EFFECTS OF DIFFERENT SUCROSE STEARATE ESTER CONCENTRATIONS ON THE QUALITY CHARACTERISTICS OF READY-TO-EAT *SAMGYETANG* DURING STORAGE

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Abstract – The effects of sucrose stearate ester at varying concentrations (0.1%, 0.2%, and 0.3%) on the physico-chemical characteristics of ready-to-eat (RTE) *Samgyetang* were identified during storage for 9 months at 25℃. Over the storage time, the addition of sucrose stearate ester had no significant effects on the proximate composition of *Samgyetang* including meat, broth and porridge, and the hardness and spreadability of the porridge, but resulted in significantly lower viscosity at month 9 compared to the control ($P<0.05$). Hardness and spreadability of *Samgyetang* porridge tended to decrease during storage. The CIE lightness (L*) values of the porridge with sucrose stearate ester added showed significantly higher values after 6 months compared to the control irrespective of concentration level ($P<0.05$). Sensory evaluations showed a positive effect from adding sucrose stearate ester to the *Samgyetang* with increased concentration and storage time, compared to the control.

Key Words – Quality changes, Sucrose stearate ester, *Samgyetang*

I. INTRODUCTION

Samgyetang, chicken soup containing ginseng and glutinous rice, is a popular, healthy meal in Korea, often eaten to supplement nutrients and prevent illness. The commercial RTE *Samgyetang* is generally produced by heating in a retort at 121℃ for 50-60 min. The product declares a shelf-life of 18 months at ambient temperature. However, consumers are put off by the sight of fat droplets on the broth. Therefore, an advanced technological approach is needed to improve the quality of *Samgyetang* and to reduce the presence of obvious fat droplets. Furthermore, the porridge element must be kept from deteriorating during shelf-life, as it is an essential part of the experience of tasting and enjoying *Samgyetang*.

Sucrose ester of fatty acids, which is a 'Generally Recognized As Safe (GRAS)' substance, finds its use as an emulsifier in a wide range of food applications including bakery items, confectionary, beverages and dairy products etc. Other functions include starch and protein interaction, sugar crystallisation and aeration for bakery items and confectionary, dispersing agent for dairy products and bacteriocidal agents for canned coffee [1]. It has also been reported elsewhere that the addition of sucrose esters was effective in improving the texture and separation index of quick-cooking rice [2]. It has a high solubility in water and has been successfully used for starch-based foods. Therefore, the use of sucrose stearate ester might be an option for dispersing the fat droplets in RTE *Samgyetang*, while preserving the porridge quality. Therefore, this study examined the effects of different sucrose ester concentrations on the various physico-chemical characteristics of RTE *Samgyetang* during storage.

II. MATERIALS AND METHODS

The preparation procedure of raw material of *Samgyetang* and its broth was followed, as described by Jang and Lee [2]. The emulsifier used in our experiment was sucrose stearate ester (S-1670, Mitsubish-Kagaku Foods Co., Japan) with a high HLB value (approx. 16). Sucrose stearate ester was added to the broth in concentrations of 0.1% (T1), 0.2 (T2) and 0.3% (T3) (w/w) and mixed thoroughly. The samples were sterilized in a retort (PRS-06-1, Kyonghan, Korea) at 120℃ for 65 min under the F-value of 8.0 after having been packaged in a retort pouch consisted of a multilayer plastic film (PET 12 ㎛/AL 9 ㎛/PA 15 ㎛/AL 7 ㎛/CPP 100 ㎛).

Quality changes of different parts of the *Samgyetang* were determined during storage at 25℃ at month 0, 3, 6 and 9 as follows:

Whole *Samgyetang*: Proximate analysis was performed separately on the breast meat, broth and porridge according to the AOAC method [3]. Sensory evaluation was done by a panel consisting of eleven trained faculty members and students using a 9-point hedonic scale (9: most acceptable, 1: least acceptable) to evaluate the quality characteristic changes in the *Samgyetang* during storage.

Porridge: Hardness was determined using a rheometer (Compac-100, Sun Scientific Co., Ltd., Japan) equipped with RDS 2.01 software. Spreadability of the porridge was measured by using a PVC pipe 31 mm dia. × 65 mm length. Forty grams of porridge sample was warmed at 60±5℃ after having any solid particles removed, with 10 mL of broth added. Twenty grams of the mixture was poured into the pipe and held for 30 seconds before measuring the spreading area (mm) on a glass plate. The pH was checked using a pH meter (SG2-ELK, Mettler Toledo Co., Ltd., Switzerland). The changes in CIE Lightness (L*) value on the surface of the porridge were monitored using a color difference meter (CR-400, Konica Minolta Sensing Inc., Japan) attached with an illuminant C.

