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Characteristics of yogurt-like products prepared from the combination of skim milk and soymilk containing saccharified-rice solution

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Abstract
Yogurt-like products were prepared from a combination of skim milk and soymilk (100:0, 75:25, 50:50, 25:75, and 0:100) containing saccharified-rice solution by lactic fermentation of four different cultures. The ratio of skim milk and soy milk had no significant effect on titratable acidity, while the type and nature of culture used for fermentation affected the titratable acidity. Lower syneresis was observed in soy-based yogurt, and both the hardness and springiness of curd increased as the proportion of soymilk in the substrate increased. Skim milk-based yogurt had higher resistance to shear force with higher yield stress. The sensory quality of yogurt produced from mixed culture had higher preference compared with that produced from a single culture (*Streptococcus thermophilus*). There was no significant difference in texture and overall acceptability among yogurts produced from mixed substrates and skim milk-based yogurt.

Keywords: *Yogurt-like products, saccharified-rice, skim milk, soymilk*

Introduction

The significant growth in the consumption of yogurt has been reported in many countries during the past decade (Tamime 2002). The increase in yogurt consumption is probably due to its high organoleptic quality and potential health-enhancing effects. The nutritional benefit of yogurt is due to milk constituents and exogenous living lactic acid bacteria (Rašic 1987; Driessen & de Boer 1989). There have been many attempts to make yogurt-like products from a variety of food resources (Rao et al. 1988). Production of yogurt-like products from soymilk is of commercial interest in Asia because soymilk is currently sold as a popular soft drink and oriental populations are accustomed to various soybean products.

Although soybean is of excellent nutritional quality among plant food proteins, the typical beany flavor limits its direct incorporation into foodstuffs in Western

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countries. Soymilk, the water extract of soybean, has relatively bland cereal-type flavor and its flavor profile can be further improved by fermentation (Hofmann & Marshall 1985; Cheng et al. 1990). Another limitation of soybean utilization in food products is related to significant levels of indigestible oligosaccharides such as raffinose and stachyose, which can cause intestinal upset (Kanda et al. 1976). However, Sakai et al. (1987) reported that indigestible soy-oligosaccharides in soymilk could preferentially be utilized by certain intestinal bifidobacteria. Thus, production of yogurt-like products containing soymilk might enhance nutritional value by providing bifidogenic activity to the products (Kikuch-Hayakawa et al. 1998).

Yogurt-like products prepared from soybean milk by conventional fermentation have been less successful than milk-based yogurt. The major drawbacks of soy-based yogurt were less desirable flavor and low acid content (Buono et al. 1990c). Based on our preliminary observations that saccharified-rice solution provides desirable flavor and promotes fermentation, in the current study we incorporated the same into a yogurt premix.

Previous studies indicated that acid production and the subsequent sensory quality of soy yogurt were largely dependent on the type of yogurt starter cultures and also on the composition of substrates (Buono et al. 1990a; Karleskind et al. 1991). Furthermore, taste and textural characteristics should be carefully considered to improve the quality of yogurt. The objective of the present study was to examine the effect of starter culture and substrate ratios on lactic fermentation and the relationship to textural characteristics in yogurt like-products.

Materials and methods

Yogurt premix

Skim milk powder was obtained from Seoul Milk Co. (Seoul, Korea) and was reconstituted in distilled water to 13.38% solid not fat. Soybean milk was prepared by the method of Buono et al. (1990b) with slight modifications. Soybeans were purchased at a local store (Seoul, Korea) and were soaked in twice the volume (w/w) of distilled water at 20°C for 10 h. The soaked soybeans were washed and placed in an Osterizer 16-speed blender (Sunbeam Co., Delray Beach, FL, USA). Two volumes of hot water (95°C) were added and blended for 10 min at the liquefy level. After blending, the liquefied soybeans were filtered through 80-mesh cheese cloth. The recovered soybean milk (11.0–12.0°brix) was immediately cooled by placing in a refrigerator and used within 1 week.

