DEVELOPMENT
OF
FLAVOR RICOTTA CHEESE

BY
THITIWORRADA PONGPUNPURK
ID 5410240

A special project submitted to
School of Biotechnology, Assumption University
In part fulfillment of the requirements of Degree of Bachelor
of Science in Biotechnology
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Faculty:	Biotechnology
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Advisor

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ABSTRACT

Ricotta cheese is acid-heated coagulated cheese produced by using either whey or whole milk. In general, ricotta cheese has only one flavor which is milk flavor. Other flavor ricotta cheese has not been produced elsewhere. Therefore, this objective was aimed to develop new flavor ricotta cheese. Based on the survey results of 400 consumers, chocolate, strawberry and banana flavors were chosen. The prototype products were produced based on JAR and preference test (9-point hedonic scale) by 30 panelists. Chocolate ricotta cheese was produced by using 99.85% chocolate milk, 0.15% citric acid, and 0.5% salt (as per weight of curd). Strawberry ricotta cheese was produced by using 99.85% strawberry milk, 0.15% citric acid, and 0.5% salt (as per weight of curd). Banana ricotta cheese was produced by using 99.85% banana milk, 0.15% citric acid, 1.4% sugar, and 0.5% salt (as per weight of curd). Most of the consumers accepted these products as 96, 94 and 88% with the preference scores of 7.7, 7.5 and 6.9 for banana, strawberry and chocolate ricotta cheese, respectively. Moreover, these products contained pH 5.7-5.9, 67.7-72.6% moisture and 20.3-21.0% yield of production.

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INTRODUCTION

Ricotta cheese is heat-acid precipitated cheese that made from cow's milk. It is primarily acid induced without fermentation by adding acid into hot milk at 75-100°C. Heat treatment denatures the whey protein, which can then be coagulated along with the casein and recovered in the cheese, resulting in high yield. Traditional Italian cheese-makers originally produced ricotta from whey left from mozzarella and provolone production, which it is also known as 'whey cheese' or 'albumin cheese' (Marth, 1999). Whole milk ricotta is a fresh cheese with soft creamy texture and high moisture content approximately 80%. It has sweet or caramel in flavor and higher nutrients than other types (Shahani, 1979)

From marketing survey, cheese was recorded as healthy food with the growth of 7% value share in 2014. During the previous three years, cheese was recorded as a healthier performance due to strong popularity towards Western cuisine such as sandwiches, cake, pizza and pasta which require a high amount of cheese in the dishes (Jungle Net, 2015). The consumption of cheese remained low in Thailand as it has limitation to only higher income consumers or the younger generation. Moreover, cheese has only one flavor, which is milk flavor available in the market. So, increasing market for cheese by adding new flavor is of interest. Therefore, this project was aimed to develop a new product, flavor ricotta cheese. The consumer acceptance of the products was also investigated as well as their some properties.

OBJECTIVES

1. To develop a new flavor of ricotta cheese.
2. To study the consumer acceptance of flavor ricotta cheese.

LITERATUE REVLEW

1. Cheeses

Cheese is dehydrated milk product containing concentrated protein (caseins) and fat, which can be made from cow, goat, and buffalo or sheep milk. During production, the milk is usually acidified, and the enzyme rennet is then added to causes coagulation. The solids are separated and pressed into final form. Some types of cheeses have molds on the rind or throughout. Most cheeses melt at cooking temperature. Generally, hundreds cheese from various countries are produced. Their styles, textures and flavors depend on the origin of the milks whether they have been pasteurized, butterfat content, bacteria and mold, processing, and aging. Herbs, spices, or wood smoke may be used as flavoring agents. The yellow to red color of many cheeses, such as Red Leicester, is produced by adding annatto. Other ingredients may be added to some cheeses, such as black pepper, garlic, chives or cranberries (Layton, 1967)

For a few cheeses, the milk is coagulated by adding acids such as vinegar or acetic acid. Most cheeses are acidified by bacteria, which turn milk sugars into lactic acid, and then the addition of rennet completes the curdling. Vegetarian alternatives to rennet are available; most are produced by fermentation of the fungus *Mucor miehei*, but others have been extracted from various species of the *Cynara* thistle family. Cheese makers near a dairy region may benefit from fresher, lower-priced milk, and lower shipping costs.

2. Ricotta cheese

Like cottage cheese, ricotta cheese is high-moisture cheese. Ricotta is not a pressed curd type of cheese. Its composition varies depending on whether it is made exclusively from whey or from blending of whey and milk. Originally, ricotta was produced from whey derived from mozzarella or provolone cheese production. Ricotta is now prepared from whole milk with or without addition of whey. When it is made from a blend of 95% sweet whey and 5% milk, ricotta contains 68-73% moisture, 16% protein, 4-10% fat and 4% lactose (Sinha, 2007).

Ricotta has a blend to slightly cooked but pleasing flavor. Its texture is soft and creamy. It is consumed as such as a spread and may be used as a replacement for cream cheese or sour cream in dips. It is basically a non-melting cheese. Its major use is in cooking of Italian cuisine (for example, lasagna and ravioli) and confectionery (Sinha, 2007).

3. Type of ricotta

Ricotta cheese is divided into three types based on the type of milk (Table 1). First, whole milk ricotta made from whole milk that contains not more than 80% moisture content and less than 11% milk fat. Second, part-skim ricotta made from milk with a reduced fat content that contain 6-11% and moisture content no more than 80%. Third, ricotta from whey or skim milk, which contains milk fat less than 1% and moisture content not more than 82.5% (Patrick, 2004). Whole milk ricotta is soft creamy cheese and has a pleasant and slightly sweet flavor. Ricotta was produced from whey derived from mozzarella or provolone cheese production. Sweet whey has suitable pH of ≥ 6 in order to maintain the sweet flavor of cheese and contain around 0.13-0.14% of lactic acid (Sinha, 2007). The use of ultrafiltration techniques to improve the yield of ricotta cheese has been demonstrated (Maubois and Kosikowski, 1978). Also a continuous manufacturing process for whole milk ricotta cheese with yields of 14.4-15.11 kg/100kg milk was reported (Modler, 1984/1988; Modler and Emmons, 1989). Ricotta has a relatively short shelf-life about 3 weeks if properly packaged and stored at 4°C or lower (True, 1973), although Kosikowski (1967) reported a shelf- life of 70 days for Ricotta made from whole milk and packaged under vacuum, gas flushed and stored at ~4°C (Patrick, 2004).

Table 1: Proximate composition of different types of ricotta cheese (Patrick, 2004)

Compositions	Whole milk	Part-skim	Whey
Moisture (g/100mg)	72	74.5	77
Fat (g/100g)	13	8	2.5
Protein (g/100g)	11	11.5	16
Carbohydrate (g/100g)	3	5	3.5
Ash (g/100g)	1	1	1
Energy (kcal/100g)	174	138	100

4. Process of ricotta production

4.1 The Heat-acid coagulated variety

Ricotta (Italy) and its many relatives, Channa and Paneer (India), some varieties of Latin American white cheese and other cheese varieties are made from sweet whey (pH 6.0 minimum and preferably > 6.3), milk, or blends of milk and sweet whey (Farkye, 2004b).

Heat treatment of milk and whey to 85-90℃ for 5-20 min before acidification (final cheese pH 5.2- 6) to coagulate both casein and denatured whey proteins. The coagulated can then be recovered as a floating (skimmed off) or a sinking curd, which is separated from the whey by draining. Acidification can be achieved using any organic acid, but lactic and citric are most commonly used (Siapantas and Kosikowski, 1973; Torres and Chandan, 1981a, b). For sinking and pressed curd varieties, slow acidification with dilute acid increases curd flocculation during acidification, increases the rate of drainage and makes the cheese less pasty and more sliceable (Parnell-Clunies *et al.,* 1985a).

Moisture of ricotta is high (55-80%) due in part to high water-holding capacity of whey proteins. For both floating and sinking curd varieties, moisture can be reduced somewhat by holding the curd in the hot curd –whey mixture after coagulation. For sinking curd, moisture reduction can be achieved by stirring out during draining, and pressing. Fat is occluded in the protein matrix (Parnell-Clunies *ET al.*1985b, c), but fat recovery is low and variable (55-85%) (Hill *et al.,* 1982; Parnell-Clunies *et al.,* 1985b, c).

A significant flavor determinant is the acidulated (Siapantas and Kosikowski, 1973). For example, more lactic acid flavor can be obtained by acidifying with fermented skim milk. Otherwise, flavor is acquired mainly via further processing, such as boiling Paneer in sweet syrups (Chandan, 1992) and frying heat-acid, Queso Blanco. Residual lactose, which is roughly 3% and varies directly with cheese moisture, ensures color and flavor development during cooking (Hill *et al.,* 1982). Frying and cooking properties of heat-acid varieties are created by their high concentrations of whey proteins, which decrease melt ability and increase water retention cheese.

Relative to Panneer and Channa, which contain no added NaCl , heat-acid Latin American, which cheese generally contains salt in moisture (SM) >5%, which provides adequate microbial stability to allow addition of flavoring condiments (Chandan, 1992). There are also traditional ripened varieties of heat-acid precipitated curd. The best known is Milzithra, a type of whey (ricotta) cheese. Similar to ripened acid coagulated varieties, ripening of Mizithra is accompanied by and depends on dramatic moisture reduction from about 70% to 40% (Weimer, 2007).