Breast Meat: Fatty acid profiles of breast meat of *Samgyetang* were investigated using the method as described by O'Fallon *et al*. [4].

Broth: Apparent viscosity of broth was measured using a Viscometer (DV-II, Brookfield Eng., USA) equipped with the cylindrical RV spindle No. 1 at 20 rpm. The viscosity was measured with the 400 mL filtrate maintained at 25℃ after having sieved the broth sample using a 350 μm mesh sieve without applying any compulsory physical force for 30 min.

III. RESULTS AND DISCUSSION

As shown in Table 1, for breast meat, broth and porridges of *Samgyetang*, there were no significant differences observed in the proximate composition between the control and the treatments ($P>0.05$). The highest moisture content of the *Samgyetang* product was observed in the broth (94.07-94.10%), followed by porridge (87.27-87.28%), and then breast meat (70.20%). Protein content was 27.6% for breast meat, 3.25-3.27% for broth, and 3.05-3.07% for porridge. Fat content of was the highest 2.00-2.03% in the broth, followed by breast meat (1.70%) and porridge (1.20-1.30%). Ash content in broth was in the range of 0.63-0.65%, while that in the breast meat and porridge was 0.50%.

The quality characteristics including hardness, lightness, pH, spreadability, viscosity and sensory attributes of *Samgyetang* products are shown in Table 2. Hardness of porridges in all samples was measured in the range of 5.6-7.8 kg/m^2 and significantly decreased over the storage time. The pH values of porridges were initially 6.2, but showed a slight increase to 6.3 at month 3, and then decreased to 6.2 thereafter. Spreadability of porridges was maintained in the range of 2.6-2.9 for the control, 2.5-3.2 for T1, 2.5-3.1 for T2 and 2.5-3.2 for T3. Spreadability decreased continuously throughout the storage time. No significant differences in the hardness, pH and spreadability values were observed between the control and the treated samples ($P<0.05$). The apparent viscosity of the broth had significantly increased after 3 months in all samples. At month 9, the viscosity of treated samples was significantly lower than the control ($P<0.05$). The CIE L* values tended to decrease while those of the treated samples were significantly higher over the storage time ($P<0.05$). This result is consistent with the previous report on the ginseng chicken porridge in which an increase of CIE L* value was observed after 3 months [5]. Sensory evaluation indicated that the sensory score decreased with longer storage time which was more pronounced in the control than in the treatments. The use of higher concentrations of sucrose stearate ester such as T2 or T3 compared to the control and T1 was evaluated as preferable by the sensory panel, especially with an extended storage.

Table 3 shows the changes in fatty acid profiles in the breast meat of *Samgyetang*. The proportion of saturated fatty acid (SAFA) and monounsaturated fatty acid (MUFA) in breast meat was significantly increased, while polyunsaturated fatty acid

(PUFA) was significantly decreased throughout the storage period ($P<0.05$). The decrease of PUFA in parallel with the increase of SAFA and MUFA in the treated samples compared to the control became pronounced after 3 months for PUFA and 6 months for MUFA ($P<0.05$). This might be attributed to the oxidative changes of unsaturated fatty acid.

IV. CONCLUSION

Sucrose stearate ester could be used as an additive for improving the quality of RTE *Samgyetang*, conforming to consumer safety standards, and reducing the size of fat droplets on the broth during storage.

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Table 1 Proximate composition of RTE *Samgyetang* with different concentrations of sucrose stearate ester

Proximate composition	C	T1	T2	T3
Moisture (%) ^{NS}				
Breast meat	70.20	70.20	70.20	70.20
Broth	94.10	94.08	94.08	94.07
Porridge	87.27	87.28	87.27	87.27
Protein (%) ^{NS}				
Breast meat	27.60	27.60	27.60	27.60
Broth	3.26	3.27	3.25	3.26
Porridge	3.06	3.07	3.05	3.06
Fat (%) ^{NS}				
Breast meat	1.70	1.70	1.70	1.70
Broth	2.01	2.00	2.03	2.03
Porridge	1.30	1.20	1.20	1.24
Ash (%) ^{NS}				
Breast meat	0.50	0.50	0.50	0.50
Broth	0.63	0.65	0.64	0.64
Porridge	0.50	0.50	0.50	0.50
Carbohydrate (%) ^{NS}				
Porridge	7.92	7.91	7.94	7.93

^{NS}: Not significant at P <0.05.
Sucrose stearate ester concentration : 0% (C), 0.1% (T1), 0.2% (T2), 0.3% (T3).