For the preparation of the saccharified-rice dispersion, roughly ground (<20 mesh) rice was soaked in six times (w/w) the quantity of distilled water and pregelatinized. The gelatinized rice solution was transferred to a flask in an 80°C water bath (Du Sung Scientific Co., Seoul, Korea) and cooled to 60°C. α-Amylase (0.15%, 22.5 units/mg solid; Sigma Chemical Company, St Louis, MO, USA) was added to the sample and incubated at 60°C for 1 h. After saccharification, 0.038% amyloglucosidase (11.6 units/mg solid; Sigma Chemical Company) was added and incubated at 60°C for 1 h. The saccharified rice solution was filtered through a 100-mesh sieve and the filtrate was diluted with distilled water to create a soluble solid content of 8°brix. The resultant dispersion was frozen at −20°C and thawed prior to experiments.

Starter culture

Lactic acid bacteria were obtained from Culture System Inc. (Mishawaka, IN, USA). *Streptococcus thermophilus* and *Lactobacillus* strains were grown for 18 h at 37°C in M17 broth (Difco, Detroit, MI, USA) and MRS broth (Difco), respectively. *Bifidobacterium longum* was incubated in blood–liver broth (Teraguchi et al. 1978) at 37°C for 24 h. The strains were stored at −80°C in the 10% skim milk medium supplemented with 30% glycerol and were subcultured three times prior to use. The four starter cultures utilized in this study are indicated in Table I.

Preparation of yogurt

Yogurt was prepared from yogurt premix. Five milk substrates were made by mixing skim milk and soymilk in the following ratios: 100:0, 75:25, 50:50, 25:75, and 0:100. The premix was made by adding saccharified-rice solution to the mixture of skim milk and soymilk at the ratio of 7:3 (v/v). The premixes were pasteurized at 100°C in a water bath for 15 min and cooled to 37°C. After the starter culture was inoculated, 1 l inoculated premix was dispensed into sterile plastic jars (Nalgene International, Rochester, NY, USA) and incubated at 37°C for 15 h. The total level of inoculum was approximately 2×10^7 colony forming units/ml for each starter culture. After the completion of fermentation, the titratable acidity and pH were immediately measured and the samples were stored in a refrigerator (4°C) until rheological determinations were made.

pH, titratable acidity and color

The pH was measured by a Corning 240 pH meter (Corning, Corning, NY, USA). For titratable acidity, 9 g curd was diluted with 18 ml distilled water and titrated with 0.1 N NaOH using phenolphthalein (0.1%) indicator. The volume of 0.1 N NaOH consumed for the titration was converted as the percentage of lactic acid. The color of the yogurt was measured by a colorimeter (CR-200; Minolta, Tokyo, Japan) and the mean of three measurements was noted.

Syneresis

Syneresis was determined by slight modification of the method reported by Modler (1994). The yogurts (100 g) were drained through a 120-mesh screen for 2 h at 3°C and the weight of collected whey was expressed as an index of syneresis.

Table I. Composition of lactic acid bacteria in starter cultures.

Culture	Composition
A	*Streptococcus thermophilus*
B	*Streptococcus thermophilus* and *Lactobacillus acidophilus* (1:1)
C	*Streptococcus thermophilus*, *Lactobacillus acidophilus* and *Lactobacillus bulgaricus* (1:1:1)
D	*Streptococcus thermophilus*, *Lactobacillus acidophilus*, *Lactobacillus bulgaricus* and *Bifidobacterium longum* (1:1:1:1)

Determination of sugar

Samples were prepared according to the method of Richmond et al. (1982) and were analyzed with a Waters 501 HPLC equipped with a 3.9 mm × 300 mm μ-Bondapak carbohydrate analysis column (Waters Associates, Bedford, MA, USA) and a 4.6 mm × 400 mm Bio-Sil NH_2 guard column (BioRad Laboratories, Richmond, CA, USA) maintained at 25°C by a water-jacketed heater. The mobile solvent phase was 65% acetonitrile in distilled water. Sugars in the effluent were quantified with a model 401 differential refractometer (Waters Associates) and Waters 745B data module. Retention time and response factors were determined from standard sugar solution (1%) of glucose, galactose, lactose, sucrose, raffinose and stachyose (Sigma Chemical Company). All chemicals and water used for analyses were high-performance liquid chromatography grade and were obtained from Fisher Scientific (Springfield, NJ, USA) otherwise stated.

