each row are significantly different (p<0.05).

Conclusions

Currently, many foods contain red ginseng, including as red ginseng concentrates, powders, tea, extracts, and beverages in Korea. Red ginseng has been shown to have anti-cancer and anti-allergic effects, as well as to improve memory improvement and attenuate impotence. We investigated the effects of red ginseng powder (RGP) on the quality, physiochemical properties and antioxidant activity of Camembert cheese. Cheese samples were prepared with 0.05%, 0.10%, 0.15% and 0.20% RGP and changes in the pH, lactic acid bacteria (LAB) and yeast populations, antioxidant activity, ginsenoside composition, total free fatty acids, total amino acid contents, chemical composition, color and sensory characteristics were monitored during ripening at 14°C for 28 d. The changes in the pH values, added RGP treatment groups was increased above all during the ripening period than control (p<0.05). The LAB population increased from 7 d to 21 d, then decreased in all experimental groups, with the highest levels being observed in the 0.10% treatment from 7 d to 21 d. The number of yeast increased continuously as the ripening period progressed, but 0.15% RGP treatment was did not showed (p<0.05). The antioxidant activity, DPPH value, ABT and total phenolic acid (TP) increased in all experimental groups. The TF and MuSF were higher on control then 0.15% RGP treatment. Short-chain

fatty acids decreased in the 0.15% RGP treatment and the control during the ripening period ($p<0.05$). The L^* value decreased and the a^*, b^* values increased as the amount of RGP added increased. The texture and total acceptability were higher at control than the all RGP groups. In conclusion, Although the addition of RGP did not exert a better effect on the ripening of the camembert cheese, but the ripening grade was similar to that of the common camembert cheese, and the additional function of the cheese was reinforced. Functional cheese could be developed.

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