Table 2 Changes in various physico-chemical and sensory characteristics of RTE *Samgyetang* during storage depending on different concentrations of sucrose stearate ester

Parameter	Sample	Storage time (months)			
		0	3	6	9
Hardness	C[1)]	7.7^{aA}	7.4^{aB}	6.9^{aC}	6.0^{aD}
of porridge	T1	7.7^{aA}	7.4^{aB}	6.9^{aC}	5.9^{aD}
(kg/m^2)	T2	7.7^{aA}	7.5^{aB}	6.8^{aBC}	5.8^{aD}
	T3	7.8^{aA}	7.6^{aB}	6.6^{aC}	5.6^{aD}
pH	C	6.2^{aC}	6.3^{aA}	6.2^{aB}	6.2^{aB}
of porridge	T1	6.2^{aB}	6.3^{aA}	6.2^{aB}	6.2^{aC}
	T2	6.2^{aB}	6.4^{aA}	6.3^{aB}	6.2^{aC}
	T3	6.2^{aB}	6.4^{aA}	6.2^{aB}	6.1^{aC}
Viscosity	C	7.5^{aB}	8.7^{aA}	8.8^{aA}	9.0^{aA}
of broth (cP)	T1	7.5^{aB}	8.5^{aA}	8.6^{aA}	8.7^{bA}
	T2	7.5^{aB}	8.5^{aA}	8.6^{aA}	8.6^{bA}
	T3	7.5^{aB}	8.4^{aA}	8.5^{aA}	8.5^{bA}
Spreadability	C	2.9^{aA}	2.8^{aB}	2.7^{aB}	2.6^{aC}
of porridge	T1	3.2^{aA}	2.8^{aB}	2.6^{aB}	2.5^{aC}
	T2	3.1^{aA}	2.8^{aB}	2.6^{aB}	2.5^{aC}
	T3	3.2^{aA}	2.8^{aB}	2.6^{aB}	2.5^{aC}
CIE L*	C	63.1^{aA}	64.7^{aA}	61.8^{bB}	60.1^{dB}
Lightness	T1	62.9^{aD}	64.6^{aC}	68.3^{abB}	71.4^{bA}
of porridge	T2	62.8^{aD}	65.0^{aC}	69.5^{aB}	70.8^{cA}
	T3	62.8^{aD}	64.8^{aC}	66.7^{abB}	76.1^{aA}
Sensory evaluation	C	8.9^{aA}	8.0^{aB}	7.4^{cC}	6.3^{dD}
on the whole	T1	8.9^{aA}	8.0^{aB}	7.4^{cC}	6.4^{cD}
Samgyetang	T2	8.9^{aA}	8.0^{aB}	7.5^{bC}	6.7^{aD}
	T3	8.9^{aA}	7.9^{bB}	7.6^{aC}	6.6^{bD}

a, b, c, d: Values in the same column with different letters are different at P <0.05.
A, B, C, D: Values in the same row with different letters are different at P <0.05.
1) For details of abbreviation, please refer to Table 1.

Table 3 Fatty acids profiles of breast meat of RTE *Samgyetang* during storage depending on different concentrations of sucrose stearate ester

Fatty acid of breast meat	Storage time (months)				
	Sample	0	3	6	9
SAFA (%)	C[1)]	34.72^{aD}	36.8^{aC}	37.23^{aB}	38.21^{aA}
	T1	34.73^{aD}	36.0^{bC}	37.82^{aB}	38.45^{aA}
	T2	34.72^{aD}	36.1^{bC}	37.45^{aB}	38.82^{aA}
	T3	34.66^{aD}	36.3^{bC}	37.21^{aB}	37.31^{bA}
MUFA (%)	C	43.70^{cD}	46.6^{aC}	51.83^{aB}	53.86^{aA}
	T1	43.74^{abD}	46.3^{aC}	47.48^{bB}	51.83^{bA}
	T2	43.72^{bD}	46.2^{aC}	48.43^{bB}	51.40^{bA}
	T3	43.76^{aD}	46.3^{aC}	48.69^{bB}	50.28^{bA}
PUFA (%)	C	21.54^{aA}	16.60^{bB}	10.94^{bC}	7.93^{bD}
	T1	21.53^{aA}	17.70^{aB}	14.70^{aC}	9.72^{aD}
	T2	21.56^{aA}	17.70^{aB}	14.12^{aC}	9.77^{aD}
	T3	21.64^{aA}	17.40^{aB}	14.10^{aC}	9.99^{aD}

a, b, c, d: Values in the same column with different letters are different P <0.05.
A, B, C, D: Values in the same row with different letters are different at P <0.05.
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