MATERIALS AND MENTHODS

1. Preliminary consumer survey on flavor preference

The consumer survey on flavor preference was randomly conducted by using 400 consumers living in Bangkok. The obtained results were analyzed to determine the most popular flavor for developing flavor ricotta cheese.

2. Ricotta cheese production

From preliminary consumer survey, strawberry, banana and chocolate milk were chosen to produce flavor ricotta cheese. One litter of flavored milk was heated to 93°C and stirred to avoid burning of milk. Citric acid (1.5 g) was then added in order to reduce pH of milk, leading to curd formation. Citric acid was needed to clot the whey/milk texture. The curd was left at that temperature for about 10 min to increase in firmness and enhance whey drainage. Then, quick stirring was applied for 15-20 s to break the curd. Whey was drained for 30 min by using cheese clothes, followed by further hanging for 15 min. The curd was weighted and 0.5% salt based on the weight of curd was added and mixed well. Finally, ricotta cheese was packed in the container and kept at 5°C for further analysis.

3. Just about right test (JAR)

Just about right and preference tests were performed by using 30 panelists including staffs and students of Assumption University. The major sensory attributes were flavor, sweetness, saltiness, sourness, texture (softness), and overall liking.

4. Development of prototype product

Based on the result from JAR, there were 2 attributes (sweetness and saltiness) for banana, 1 attribute (saltiness) for chocolate and banana ricotta cheeses needed to be adjusted. The amount of sugar added for banana ricotta cheese was varied as 1.0, 1.2 and 1.4% (w/w of curd). At the same time, the amount of added salt was varied as 0.3, 0.4 and 0.5% (w/w of curd) for banana ricotta cheese; and 0.4, 0.5 and 0.6% for strawberry and chocolate ricotta

cheeses. Sensory analysis of each product was performed by using 9-point hedonic scale preference test and 30 panelists.

5. Consumer acceptance

The prototype products of 3 flavor ricotta cheeses were produced and tested for consumer acceptance using 100 consumers, including staffs and students at Assumption University. The questionnaire used in this part was divided into three parts. The first part was the basic information of consumer's behavior on cheese in the market. The second part was formation of consumer's on each flavor ricotta cheese. The final part was demographic information of consumer. Three flavor ricotta cheeses as banana, strawberry and chocolate were served with bread. The consumers were asked to rinse their mouth with water after tasting of each sample.

6. Determination of some properties of ricotta cheese

6.1 pH

pH was measured using pH meter (pH-211 microprocessor pH meter)

6.2 Moisture content

Moisture content was measured by using oven method (AOAC official method 977.11, moisture content in cheese, 2006). Two gram of samples were placed into dried aluminum pan, placed them in oven at 100°C for one hour, transferred to desiccators half an hour, and weighted.

$$\%\ moisture\ content = \frac{Original\ weight - Oven\ dry\ weight}{Original\ weight} X\ 100$$

6.3 Yield percentage

Yield percentage was calculated follow formulary

$$\text{Yield percentage} = \frac{weight\ of\ cheese}{weight\ of\ raw\ material\ used}\ x\ 100$$

6.4. Texture profile analysis

The sample were measured for softness after leaving from refrigerator at 1.30 min by using texture analyzer (TA-XT plus, Charpa Techcenter Co., Ltd) equipped with Probe at 4mm DIA cylinder stainless, Load cell at 5 kg., test speed at 1 mm/sec, target mode at 50 compression.

6.5. Colorimeter

The sample were measured color by using Colorimeter (HunterLab, model MSEZ) with five points around the plate of sample. Result will get L*, a*, and b* value. Firstly value, L* axis is lightness. Secondly value, a^* axis is with green at negative, and magenta at positive a^* values. Finally value, b^* axis, is with blue at negative and yellow at positive b^* values.

7. Statistics analysis

The Randomize Complete Block Design was used in this experiment. Duncan test was also used to determine significant differences at 95% confidential level. All statistical analysis were performed by using SAS program version 9.3

RESULT AND DISCUSION

1. Preliminary consumer survey on flavor preference

Four hundreds consumers (The Mall Ngam Wong Wan, Public Park, Central Plaza Lard prao, and staffs, students in Assumption University, Hua Mak Campus) participated in the survey. The results were shown in Figures 1 and 2.

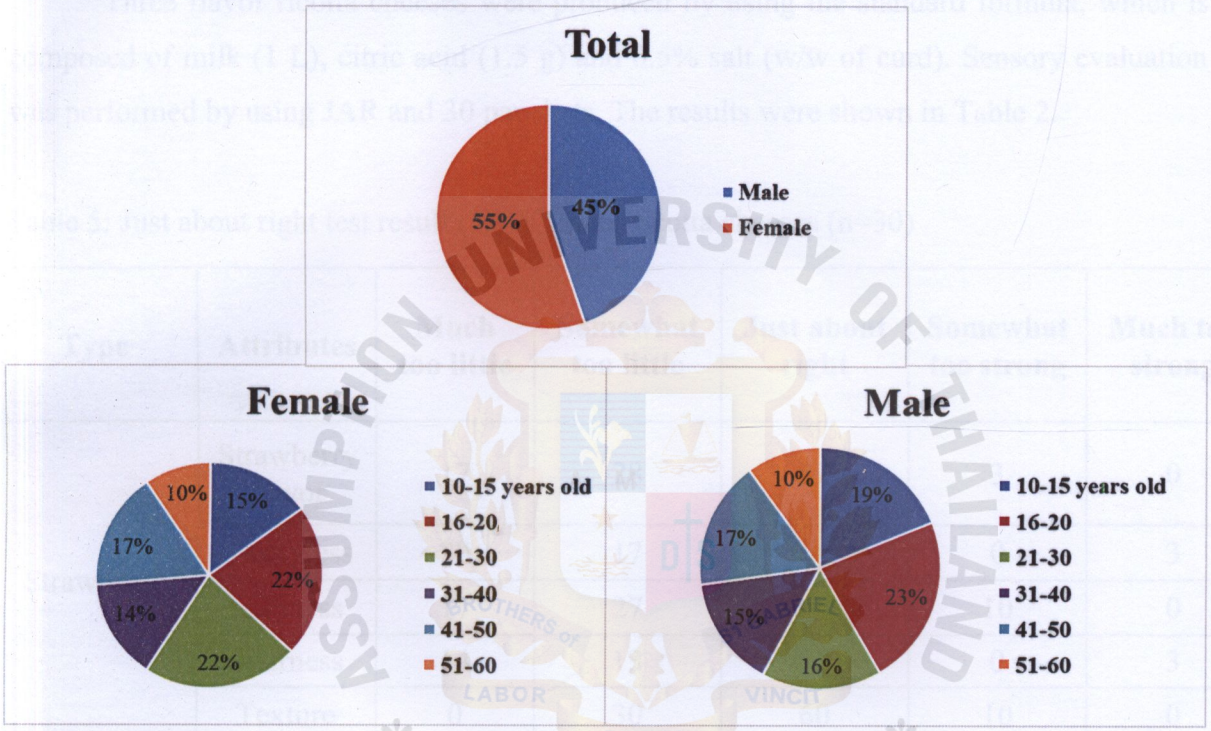

Figure 5.the percentage of male and female in each age groups of consumer survey (n=400)

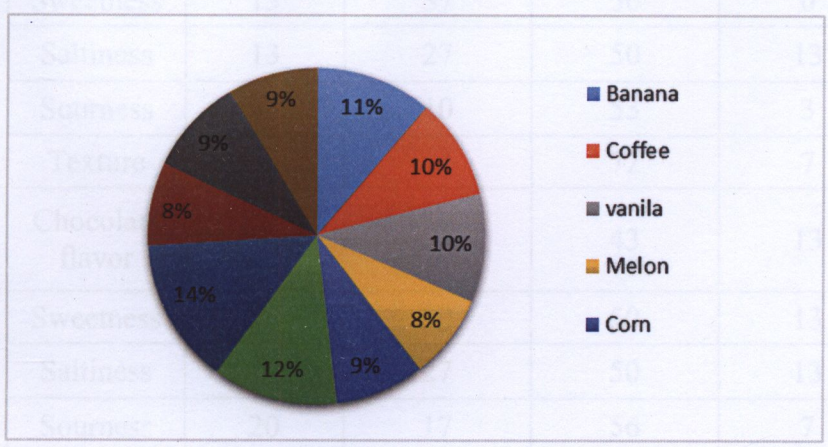

Figure 6: The percentage of preferred flavor of consumer (n=400)

The highest group of survey was female especially in the age range of 16-20 and 21-25 years. It was recognized that the three most popular flavors were chocolate (14%), strawberry (12%) and banana (11%). Therefore, these flavors were chosen for the further steps.

2. Just about right

Three flavor ricotta cheeses were produced by using the standard formula, which is composed of milk (1 L), citric acid (1.5 g) and 0.5% salt (w/w of curd). Sensory evaluation was performed by using JAR and 30 panelists. The results were shown in Table 2.