Texture profile analysis

Texture profile analysis of undisturbed yogurt was performed using a Texture Analyzer (TA.XT2; Texture Technologies Corp., Scarsdale, NY, USA). The samples in straight-sided Nalgene jars (60 mm i.d. × 60 mm high) were compressed to 80% of their original height by a flat-headed cylinder plunger (25.4 mm diameter) with a deformation rate of 50 mm/min. From the texture profile analysis curves, the hardness, cohesiveness, gumminess, springiness, and adhesiveness were calculated by Texture analyzer software (version 3.7; Texture Technologies Corp).

Flow characteristics

Yogurt samples (4°C) were subjected to a stirring process prior to measurement of viscosity. The samples were mixed using an Omni 5000 homogenizer (Omni International, Waterbury, CT, USA) equipped with a 35 mm generator at speed setting 4 for 30 sec to make a uniform dispersion. The apparent viscosity was determined with a Haake rotational viscometer (Model RV 20; Haake Mess-Technik GmbH, Karlsruhe, Germany) equipped with M-5 OSC measuring head and MV rotor assembly. During the measurements, the temperature was maintained at 10°C by the controller. The shear rate was linearly increased at a rate of 0–500/sec in 3 min.

Flow properties were described by the power equation: $\sigma = KD^n$, where σ is the shear stress, K is the consistency index, D is the shear rate and n is the flow behavior index.

The value of yield stress and apparent viscosity was evaluated by fitting data to the Herschel–Bulkey equation: $\sigma - \sigma_0 = KD^n$, where, σ is the shear stress, σ_0 is the yield stress, K is the consistency coefficient, D is the shear rate and n is the flow behavior index.

Sensory evaluation

Fifteen trained panelists (six males and nine females) were selected from the pool of employees at the Korea Food Research Institute based on their ability to differentiate yogurt flavor and familiarity to yogurt. The definition of each attribute was given to the panel before a session and the flavor, taste, and texture were evaluated

on a nine-point scale. A standard nine-point hedonic scale was used for evaluating acceptance of samples. Three-digit coded samples at 10°C were randomly presented to panelists and spring water was provided between consecutive samples for mouth-rinsing.

Statistical analysis

The experiments were replicated three times and the effect of starter culture and substrate ratios on each parameter was analyzed by analysis of variance using the general linear models procedures of SAS systems (SAS Institute Inc. 1988). The level of significant difference was defined by Tukeys test ($P \leq 0.05$).

Results and discussion

pH, titratable acidity and syneresis

The pH of yogurt after 15 h fermentation was in the range of 3.68 to 4.40 and was found to vary with the starter culture and substrate ratios (Figure 1). Yogurt fermentation was monitored up to 15 h as a prolonged incubation time is usually not desirable for commercial production in the dairy industry.

The initial pH of soymilk was 6.8 and was slightly higher than previous reports of 6.5 and 6.6 (Pinthong et al. 1980; Buono et al. 1990b). All tested starter cultures produced enough acid to form a coagulum of yogurt premix. The pH of yogurt produced from culture A (*S. thermophilus*) or B (1:1 mixture of *S. thermophilus* and *Lactobacillus acidophillus*) showed a significant difference ($P \leq 0.05$) from culture C or culture D after 15 h fermentation. The pH of yogurt produced from culture A or culture B decreased as the proportion of soymilk in the substrate increased. The opposite trend was observed for culture C (1:1:1 mixture of *S. thermophilus*, *L. acidophillus* and *Lactobacillus bulgaricus*) while no significant changes in pH were found for culture D (*S. thermophilus*, *L. acidophillus*, *L. bulgaricus* and *B. longum*).

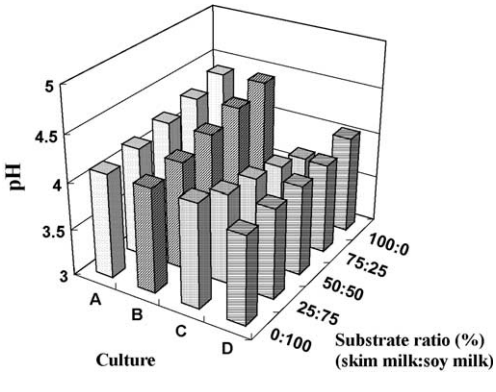

Figure 1. pH of yogurts prepared from different cultures and substrate ratios after fermentation for 15 h at 37°C. Culture A, *S. thermophilus*; culture B, mixture of *S. thermophilus* and *L. bulgaricus* (1:1); culture C, mixture of *S. thermophilus*, *L. bulgaricus* and *L. acidophilus* (1:1:1); culture D, mixture of *S. thermophilus*, *L. bulgaricus*, *L. acidophilus* and *B. longum* (1:1:1:1).

The effect of culture and substrate ratios on titratable acidity showed a similar trend as observed in the case of pH variation. Culture C or culture D produced a significantly larger amount of acid than culture A or culture B. The effect of substrate ratios on acidity was not significant (Figure 2). This result suggests that the amount of acid production from the soymilk was similar to that of skim milk in the presence of saccharified-rice solution. Rao et al. (1988) reported that *S. thermophilus* was able to utilize sugars in soymilk and produced acids from soymilk. Buono et al. (1990a) also reported that the mixed culture of *L. bulgaricus* and *S. thermophilus* consumed as much as 27% of the stachyose in soymilk after 7 h of fermentation at 44°C.

Acid production is dependent upon the concentration of viable bacteria that is able to utilize carbohydrate sources available in the substrate. The total carbohydrate content in soymilk was much smaller than that in skim milk and was not enough to maintain active growth of lactic acid bacteria saccharified-rice solution provided as a readymade substrate for the growth of culture (Table II).

Syneresis is a quality defect frequently faced in yogurt manufacture. Less syneresis was found in the yogurts produced from the mixture of skim milk and soymilk regardless of the type of starter culture (Figure 3). This result was consistent with that of Shirai et al. (1992) that soy milk-based yogurt produced relatively smaller syneresis than skim milk-based yogurt. The yogurt prepared from skim milk alone resulted in the highest syneresis. The yogurt containing soymilk showed significantly lower syneresis. However, the susceptibility toward syneresis was not changed proportionally according to substrate ratios. The yogurt prepared from equal proportion of skim milk and soymilk showed the smallest syneresis. Harwarker and Kalab (1986) reported that the microstructure of yogurt consists of chains and cluster of casein molecules and the susceptibility of syneresis is closely related to the space between casein clusters. Based on the aforementioned result, the incorporation of soymilk into the substrate filled in the spaces between casein clusters of skim milk gel and reinforced the gel network.