Table 5: Just about right test result (%) of flavor ricotta cheeses (n=30)

Type	Attributes	Much too little	Somewhat too little	Just about right	Somewhat too strong	Much too strong
Strawberry	Strawberry flavor	17	28	52	3	0
	Sweetness	20	17	60	0	3
	Saltiness	17	27	46	10	0
	Sourness	14	13	70	0	3
	Texture	0	30	60	10	0
Banana	Banana flavor	0	34	43	13	10
	Sweetness	13	37	50	0	0
	Saltiness	13	27	50	13	0
	Sourness	34	10	53	3	0
	Texture	4	14	72	7	3
Chocolate	Chocolate flavor	10	34	43	13	0
	Sweetness	17	20	50	13	0
	Saltiness	10	27	50	13	0
	Sourness	20	17	56	7	0
	Texture	3	14	70	13	0

From Table 2, it was noticed that strawberry ricotta cheese was 46% of just about right in saltiness that trended to somewhat too little. In contrast, the strawberry flavor, sourness, sweetness, and texture of strawberry ricotta cheese had more than 50% of just about right. So, saltiness was adjusted in the further step. For banana ricotta cheese, it was noted that the percentage of banana flavor, sweetness and saltines were lower than 50% of just about right which was somewhat too little. Conversely, texture and sourness of banana ricotta cheese were more than 50% of just about right. So, sweetness and saltines was adjusted. For chocolate ricotta cheese, the percentage of banana flavor was lower than 50% of just about right which was somewhat too little. While, sweetness and saltines were only 50% of just about right and had somewhat too little. Conversely, texture and sourness of chocolate ricotta cheese were more than 50% of just about right. So, chocolate flavor, sweetness and saltiness were adjusted.

Unfortunately, it was noted that the flavor of all flavor ricotta cheese were needed to be adjusted, however, due to the commercial flavor milk was used and the lack to equipment for flavor blending, therefore, the flavor of all ricotta cheeses remained unadjusted.

3. Development of prototype products

For strawberry ricotta cheese, saltiness was adjusted by increasing the amount of salt added in curd as 0.4 (control), 0.5 and 0.6% (w/w of curd). The sensory properties were analyzed by using 9-point hedonic scale preference test and 30 panelists. The results were showed in Table3.

Table 6: Preference scores of Strawberry ricotta cheese with added salt variation (n=30)

Salt (%)	Flavor	Sweetness	Saltiness	Sourness	Texture	Overall
0.4 (Control)	$7.0 \pm 1.2^{b*}$	6.3 ± 1.0^{b}	6.4 ± 1.4^{b}	6.2 ± 1.7^{b}	6.5 ± 1.1^{b}	6.6 ± 1.0^{b}
0.5	7.5 ± 1.2^{a}	7.3 ± 1.3^{a}	7.2 ± 1.6^{a}	7.0 ± 1.4^{a}	6.9 ± 0.7^{a}	7.3 ± 1.2^{a}
0.6	6.9 ± 1.7^{b}	6.3 ± 1.3^{b}	6.2 ± 2.1^{b}	6.1 ± 2.0^{b}	6.1 ± 0.8^{c}	6.1 ± 1.4^{c}

*Treatments with different superscripted letters are significantly different at $p \leq 0.05$

From Table 3, it could be seen that the strawberry ricotta cheese with 0.5% salt obtained significantly ($p \leq 0.05$) higher scores than that of control (0.4%) and 0.6% in all attributes as strawberry flavor (7.5), sweetness (7.3), saltiness (7.2), sourness (7.0), texture (6.9) and overall acceptance (7.3). Strawberry ricotta cheese with 0.4 and 0.6% salt had no

significant differences ($p>0.05$) in all attributes. It was implied that either increasing or reducing salt by 1% can lead to the changes in other product attributes rather than saltiness. Therefore, 0.5% salt was chosen for further study of strawberry ricotta cheese.

For banana ricotta cheese, sweetness was adjusted by varying the amount of added sugar as 0.0 (control), 0.2 and 0.4% in banana milk. The sensory properties were analyzed by using 9-point hedonic scale preference test and 30 panelists. The results were showed in Table 4.

Table 4: Preference scores of Banana ricotta cheese with varying of sugar added (n=30)

Sugar (%)	Flavor	Sweetness	Saltiness	Sourness	Texture	Overall
0 (Control)	6.6 ± 1.6^{a}	6.2 ± 1.4^{b}	6.3 ± 1.9^{a}	6.2 ± 1.6^{ab}	6.6 ± 0.8^{ab}	6.4 ± 1.9^{b}
0.2	6.6 ± 1.4^{a}	6.4 ± 1.4^{ab}	6.2 ± 1.8^{a}	5.8 ± 1.5^{b}	6.3 ± 1.1^{b}	6.4 ± 1.5^{ab}
0.4	7.0 ± 1.5^{a}	6.8 ± 1.5^{a}	6.7 ± 1.7^{a}	6.4 ± 0.6^{a}	6.7 ± 0.6^{a}	6.9 ± 1.0^{a}

*Treatments with different superscripted letters are significantly different at $p \leq 0.05$

From Table 4, It was noticed that banana ricotta cheese containing 0.4% added sugar obtained a significantly ($p \leq 0.05$) higher preference scores in all attribute than those of control and 0.2%. On the other hand, banana flavor and saltiness of all samples were not significant ($p > 0.05$) differences. At a same time, samples of 0.0% and 0.2% were not significant different ($p > 0.05$) in all attributes. However, sample of 0.4% had the highest scores in all attributes as banana flavor (7.0), sweetness (6.8), saltiness (6.7), sourness (6.4), texture (6.7) and overall acceptance (6.9). Thus, 0.4% added sugar in banana ricotta cheese was selected for saltiness adjustment.

For saltiness adjustment of banana ricotta cheese, the amount of added salt was varied as 0.4, 0.5 (control) and 0.6% (w/w of curd). The sensory properties were analyzed by using 9-point hedonic scale preference test and 30 panelists. The results were showed in Table5

Table 7: Preference scores of Banana ricotta cheese with varying of salt added (n=30)

Salt (%)	Flavor	Sweetness	Saltiness	Sourness	Texture	Overall
0.4 (control)	6.8 ± 1.3^{a}	6.6 ± 1.2^{b}	6.5 ± 1.7^{b}	6.1 ± 1.3^{a}	6.5 ± 1.1^{b}	6.8 ± 1.3^{b}
0.5	7.1 ± 1.0^{a}	7.3 ± 0.8^{a}	7.6 ± 1.0^{a}	6.3 ± 1.5^{a}	7.0 ± 0.7^{a}	7.4 ± 0.8^{a}
0.3	7.0 ± 1.4^{a}	6.8 ± 1.3^{b}	6.7 ± 1.7^{b}	6.3 ± 0.6^{a}	6.8 ± 0.7^{ab}	7 ± 1.0^{b}

*Treatments with different superscripted letters are significantly different at $p \leq 0.05$

From Table 5, it could be seen that the banana ricotta cheese with 0.5% salt obtained significantly ($p \leq 0.05$) higher preference scores than that of control (0.4%) and 0.3% in all attributes as banana flavor (7.1), sweetness (7.3), saltiness (7.6), sourness (6.3), texture (6.8) and overall acceptance (7.4). In contrast, banana flavor, sourness attributes were not significant differences ($p > 0.05$). Meanwhile, samples of 0.3 and 0.4% were not significant different ($p > 0.05$) in all attributes. Therefore, 0.5% salt was chosen for further study of banana ricotta cheese.

For chocolate ricotta cheese, saltiness was adjusted by increasing the amount of salt added in curd as 0.4 (control), 0.5 and 0.6% (w/w of curd). The sensory properties were analyzed by using 9-point hedonic scale preference test and 30 panelists. The results were showed in Table 6.

Table 8: Preference scores of Chocolate ricotta cheese with varying of salt added (n=30)

Salt (%)	Flavor	Sweetness	Saltiness	Sourness	Texture	Overall
0.4 (Control)	7.0 ± 0.8^{a}	8.0 ± 0.7^{a}	7.1 ± 0.8^{b}	7.3 ± 0.7^{b}	7.9 ± 0.8^{a}	6.9 ± 0.8^{b}
0.5	7.4 ± 0.6^{a}	8.0 ± 0.7^{a}	7.9 ± 0.6^{a}	7.6 ± 0.9^{a}	8.1 ± 0.6^{a}	7.8 ± 0.7^{a}
0.6	7.0 ± 0.8^{a}	7.8 ± 0.9^{a}	6.6 ± 0.7^{c}	6.5 ± 0.5^{c}	7.6 ± 1.0^{b}	7.0 ± 0.8^{b}

*Treatments with different superscripted letters are significantly different at $p \leq 0.05$

From Table 6, it was noticed that chocolate ricotta cheese containing 0.5% salt obtained significantly ($p \leq 0.05$) higher preference scores in all attribute than those of 0.4 (control) and 0.6% as chocolate flavor (7.4), sweetness (8.0), saltiness (7.9), sourness (7.6), texture (8.1) and overall acceptance (7.8). At the same time, saltiness, sourness, and texture in all samples were significantly differences ($p \leq 0.05$). On the other hand, chocolate flavor and sweetness of all samples were not significant difference ($p>0.05$). Moreover, samples of

0.4% and 0.6% were not significant different ($p>0.05$) in overall acceptance. Therefore, 0.5% salt was chosen for further study of chocolate ricotta cheese.

4. Consumer acceptance

The consumer acceptance survey was conducted by using questionnaire and 9-hedonic scale preference test. One hundred consumers including staffs and students at Assumption University, Hua-mak Campus, were involved in the survey. The questionnaire composed of three parts. The first part was basic information of consumer's behavior on cheese in the market. The second part was consumer's preference on each flavor of ricotta cheeses including chocolate, strawberry, and banana ricotta cheese. The final part was demographic information of consumers. The results were demonstrated in Figures 3 to 4.