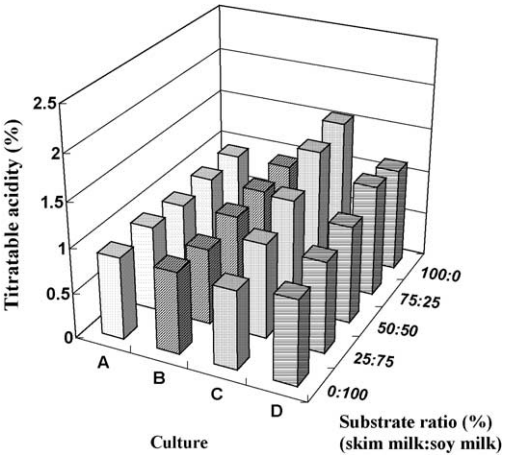

Figure 2. Titratable acidity of yogurts produced from different starter cultures and substrate ratios after fermentation for 15 h at 37°C. Culture A, *S. thermophilus*; culture B, mixture of *S. thermophilus* and *L. bulgaricus* (1:1); culture C, mixture of *S. thermophilus*, *L. bulgaricus* and *L. acidophilus* (1:1:1); culture D, mixture of *S. thermophilus*, *L. bulgaricus*, *L. acidophilus* and *B. longum* (1:1:1:1).

Table II. Carbohydrate contents of the yogurt premix.

Yogurt premix	Carbohydrate (%)				
	Glucose+galactose	Sucrose	Lactose	Raffinose	Stachyose
Skim milk	–	–	6.05	–	–
Soy milk		0.63	–	0.37	0.56
Saccharified-rice solution	0.83	–	–	–	–

Color

The color of yogurt was affected by the composition of substrates. The lightness (*L* value) of yogurt appeared to be decreased as the proportion of soymilk in the substrate increased. Significant difference was found among soy-based yogurt and others (Table III). The redness, hue (*a* value), was decreased as the proportion of soymilk in the substrate increased. Shirai et al. (1992) reported that milk has higher green component (lower *a* value) than soymilk because of its riboflavin content. The brown component, chroma (*b* value), was significantly increased as the proportion of soymilk in the substrate increased.

Texture

Texture and rheological properties of yogurt play an important role in quality control and product development. Generally, yogurt is classified into set-type and stirred-type. In set-type yogurt textural characteristics of curd are primary interest, while flow behavior is given more emphasis in stirred type-yogurt.

The textural parameters of yogurt were mainly influenced by substrate ratios. The hardness and springiness of yogurt significantly increased as the proportion of soymilk increased in the substrate regardless of the kinds of cultures (Table IV). This result indicated that soymilk in the mixed substrate added firmness and provided higher resistance against stress. Thus, the curd became more elastic and recovered some of its original structure when the stress was removed. Cheng et al. (1990) compared the

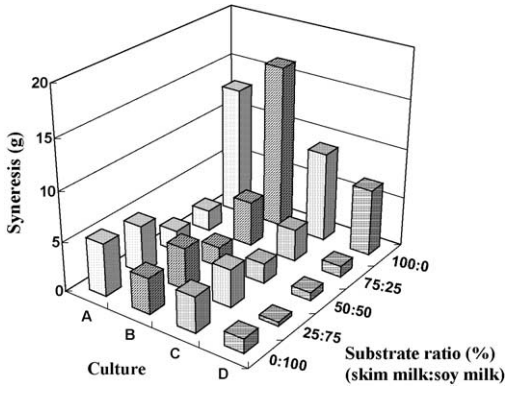

Figure 3. Syneresis of yogurts produced with different starter cultures and substrate ratios after fermentation for 15 h at 37°C. Culture A, *S. thermophilus*; culture B, mixture of *S. thermophilus* and *L. bulgaricus* (1:1); culture C, mixture of *S. thermophilus*, *L. bulgaricus* and *L. acidophilus* (1:1:1); culture D, mixture of *S. thermophilus*, *L. bulgaricus*, *L. acidophilus* and *B. longum* (1:1:1:1).

Table III. The effect of the substrate ratios on the Hunter color values of the yogurt.