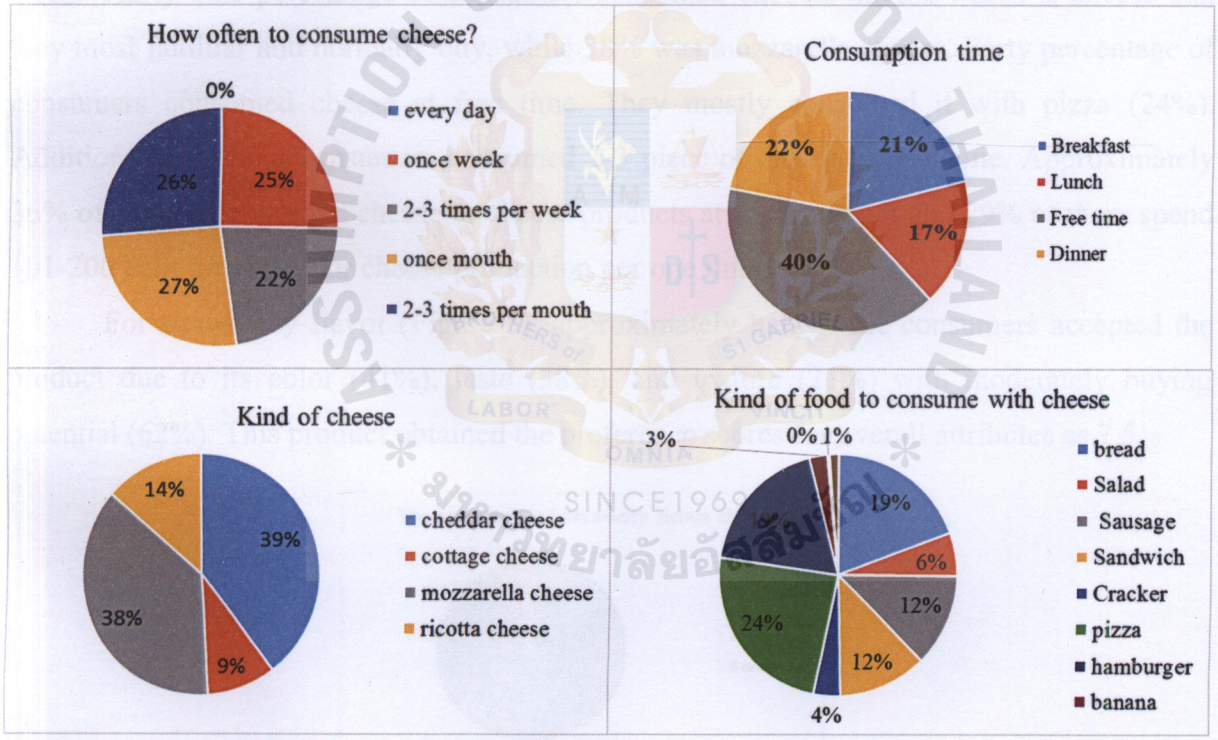

Figure 7: Eating behavior's of consumer (n=100)

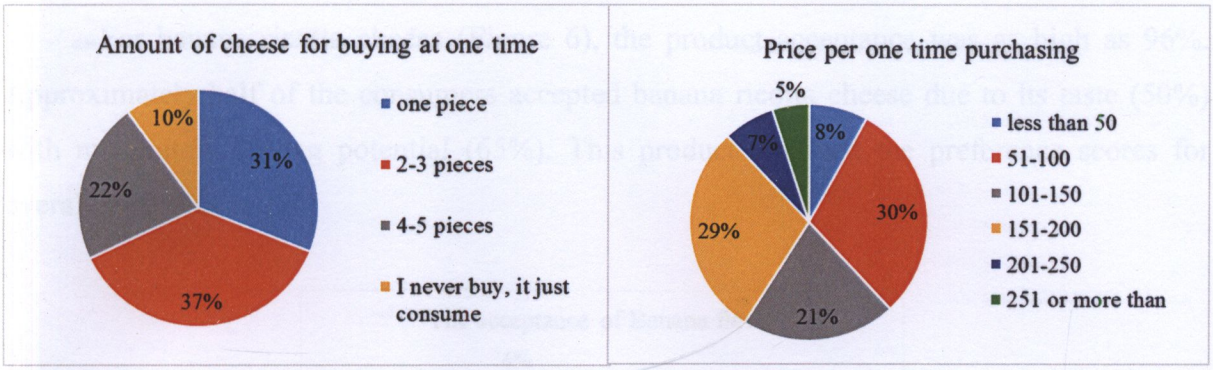

Figure 8: Buying behavior of consumer (n=100)

For eating behavior, it was noticed that 27% of consumers consumed cheese or cheese product once a month, 26% for once a week, 2-3 time per mouth and 22% for 2-3 time per week. Thirty nine percentage of consumers consumed cheddar cheese which is cheese that they most familiar and normally buy, while 38% was mozzarella cheese. Forty percentage of consumers consumed cheese at free time. They mostly consumed it with pizza (24%). Additionally, 37% of consumers consumed 2-3 piece of cheese at one time. Approximately 36% of consumers bought cheese or cheese products at super market and 29% of them spend 101-200 baht for cheese or cheese production per one time

For strawberry flavor (Figure 5), approximately half of the consumers accepted the product due to its color (41%), taste (38%), and texture (21%) with moderately buying potential (62%). This product obtained the preference scores for overall attributes as 7.5.

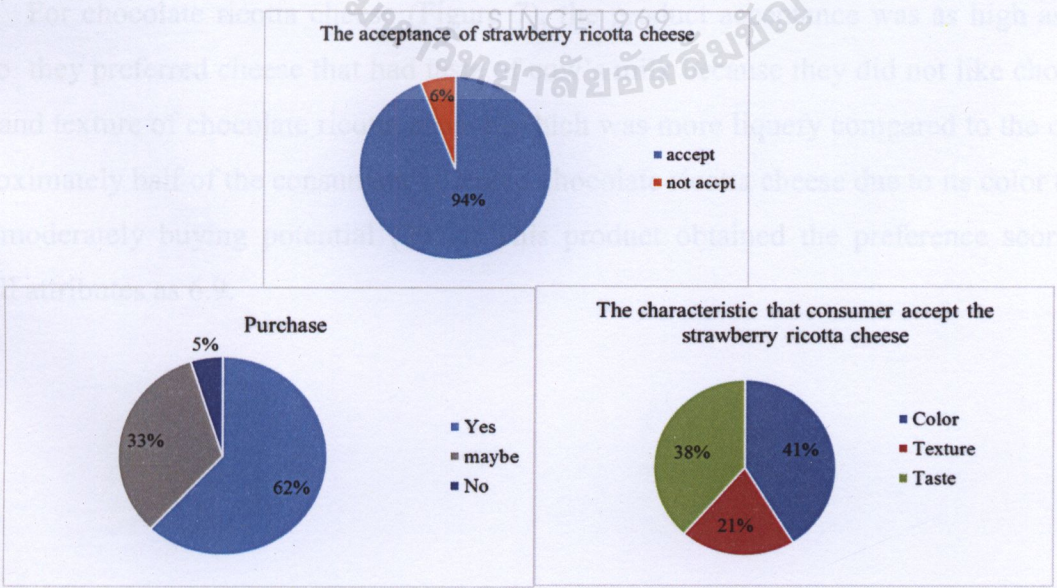

Figure 5: Consumer acceptance of strawberry ricotta cheese (n=100)

For banana ricotta cheese (Figure 6), the product acceptance was as high as 96%. Approximately half of the consumers accepted banana ricotta cheese due to its taste (50%) with moderately buying potential (65%). This product obtained the preference scores for overall attributes as 7.7.

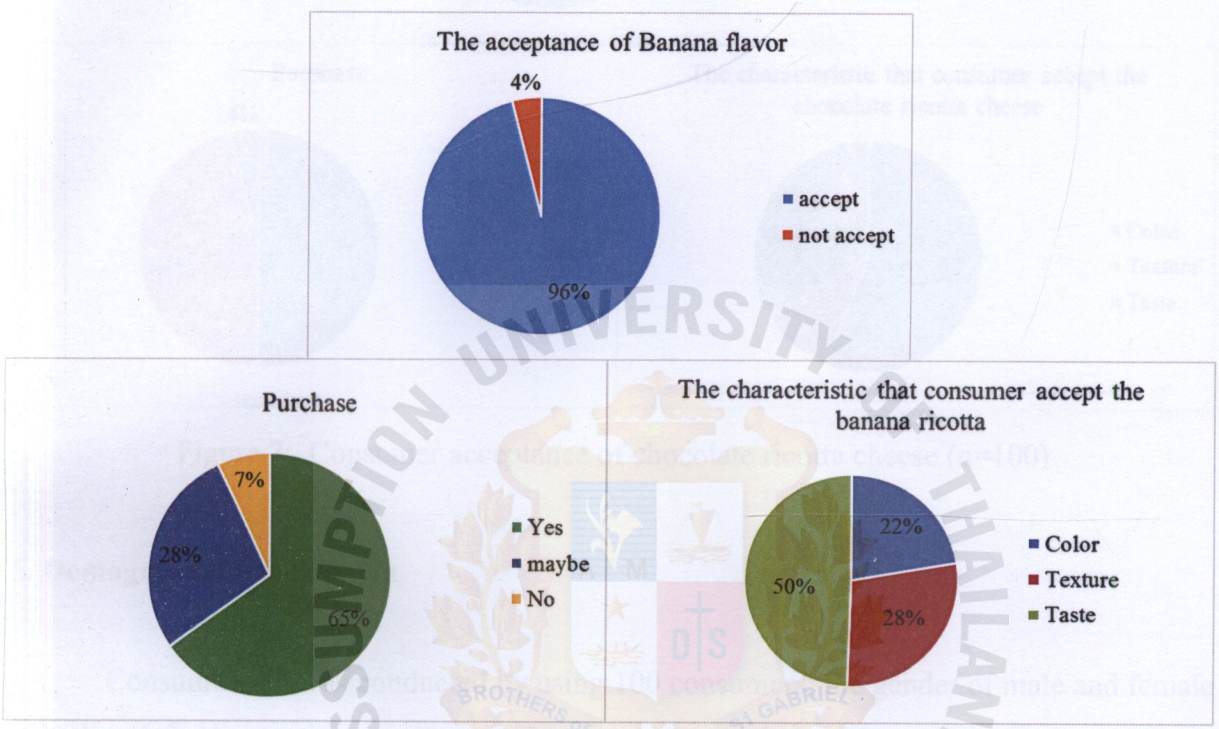

Figure 6: Consumer acceptance of banana ricotta cheese (n=100)

For chocolate ricotta cheese (Figure 7), the product acceptance was as high as 88% due to they preferred cheese that had taste of cow's milk because they did not like chocolate milk and texture of chocolate ricotta cheese, which was more liquefy compared to the others. Approximately half of the consumers accepted chocolate ricotta cheese due to its color (56%) with moderately buying potential (50%). This product obtained the preference scores for overall attributes as 6.9.

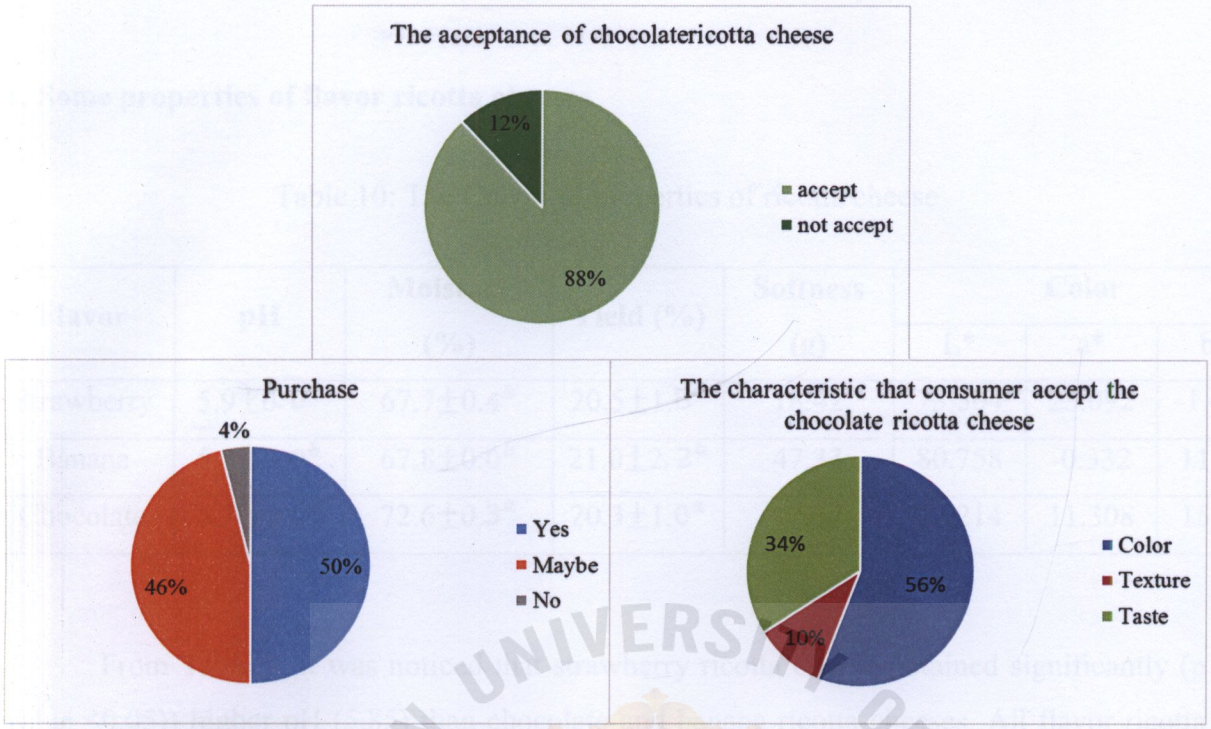

Figure 7: Consumer acceptance of chocolate ricotta cheese (n=100)

5. Demographic information

Consumer test was conducted by using 100 consumers; the gender of male and female was about1:2. Ninety six percentages of consumers participate this test were Asian students. Most of age group was 20-29 years old (62%), which less than 20 years old (34%) (Table 7).

Table 9: The percentage of demographic information of consumer (n=100)

Gender	Male	37%
	Female	63%
Age	Less than 20 years old	34%
	20-29	62%
	30-39	2%
	40-49	1%
	50-59	1%
	60 years and more than	0%
Occupation	Student	96%
	Employee	4%
Nationality	Asian	100%

6. Some properties of flavor ricotta cheeses

Table 10: The Chemical properties of ricotta cheese

Flavor	pH	Moisture (%)	Yield (%)	Softness (g)	Color		
					L*	a*	b*
Strawberry	5.9 ± 0.0^{a}	67.7 ± 0.4^{b}	20.5 ± 1.8^{a}	18.42	73.504	25.092	-1.498
Banana	5.8 ± 0.0^{b}	67.8 ± 0.0^{b}	21.0 ± 2.2^{a}	47.33	80.758	-0.332	11.18
Chocolate	5.7 ± 0.0^{c}	72.6 ± 0.3^{a}	20.3 ± 1.0^{a}	12.37	47.214	11.308	15.73

From Table 8, it was noticed that strawberry ricotta cheese obtained significantly (p value $\leq$0.05)) higher pH (5.85) than chocolate and banana ricotta cheeses. All flavor ricotta cheeses had pH within the standard range of 5.2- 6.0. Moreover, chocolate ricotta cheese obtained higher moisture content (73%) than strawberry (67.7%) and banana (67.8%) ricotta cheeses that both were not significant different ($p>0.05$). All flavor ricotta cheeses had the moisture contents in the a range of standard moisture content (55-80%) (Patrick, 2004). Additionally, % yield of all flavor ricotta cheeses were not significant different ($p>0.05$). Moreover, the texture of chocolate ricotta cheese was the highest in term of softness (12.37 g) than strawberry (18.42 g) and banana ricotta cheese (47.33 g). For L*, a* and b* values, strawberry ricotta cheese had light magenta blue color, banana ricotta cheese had light green yellow, and chocolate ricotta cheese had dark magenta yellow color (Figure 8).

Figure 8: Color of strawberry, banana, and chocolate ricotta cheese

CONCLUSION

Prototype formula of chocolate ricotta cheese was 100.00% chocolate milk, 0.15% citric acid, and 0.50% salt; Strawberry ricotta cheese was 100.00% strawberry milk, 0.15% citric acid, and 0.50% salt; and Banana ricotta cheese was 100.00%% banana milk, 0.15% citric acid, 0.40% added sugar, and 0.50% salt. Banana ricotta cheese had 96% acceptance with the preference score of 7.7; strawberry ricotta cheese had 94% consumer acceptance with the preference score of 7.5; and chocolate ricotta cheese had 88% consumer acceptance with the preference score of 6.9. Flavor ricotta cheeses had pH 5.7-5.9, moisture 67.7-72.6% and yield 20.3-21.0%. For texture, chocolate ricotta cheese the texture of chocolate ricotta cheese was highest softness (12.37) than strawberry (18.42) and banana ricotta cheese (47.33) respectively. Moreover, strawberry ricotta cheese had light magenta blue color, banana ricotta cheese light green yellow, and chocolate ricotta cheese had dark magenta yellow color.

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APPENDIX A
STATISTICAL ANALYSIS

* Statistical analysis use ANOVA at $\alpha = 0.05$ and test treatment means with Duncan's multiple range test at $\alpha = 0.05$

1.1 Chocolate test: varying % salt

The ANOVA Procedure

Dependent Variable: Flavor

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	42.76396105	1.33637378	7.24	<.0001
Error	146	26.94553615	0.18455847		
Corrected Total	178	69.70949721			

R-Square	Coeff Var	Root MSE	Flavor Mean
0.613460	5.883617	0.429603	7.301676

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	0.87305653	0.43652826	2.37	0.0975
Panel	29	41.70949721	1.43825852	7.79	<.0001
dup	1	0.18140732	0.18140732	0.98	0.3231

Dependent Variable: Sweetness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	15.4836648	0.4838645	0.81	0.7484
Error	146	86.8403575	0.5947970		
Corrected Total	178	102.3240223			

R-Square	Coeff Var	Root MSE	Sweetness Mean
0.151320	9.715012	0.771231	7.938547

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	2.22176246	1.11088123	1.87	0.1582
Panel	29	10.29068901	0.35485135	0.60	0.9478
dup	1	2.97121336	2.97121336	5.00	0.0269

Dependent Variable: Saltiness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	79.3828180	2.4807131	5.79	<.0001
Error	146	62.5501429	0.4284256		
Corrected Total	178	141.9329609			