Sample	Lightness (L)	Hue (a)	Chroma (b)
Yogurt premix			
Skim milk	85.17	−5.06	4.60
Soy milk	82.79	−6.03	12.40
Saccharified-rice solution (8°brix)	37.64	−0.52	7.95
Substrate ratio (%) (skim milk:soy milk)			
100:0	84.77^{a}	-2.58^{c}	7.22^{b}
75:25	82.37^{b}	-2.29^{bc}	9.02^{ab}
50:50	82.02^{b}	-1.91^{abc}	9.85^{a}
25:75	81.94^{b}	-1.67^{ab}	10.82^{a}
0:100	82.46^{b}	-1.44^{a}	10.90^{a}

The value at each substrate ratio is an average of all four cultures. All premix used for yogurt preparation contained saccharified-rice solution at a ratio of 7:3 (the mixture of skim milk and soy milk:saccharified-rice solution, v/v). $^{a-c}$ means without a common superscript in a column were significantly different ($P \leq 0.05$).

penetration force of yogurt, soy-based yogurt and soy-based yogurt with added lactose. The penetration force of soy-based yogurt was three times higher than yogurt. Higher gumminess was observed in yogurts made with a higher proportion of soymilk in the substrate. Gumminess showed a similar pattern with hardness since it is related to the extent of sample deformation. Adhesiveness also increased as the proportion of soymilk increased in the substrate.

Flow properties of yogurt

The flow properties of tested yogurt were described by the power law model. The substrate ratio had a dominant effect over the effect of culture on flow characteristics. The yogurt showed pseudoplastic behavior with yield stress (Figure 4). The flow curve was shifted downward with significantly lower yield stress as the proportion of soymilk in the substrate increased (Figure 4). Ramaswamy and Basak (1991) reported that yield stress appeared to be an inherent property although yogurt had a shear-thinning effect. The presence of yield stress suggests that the existence of a network structure and skim milk-based yogurt retained higher residual viscosity after shear-induced disruption of structural network than soy-based yogurt.

Table IV. Texture profile analysis of yogurt prepared with different substrate ratios.

Substrate (skim milk:soy milk (v/v)) (%)	Hardness (g)	Springiness	Gumminess	Cohesiveness	Adhesiveness
100:0	59.39^{e}	0.63^{d}	19.08^{e}	0.31^{bc}	29.58^{c}
75:25	92.58^{bc}	0.71^{cd}	27.04^{d}	0.26^{d}	27.64^{c}
50:50	113.33^{b}	0.75^{bc}	41.03^{c}	0.30^{c}	134.77^{b}
25:75	116.33^{b}	0.84^{ab}	59.81^{b}	0.33^{ab}	197.64^{b}
0:100	201.84^{a}	0.92^{a}	99.01^{a}	0.35^{a}	258.85^{a}

The value at each substrate ratio is an average of all four cultures. All premix used for yogurt preparation contained saccharified-rice solution at a ratio of 7:3 (the mixture of skim milk and soy milk:saccharified-rice solution, v/v). $^{a-e}$ means without a common superscript in a column were significantly different ($P \leq 0.05$).

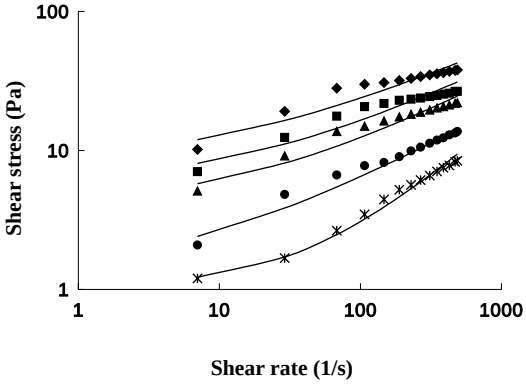

Figure 4. Flow curve of yogurts produced from different substrate ratios. Culture D (mixture of *S. thermophilus*, *L. bulgaricus*, *L. acidophilus* and *B. longum*, 1:1:1:1) was used for sample preparation. ◆, 100:0 (skim milk); ●, 75:25; ★, 50:50; π, 25:75; ■, 0:100 (soy milk).