R-Square	Coeff Var	Root MSE	Saltiness Mean
0.559298	9.075374	0.654542	7.212291

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	54.56233942	27.28116971	63.68	<.0001
Panel	29	22.63296089	0.78044693	1.82	0.0113
dup	1	2.18751770	2.18751770	5.11	0.0253

Dependent Variable: Sourness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	45.0853126	1.4089160	2.65	<.0001
Error	146	77.6968103	0.5321699		
Corrected Total	178	122.7821229			

R-Square	Coeff Var	Root MSE	Sourness Mean
0.367198	10.22556	0.729500	7.134078

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	38.85302686	19.42651343	36.50	<.0001
Panel	29	6.14878957	0.21202723	0.40	0.9975
dup	1	0.08349619	0.08349619	0.16	0.6926

Dependent Variable: Texture

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	43.8219734	1.3694367	2.30	0.0004
Error	146	86.9601495	0.5956175		
Corrected Total	178	130.7821229			

R-Square	Coeff Var	Root MSE	Texture Mean
0.335076	9.811470	0.771763	7.865922

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	9.90641669	4.95320835	8.32	0.0004
Panel	29	33.91545624	1.16949849	1.96	0.0050
dup	1	0.00010043	0.00010043	0.00	0.9897

Dependent Variable: Overall

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	69.0145660	2.1567052	5.67	<.0001
Error	146	55.4882273	0.3800564		
Corrected Total	178	124.5027933			

R-Square	Coeff Var	Root MSE	Overall Mean
0.554321	8.541114	0.616487	7.217877

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	25.58725657	12.79362829	33.66	<.0001
Panel	29	43.36945996	1.49549862	3.93	<.0001
dup	1	0.05784948	0.05784948	0.15	0.6970

Duncan's Multiple Range Test

Control = 404
Treatment 1 = 245
Treatment 2 = 439

- Flavor

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.40000	60	404
A			
A	7.25424	59	439
A			
A	7.25000	60	245

- Sweetness

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	8.0167	60	245
A			
A	8.0167	60	404
A			
A	7.7797	59	439

- Saltiness

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.9333	60	404
B	7.1000	60	245
C	6.5932	59	439

- Sourness

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.6333	60	404
B	7.2500	60	245
C	6.5085	59	439

- Texture

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	8.1333	60	404
A			
A	7.9000	60	245
B	7.5593	59	439

- Overall acceptance

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.7500	60	404
B	6.9661	59	439
B			
B	6.9333	60	245

1.2 Strawberry test: varying % salt

The ANOVA Procedure

Dependent Variable: Flavor

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	133.3555556	4.1673611	2.95	<.0001
Error	147	207.5944444	1.4122071		
Corrected Total	179	340.9500000			

R-Square	Coeff Var	Root MSE	Flavor Mean
0.391129	16.62046	1.188363	7.150000

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	11.1000000	5.5500000	3.93	0.0217
Panel	29	122.1166667	4.2109195	2.98	<.0001
dup	1	0.1388889	0.1388889	0.10	0.7543

Dependent Variable: Sweetness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	106.1222222	3.3163194	2.55	<.0001
Error	147	191.1222222	1.3001512		
Corrected Total	179	297.2444444			

R-Square	Coeff Var	Root MSE	Sweetness Mean
0.357020	17.16083	1.140242	6.644444

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	38.67777778	19.33888889	14.87	<.0001
Panel	29	67.24444444	2.31877395	1.78	0.0140
dup	1	0.20000000	0.20000000	0.15	0.6955

Dependent Variable: Saltiness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	213.2777778	6.6649306	2.77	<.0001
Error	147	354.3000000	2.4102041		
Corrected Total	179	567.5777778			

R-Square	Coeff Var	Root MSE	Saltiness Mean
0.375768	23.56214	1.552483	6.588889

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	31.6777778	15.8388889	6.57	0.0018
Panel	29	181.2444444	6.2498084	2.59	0.0001
dup	1	0.3555556	0.3555556	0.15	0.7015

Dependent Variable: Sourness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	193.2111111	6.0378472	2.46	0.0002
Error	147	361.4333333	2.4587302		
Corrected Total	179	554.6444444			

R-Square	Coeff Var	Root MSE	Sourness Mean
0.348351	24.28968	1.568034	6.455556

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	28.5444444	14.2722222	5.80	0.0037
Panel	29	164.3111111	5.6659004	2.30	0.0006
dup	1	0.3555556	0.3555556	0.14	0.7043

Dependent Variable: Texture

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	47.6555556	1.4892361	2.00	0.0030
Error	147	109.2055556	0.7428949		
Corrected Total	179	156.8611111			

R-Square	Coeff Var	Root MSE	Texture Mean
0.303807	13.31712	0.861914	6.472222

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	20.84444444	10.42222222	14.03	<.0001
Panel	29	26.36111111	0.90900383	1.22	0.2178
dup	1	0.45000000	0.45000000	0.61	0.4376

Dependent Variable: Overall

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	120.3111111	3.7597222	3.04	<.0001
Error	147	182.0166667	1.2382086		
Corrected Total	179	302.3277778			

R-Square	Coeff Var	Root MSE	Overall Mean
0.397949	16.70514	1.112748	6.661111

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	48.67777778	24.33888889	19.66	<.0001
Panel	29	71.49444444	2.46532567	1.99	0.0042
dup	1	0.13888889	0.13888889	0.11	0.7382

Duncan's Multiple Range Test

Control = 404
Treatment 1 = 245
Treatment 2 = 439

- Flavor

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.5000	60	245
B	7.0000	60	404
B			
B	6.9500	60	439

- Sweetness

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.3000	60	245
B	6.3167	60	404
B			
B	6.3167	60	439

- Saltiness

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.1667	60	245
B	6.4167	60	404
B			
B	6.1833	60	439

- Sourness

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.0167	60	245
B	6.2167	60	404
B			
B	6.1333	60	439

- Texture

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	6.8833	60	245
B	6.4833	60	404
C	6.0500	60	439

- Overall acceptance

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.3333	60	245
B	6.5833	60	404
C	6.0667	60	439

1.3 Banana test: varying % sugar

The ANOVA Procedure

Dependent Variable: Flavor

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	153.8444444	4.8076389	2.77	<.0001
Error	147	254.8833333	1.7339002		
Corrected Total	179	408.7277778			

R-Square	Coeff Var	Root MSE	Flavor Mean
0.376398	19.53996	1.316776	6.738889

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	4.0111111	2.0055556	1.16	0.3174
Panel	29	148.2277778	5.1113027	2.95	<.0001
dup	1	1.6055556	1.6055556	0.93	0.3375

Dependent Variable: Sweetness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	118.9555556	3.7173611	2.36	0.0003
Error	147	231.5944444	1.5754724		
Corrected Total	179	350.5500000			

R-Square	Coeff Var	Root MSE	Sweetness Mean
0.339340	19.46013	1.255178	6.450000

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	8.6333333	4.3166667	2.74	0.0679
Panel	29	109.3833333	3.7718391	2.39	0.0004
dup	1	0.9388889	0.9388889	0.60	0.4414

Dependent Variable: Saltiness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	187.2111111	5.8503472	2.15	0.0012
Error	147	400.8500000	2.7268707		
Corrected Total	179	588.0611111			

R-Square	Coeff Var	Root MSE	Saltiness Mean
0.318353	25.91441	1.651324	6.372222

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	6.9777778	3.4888889	1.28	0.2813
Panel	29	178.2277778	6.1457854	2.25	0.0009
dup	1	2.0055556	2.0055556	0.74	0.3925

Dependent Variable: Sourness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	124.7000000	3.8968750	3.07	<.0001
Error	147	186.3000000	1.2673469		
Corrected Total	179	311.0000000			

R-Square	Coeff Var	Root MSE	Sourness Mean
0.400965	18.25565	1.125765	6.166667

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	7.9000000	3.9500000	3.12	0.0472
Panel	29	116.0000000	4.0000000	3.16	<.0001
dup	1	0.8000000	0.8000000	0.63	0.4282

Dependent Variable: Texture

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	36.0111111	1.1253472	1.61	0.0313
Error	147	102.8500000	0.6996599		
Corrected Total	179	138.8611111			

R-Square	Coeff Var	Root MSE	Texture Mean
0.259332	12.81381	0.836457	6.527778

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	4.31111111	2.15555556	3.08	0.0489
Panel	29	31.69444444	1.09291188	1.56	0.0458
dup	1	0.00555556	0.00555556	0.01	0.9291

Dependent Variable: Overall

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	147.2222222	4.6006944	2.61	<.0001
Error	147	259.3277778	1.7641345		
Corrected Total	179	406.5500000			

R-Square	Coeff Var	Root MSE	Overall Mean
0.362126	20.27797	1.328207	6.550000

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	9.2333333	4.6166667	2.62	0.0764
Panel	29	136.3833333	4.7028736	2.67	<.0001
dup	1	1.6055556	1.6055556	0.91	0.3417

Duncan's Multiple Range Test

Control = 439
Treatment 1 = 245
Treatment 2 = 404

- Flavor

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	6.9500	60	404
A			
A	6.6333	60	245
A			
A	6.6333	60	439

- Sweetness

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	6.7500	60	404
A			
B A	6.3667	60	245
B			
B	6.2333	60	439

- Saltiness

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	6.6500	60	404
A			
A	6.2500	60	439
A			
A	6.2167	60	245

- Sourness

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	Treatment
	A	6.3833	60	404
	A			
B	A	6.2333	60	439
B				
B		5.8833	60	245