The flow behavior index is considered as a deviation from Newtonian flow, and a value less than 1 indicates pseudoplastic flow (Benezech & Maingonnat 1994). The flow behavior index of the yogurts was between 0.27 and 0.40 (Figure 5). When the substrate ratios were equal to or less than 50:50 (skim milk:soy milk) the flow behavior index did not show significant differences. However, the flow behavior index increased and showed significant difference at the ratios of 25:75 and 0:100. This result suggested that soy-based yogurt had less shear-thinning effect. The consistency index was decreased as the proportion of soymilk increased in the substrate (Figure 6). This could be due to decreased volume fraction of large cluster such as caseins.

Shama et al. (1973) reported that shear conditions in the mouth depended on the flow properties of the foods. Cutler et al. (1983) showed that objective measurement at a low shear rates (10/sec) produced a better correlation with oral conception for shear thinning food materials. Skriver et al. (1999) suggested that lower shear rate of

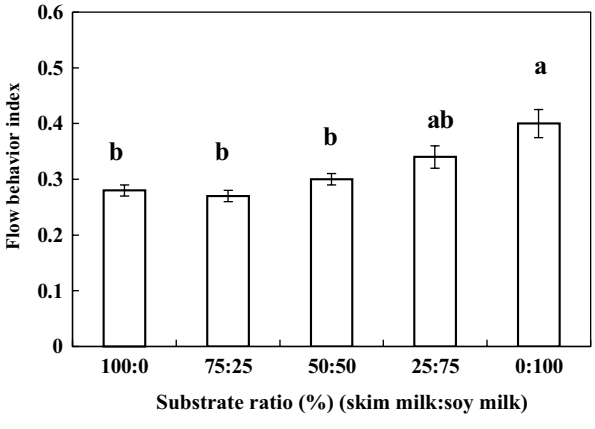

Figure 5. Flow behavior index of yogurts produced from different substrate ratios. Culture D (mixture of *S. thermophilus*, *L. bulgaricus*, *L. acidophilus* and *B. longum*, 1:1:1:1) was used for sample preparation. [a,b] Means with different superscripts are significantly different ($P \leq 0.05$).

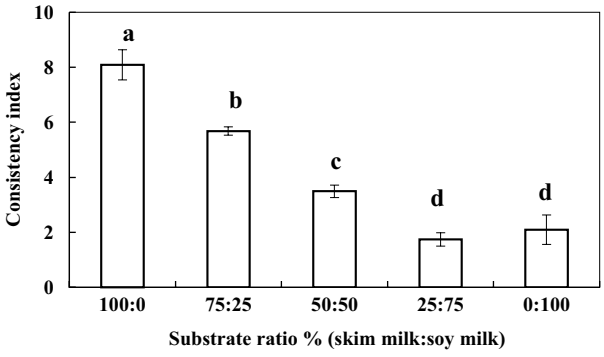

Figure 6. Consistency index of yogurts produced from different substrate ratios. Culture D (mixture of *S. thermophilus*, *L. bulgaricus*, *L. acidophilus* and *B. longum*, 1:1:1:1) was used for sample preparation. [a,b,c,d] Means with different superscripts are significantly different ($P \leq 0.05$).

~22/sec was an optimal condition to measure oral viscosity for set-style yogurt whereas ~100/sec was good for stirred yogurt. Apparent viscosity measured at 18/sec and 100/sec was significantly higher for the yogurt containing a higher proportion of skim milk, and the difference among samples was clearly demonstrated (Figure 7). Thus, substrate ratios directly influenced the texture and flow properties of yogurt.

Sensory evaluation

The effects of culture and substrate ratios on sensory attribute were evaluated separately. On the whole, yogurt produced from culture C or culture D showed better sensory quality than that from culture A or culture B (Table V). The lowest scores were given to yogurt produced from culture A. There was an organoleptic preference for the yogurt prepared from mixed culture over pure culture fermentation using *S. thermophilus*.