- Texture

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	Treatment
	A	6.6833	60	404
	A			
B	A	6.5833	60	439
B				
B		6.3167	60	245

- Overall acceptance

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	Treatment
	A	6.8667	60	404
	A			
B	A	6.4333	60	245
B				
B		6.3500	60	439

1.4 Banana test: varying % Salt

The ANOVA Procedure

Dependent Variable: Flavor

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	115.8444444	3.6201389	3.28	<.0001
Error	147	162.4833333	1.1053288		
Corrected Total	179	278.3277778			

R-Square	Coeff Var	Root MSE	Flavor Mean
0.416216	15.15151	1.051346	6.938889

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	3.3444444	1.6722222	1.51	0.2237
Panel	29	112.4944444	3.8791188	3.51	<.0001
dup	1	0.0055556	0.0055556	0.01	0.9436

Dependent Variable: Sweetness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	108.6777778	3.3961806	3.65	<.0001
Error	147	136.6333333	0.9294785		
Corrected Total	179	245.3111111			

R-Square	Coeff Var	Root MSE	Sweetness Mean
0.443020	14.01753	0.964095	6.877778

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	16.67777778	8.33888889	8.97	0.0002
Panel	29	91.97777778	3.17164751	3.41	<.0001
dup	1	0.02222222	0.02222222	0.02	0.8773

Dependent Variable: Saltiness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	195.4222222	6.1069444	3.73	<.0001
Error	147	240.7777778	1.6379441		
Corrected Total	179	436.2000000			

R-Square	Coeff Var	Root MSE	Saltiness Mean
0.448011	18.54814	1.279822	6.900000

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	41.2000000	20.6000000	12.58	<.0001
Panel	29	154.2000000	5.3172414	3.25	<.0001
dup	1	0.0222222	0.0222222	0.01	0.9074

Dependent Variable: Sourness

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	103.2000000	3.2250000	2.85	<.0001
Error	147	166.5500000	1.1329932		
Corrected Total	179	269.7500000			

R-Square	Coeff Var	Root MSE	Sourness Mean
0.382576	17.03074	1.064422	6.250000

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	3.23333333	1.61666667	1.43	0.2434
Panel	29	99.91666667	3.44540230	3.04	<.0001
dup	1	0.05000000	0.05000000	0.04	0.8339

Dependent Variable: Texture

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	31.9000000	0.9968750	1.50	0.0570
Error	147	97.8500000	0.6656463		
Corrected Total	179	129.7500000			

R-Square	Coeff Var	Root MSE	Texture Mean
0.245857	12.08698	0.815871	6.750000

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	5.73333333	2.86666667	4.31	0.0152
Panel	29	24.91666667	0.85919540	1.29	0.1649
dup	1	1.25000000	1.25000000	1.88	0.1727

Dependent Variable: Overall

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	55.7111111	1.7409722	1.85	0.0077
Error	147	138.3500000	0.9411565		
Corrected Total	179	194.0611111			

R-Square	Coeff Var	Root MSE	Overall Mean
0.287080	13.71750	0.970132	7.072222

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	9.87777778	4.93888889	5.25	0.0063
Panel	29	44.89444444	1.54808429	1.64	0.0297
dup	1	0.93888889	0.93888889	1.00	0.3195

Duncan's Multiple Range Test

Control = 245
Treatment 1 = 439
Treatment 2 = 404

- Flavor

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.0667	60	439
A			
A	7.0000	60	404
A			
A	6.7500	60	245

- Sweetness

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.2833	60	439
B	6.8000	60	404
B			
B	6.5500	60	245

- Saltiness

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.5667	60	439
B	6.6667	60	404
B			
B	6.4667	60	245

- Sourness

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	6.3833	60	404
A			
A	6.3000	60	439
A			
A	6.0667	60	245

- Texture

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	Treatment
	A	6.9500	60	439
	A			
B	A	6.7833	60	404
B				
B		6.5167	60	245

- Overall acceptance

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	7.4000	60	439
B	6.9500	60	404
B			
B	6.8667	60	245

1.5 Final test : overall acceptance with each flavor ricotta cheese

The ANOVA Procedure

Dependent Variable: overall acceptance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	101	271.1100000	2.6842574	3.75	<.0001
Error	198	141.8066667	0.7161953		
Corrected Total	299	412.9166667			

R-Square	Coeff Var	Root MSE	Score Mean
0.656573	11.46208	0.846283	7.383333

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Sample	2	41.5266667	20.7633333	28.99	<.0001
Panelist	99	229.5833333	2.3190236	3.24	<.0001

Duncan's Multiple Range Test

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Sample
A	7.7400	100	banana
A			
A	7.5400	100	strawberry
B	6.8700	100	chocolate

1.6 Chemical properties

The ANOVA Procedure

Dependent Variable: PH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	0.06000000	0.01500000	1.66E14	<.0001
Error	4	0.00000000	0.00000000		
Corrected Total	8	0.06000000			

R-Square	Coeff Var	Root MSE	PH Mean
1.000000	1.65177E-7	9.49766E-9	5.750000

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	0.06000000	0.03000000	3.33E14	<.0001
time	2	0.00000000	0.00000000	0.00	1.0000

Dependent Variable: moisture

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	47.72462069	11.93115517	82.06	0.0004
Error	4	0.58155249	0.14538812		
Corrected Total	8	48.30617318			

R-Square	Coeff Var	Root MSE	moisture Mean
0.987961	0.549662	0.381298	69.36957

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	47.69541536	23.84770768	164.03	0.0001
time	2	0.02920533	0.01460266	0.10	0.9067

Dependent Variable: yield

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	11.48444444	2.87111111	1.57	0.3365
Error	4	7.31777778	1.82944444		
Corrected Total	8	18.80222222			

R-Square	Coeff Var	Root MSE	yield Mean
0.610803	6.564101	1.352570	20.60556

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Treatment	2	0.75055556	0.37527778	0.21	0.8226
time	2	10.73388889	5.36694444	2.93	0.1643

Duncan's Test

Duncan's Multiple Range Test for PH

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	9.02E-17

Number of Means	2	3
Critical Range	.00000002153	.00000002200

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	5.8500000	3	Strawber

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
B	5.7500000	3	Banana
C	5.6500000	3	Chocolat

Duncan's Multiple Range Test for moisture

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.145388

Number of Means	**2**	**3**
Critical Range	.8644	.8833

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	Treatment
A	72.6249	3	Chocolate
B	67.7785	3	Banana
B			
B	67.7053	3	Strawberry

Duncan's Multiple Range Test for yield

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	1.829444

Number of Means	**2**	**3**
Critical Range	3.066	3.133

Means with the same letter are not significantly different.

Duncan Grouping	**Mean**	**N**	**Treatment**
A	21.000	3	Banana
A			
A	20.500	3	Strawberry
A			
A	20.317	3	Chocolate