The soy milk-based yogurt had a lower score in flavor whereas it had a higher score in sensory texture than that of skim milk-based yogurt (Table VI). The lower score in flavor and overall acceptability for soy-based yogurt might be partly due to the

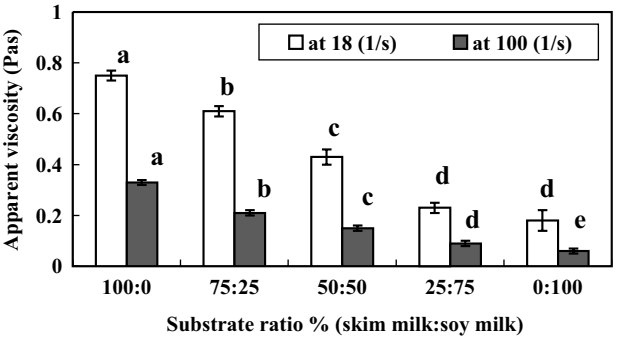

Figure 7. Apparent viscosity of yogurts produced from different substrate ratios. Culture D (mixture of *S. thermophilus*, *L. bulgaricus*, *L. acidophilus* and *B. longum*, 1:1:1:1) was used for sample preparation. Viscosity was measured at shear rate of 18/sec and 100/sec, respectively. [a,b,c,d,e] Means with different superscripts are significantly different ($P \leq 0.05$).

Table V. The effect of cultures on the sensory quality of yogurt.

Culture	Attribute		
	Flavor	Texture	Acceptability
A	3.60[b]	3.96[b]	3.38[b]
B	4.26[ab]	4.66[ab]	4.16[ab]
C	4.54[a]	4.60[ab]	4.31[ab]
D	4.36[a]	4.82[a]	4.46[ab]

Culture A, S. thermophilus; culture B, mixture of S. thermophilus and L. bulgaricus (1:1); culture C, mixture of S. thermophilus, L. bulgaricus and L. acidophilus (1:1:1); culture D, mixture of S. thermophilus, L. bulgaricus, L. acidophilus and B. longum (1:1:1:1). [a,b] Means with different superscript within columns are significantly different ($P \leq 0.05$).

objectionable beany flavor still present in yogurt. The highest scores for sensory texture were given to the yogurt prepared from a mixed substrate of 50:50 and 25:75 (skim milk:soy milk). There was no difference in overall acceptability between skim milk-based yogurt and the yogurt prepared from mixed substrate.

In addition to flavor and texture, the difference in acidity may affect the overall acceptability. Pinthong et al. (1980) reported that acidity more than 1.8% led to unpleasant acid taste and that titratable acidity about 1.15% was considered as an optimum range. Although there was a variation in terms of cultures and substrate ratios, the titratable acidity produced from mixed substrates by culture D was close to the optimum acidity range (1.01–1.24). Based on sensory evaluation, the optimum condition for the production of high-quality product was the substrate ratio of 50:50 and culture D.

Conclusion

The starter culture used in the production of yogurt-like products played an important role in acidity and flavor. The addition of saccharified-rice solution to yogurt premix effectively overcame problem of low acid production frequently faced in soy-based yogurt. The appropriate substrate ratios of skim milk to soymilk can improve the textural quality of yogurt-like products without sacrificing flavor quality.

Table VI. The effect of substrate ratios on the sensory quality of yogurt.

Substrate ratio (%) (skim milk:soy milk)	Attribute		
	Flavor	Texture	Acceptability
100:0	4.28[a]	3.75[c]	3.94[ab]
75:25	4.70[a]	4.10[bc]	4.21[a]
50:50	4.68[a]	4.80[ab]	4.71[a]
25:75	4.03[ab]	5.10[a]	4.28[a]
0:100	3.28[b]	4.63[ab]	3.25[b]

All premix used for yoghurt preparation contained saccharified-rice solution at the ratio of 7:3 (the mixture of skim milk and soy milk:saccharified rice solution, v/v). [a–c] Means with different superscripts within columns are significantly different ($P \leq 0.05$).

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