1.1

APPENDIX B
GRAPH

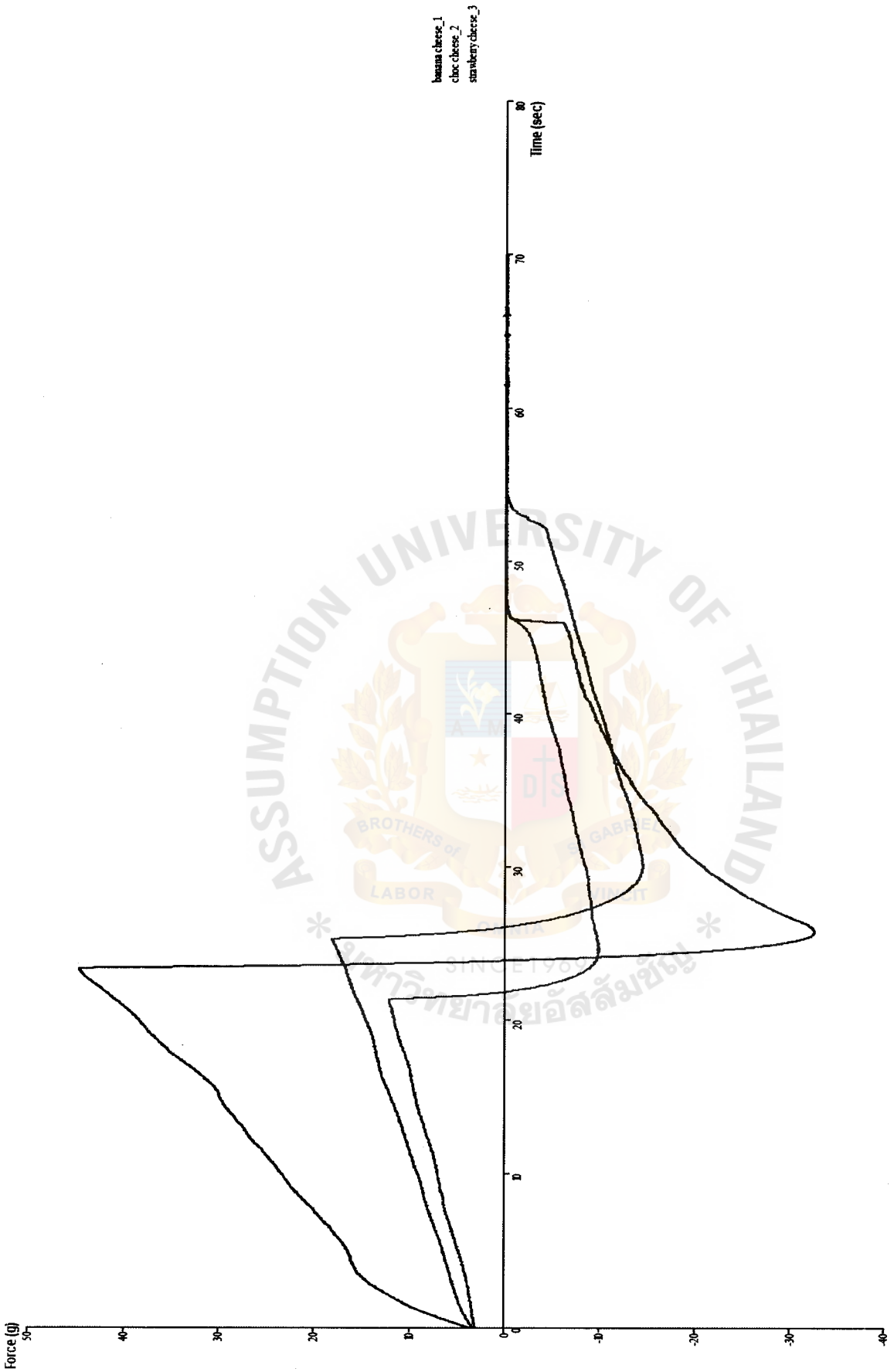

Figure 9: Graph was showed the softness texture of flavor ricota chesse

APPENDIX C
QUESTIONER

แบบสำรวจ

เรื่อง รสชาติ และ กลิ่น ของเนยแข็ง

เพศ ( ) หญิง ( )ชาย

อายุ ( ) 10-15 ( ) 16-20 ( ) 21-30

( ) 31-40 ( ) 41-50 ( ) 51-60

คำชี้แจง : หากมีการผลิตเนยแข็งที่มีรสชาติ และ กลิ่นที่แตกต่างกัน ท่านอยากให้เนยแข็งมีรสชาติ และ กลิ่นแบบใดมากที่สุด (เลือกมา 5 ข้อ)

( ) สตอร์เบอรี่ ( ) วนิลา

( ) กาแฟ ( ) ช็อคโกแล็ต

( ) กล้วย ( ) Butterscotch

( ) เมล่อน ( ) ชาเขียว

( ) ข้าวโพด ( ) น้ำผึ้ง

Questionnaire

Please test the sample and choose the statement and score the sample following the preference test of 9-point hedonic score below at the last for each attribute.

กรุณาชิมตัวอย่างที่เสนอ พร้อมให้คะแนนความชอบในแต่ละคุณลักษณะทางประสาทสัมผัสที่ใกล้เคียงกับความรู้สึกของท่านมากที่สุด โดยกำหนดให้

The 9-point hedonic score preference test

9 = like extremely (ชอบมากที่สุด)
8 = like very much (ชอบมาก)
7 = like moderately (ชอบปานกลาง)
6 = like slightly (ชอบเล็กน้อย)
5 = neither like nor dislike (บอกไม่ได้ว่าชอบหรือไม่ชอบ)
4 = dislike slightly (ไม่ชอบเล็กน้อย)
3 = dislike moderately (ไม่ชอบปานกลาง)
2 = dislike very much (ไม่ชอบมาก)
1 = dislike extremely (ไม่ชอบมากที่สุด)

Attribute คุณลักษณะ	Preference score (คะแนนความชอบ)	Much too little ไม่มีรสชาติ	Some what too little มีรสชาติเล็กน้อย	Just about right รสชาติกำลังพอดี	Some what too strong มีรสชาติมากเล็กน้อย	Much too strong มีรสชาติมากที่สุด
flavor กลิ่น และ รสชาติ						
Sweetness ความหวาน						
Saltiness ความเค็ม						
Sourness ความเปรี้ยว						
Texture (Softness) ลักษณะเนื้อชีส						

Questionnaire

Introduction 1. Please rise your mouth with water before testing each sample.

2. Taste sample and evaluate each sample by rating the score in each attribute according to 9-point hedonic scale.

1 = Dislike extremely
2 = Dislike very much
3 = Dislike moderately
4 = Dislike slightly
5 = neither like nor dislike
6 = Like slightly
7 = Like moderately
8 = Like very much
9 = Like extremely

Sample code	No.	No.	No.
Flavor			
Sweetness			
Saltiness			
Sourness			
Texture (Softness)			
Over all			

Which sample would you like the most? .....

Consumer Acceptance survey

"New flavor ricotta cheese"

This survey is a part of a special project (FT 4190) under a title "Development of ricotta cheese by adding flavor" for Bachelor's degree. This survey will do in order to study the consumer's behaviors, attitudes, and needs toward a development of a new flavor ricotta cheese. Please kindly complete question by checking √ in the provided spaces.

Part1: Basic information of consumer's behavior on cheese in the market

1. Have you ever consume cheese or cheese product (pizza, cheese hamburger, sausage cheese stick, etc.) in the last months?

☐ Yes ☐ No

2. What kinds of cheese do you familiar and normally buy? (Please only three types)

☐ Cheddar cheese ☐ Ricotta cheese

☐ Cottage cheese ☐ Other (please specify)

☐ Mozzarella cheese

3. How often do you consume cheese

☐ Every day ☐ Once a week

☐ Once a month

☐ 2-3 times per week ☐ Less than once a month

☐ 2-3 times per month

4. What time of the day that you normally consume cheese or cheese product?

☐ Breakfast ☐ Free time

☐ Lunch ☐ After meal

☐ Dinner ☐ Other (please specify)

☐ At night

5. Which food type do you consume with cheese

☐ Bread
☐ Pizza
☐ Sausage
☐ Hamburger
☐ Salad
☐ Banana
☐ Sandwich
☐ None
☐ Cracker
☐ Other (please specify)

6. How many pieces of cheese do you usually buy at one time?

☐ One piece
☐ I never buy it, just consume (skip to part 2)
☐ 2-3 pieces
☐ Other (please specify)
☐ 4-5 pieces

7. Where do you usually buy cheese?

☐ Convenience store (e.g. 7-11, family Mart)
☐ Supper market (e.g. Tops, Home Fresh Mart)
☐ Hyper market (e.g. Tesco Lotus, Big c, Food land)
☐ Other (please specify
☐)

8. How much do you spend for cheese product in average per one time purchasing?

_____ Baht

Part2: information of consumer's behavior on chocolate cheese

Instruction: Please taste this chocolate cheese and answer following

Objectives of this project are develop a new flavor of cheese, chocolate cheese And also increases consume cheese in Thailand.

9. How would you rate this product using 9-point Hedonic scale when

9 = like extremely	4 = dislike slightly
8 = like very much	3 = dislike moderately
7 = like moderately	2 = dislike very much
6 = Like slightly	1 = dislike extremely
5 = neither like nor dislike	

Score_____

10. Do you accept this product?

☐ Accept ☐ Not accept

(why)_____

_____

11. Will you buy this product if it sells in the market with the reasonable price?

☐ Yes

☐ Maybe

☐ No, because_____

12. Which following characteristic is/are the reason why you accept this project?

☐ Color	☐ Chocolate aroma (smell)
☐ Taste	☐ Other
☐ Texture	_____
☐ Chocolate flavor	

Comment

_____

_____

Part3: information of consumer's behavior on Strawberry cheese

Instruction: Please taste this Strawberry cheese and answer following

Objectives of this project are develop a new flavor of cheese, **Strawberry cheese**

And also increases consume cheese in Thailand.

13. How would you rate this product using 9-point Hedonic scale when

9 = like extremely	4 = dislike slightly
8 = like very much	3 = dislike moderately
7 = like moderately	2 = dislike very much
6 = Like slightly	1 = dislike extremely
5 = neither like nor dislike	

Score_____

14. Do you accept this product?

☐ Accept ☐ Not accept

(why)_____

_

15. Will you buy this product if it sells in the market with the reasonable price?

☐ Yes

☐ Maybe

☐ No, because_____

16. Which following characteristic is/are the reason why you accept this project?

☐ Color	☐ Chocolate aroma (smell)
☐ Taste	☐ Other
☐ Texture	_____
☐ Chocolate flavor	

Comment

_____

_____

Part4: information of consumer's behavior on Banana cheese

Instruction: Please taste this banana cheese and answer following

Objectives of this project are develop a new flavor of cheese, **banana cheese**

And also increases consume cheese in Thailand.

17. How would you rate this product using 9-point Hedonic scale when

9 = like extremely
8 = like very much
7 = like moderately
6 = Like slightly
5 = neither like nor dislike
4 = dislike slightly
3 = dislike moderately
2 = dislike very much
1 = dislike extremely

Score_____

18. Do you accept this product?

☐ Accept ☐ Not accept

(why)_____

19. Will you buy this product if it sells in the market with the reasonable price?

☐ Yes
☐ Maybe
☐ No, because_____

20. Which following characteristic is/are the reason why you accept this project?

☐ Color
☐ Taste
☐ Texture
☐ Chocolate flavor
☐ Chocolate aroma (smell)
☐ Other _____

Comment

_____

_____

Part6: Demographic information

1. Gender

☐ Male ☐ Female

2. Age

☐ Less than 20 years old ☐ 40-49 years old

☐ 20-29 years old ☐ 50-59 years old

☐ 30-39 years old

☐ 60 years old and more than

3. Occupation

☐ Student ☐ Businessman or businesswoman

☐ Employee ☐ Housewife

☐ Other_____

4. Nationality

☐ Asian

☐ American

☐ European

☐ Other_____