Prev. Nutr. Food Sci. 2024;29(1):63-69
https://doi.org/10.3746/pnf.2024.29.1.63
ISSN 2287-8602

Improving the Nutritional Value of Natural Cheese Analog Products Using Nam Dok Mai Mango

Suchanart Thippayajan[1], Orawan Oupathumpanont[2], and Sunan Parnsakhorn[3]

[1]Department of Home Economics Technology, Faculty of Home Economics Technology, [2]Department of Food and Nutrition, Faculty of Home Economics Technology, and [3]Department of Agricultural Engineering, Faculty of Engineering, Rajamangala University of Technology Thanyaburi, Pathum Thani 12110, Thailand

ABSTRACT: This research aimed to (1) discover the appropriate formula for the production of Nam Dok Mai mango cheese analog products and (2) study the physical, nutritional, microbial, and sensory properties of the produced Nam Dok Mai mango cheese analogs. To investigate the appropriate formula, the factors studied included the pH value of Nam Dok Mai mango juice (2.50 or 3.00) and the proportion of salted butter (18.0% or 19.5%) and carrageenan (0.8% or 0.9%). The study was conducted by using the factorials in a completely randomized design experiment. It was found that the optimal formula for the Nam Dok Mai mango cheese analog consisted of 33.0% casein protein, 46.0% Nam Dok Mai mango juice (pH 3), 19.5% salted butter, 0.5% sodium citrate, 0.9% carrageenan, and 0.1% xanthan gum. Regarding the nutritional value, it was found that the Nam Dok Mai cheese analog (100 g) contained 129.00 μg of β-carotene, 148.41 mg of calcium, 1.15 g of dietary fiber, and 21.50 μg of vitamin A. Sixty-eight percent of consumers scored it as "moderate" for overall acceptability. However, when the consumers received the nutritional information of the Nam Dok Mai mango cheese analog, many (76%) said they would buy the product because it contains vitamin A that important for vision and eye health. Consuming enough vitamin A helps protect against certain eye diseases, such as age-related macular degeneration. This is consistent with the lifestyles of people today who use their eyes too hard, such as staring at a computer screen and cell phones all day.

Keywords: cheese, consumer behavior, fruit, nutritive value

INTRODUCTION

Cheese products are popular around the world. Cheese is used as a component of foods such as hamburgers, sandwiches, salads, and processed food products or as the main ingredient in food products such as pizza and pasta dishes. It is also used as a component in modern Asian twist cuisine. In addition, cheese is popular in Shabu- and Korean-style grill. Cheese is produced from the milk of many domestic animals, including cows, sheep, and buffalo (Villalobos-Chaparro et al., 2018). At present, consumers want to reduce the environmental footprint of their diet, so switching to plant-based alternatives is a good option. However, cheese produced from raw milk has high production costs; this has resulted in the development of low-cost alternative cheeses, known as cheese analogs. In addition to being low in cost, cheese analogs have fast and easy production processes and high storage stability (Aini et al., 2019). A cheese analog is a product that resembles cheese. It is produced from milk fat or vegetable oil, milk or plant protein, emulsified salts, and additives (Badem and Uçar, 2016). The cheese analog industry can be found worldwide, with the major manufacturers being located in the United States and Europe. The global cheese analog market was valued at $2,470 million in 2018 and is expected to reach $5,200 million by the end of 2025.

Nam Dok Mai mango is an important economic fruit in Thailand and is accepted by consumers worldwide. It has an output of approximately 1,300,000,000 kg per year and an export volume of approximately 1,000,000 kg per year. Its fragrance is unique, so it is desired by consumers and is exported to foreign markets such as Japan, Vietnam, Malaysia, South Korea, China, Laos, and Hong Kong (Ngamrabam et al., 2018). It has also gained shares in other countries such as New Zealand and the United States (Tasuk, 2013). However, due to the global situation of coronavirus disease 2019, farmers who grow Nam

Received 27 November 2023; Revised 21 January 2024; Accepted 24 January 2024; Published online 31 March 2024
Correspondence to Orawan Oupathumpanont, E-mail: orawan_o@rmutt.ac.th

Dok Mai mangoes have seen the price of Nam Dok Mai mangoes falling because the output exceeds the domestic demand. Because the product cannot be exported due to Covid restrictions, oversupply has occurred, resulting in spoilage and waste.

Nam Dok Mai mangoes are rich in vitamin A and β-carotene, which are natural phytochemicals that are beneficial to eye health. In this study, we considered the possibility of incorporating mangoes into cheese analog products due to their good smell, sweetness, and deliciousness, as well as their high content of β-carotene and vitamin A. Currently, the cheese products on the market are available in a limited amount of flavors. Therefore, we aimed to produce a novel and interesting product that had added health benefits that respond to the consumption behavior of today's health-conscious consumers. The use of Nam Dok Mai mangoes in cheese analogs will help to reduce the loss of Nam Dok Mai mangoes.

MATERIALS AND METHODS

Preparation of the Nam Dok Mai mango cheese analog

We produced the Nam Dok Mai mango cheese analog by following the basic formula specified in Table 1. In brief, milk powder was mixed with water (60℃～65℃), and vinegar (4%) was added. Then, the mixture was filtered through a cheesecloth, and the solid mixture that remained in the cloth was pressed to leave only casein protein. We produced Nam Dok Mai mango juice by preparing mango pulp and concentrated mango juice (62.53±0.15 °Brix) in a ratio of 1:1 and mixed them in a blender until a homogeneous mixture was obtained. Next, we heated the mango juice with salted butter until the butter melted. The mixture was stirred until the ingredients were thoroughly mixed. Then, we blended this mixture with the prepared casein protein until the mixture was smooth and homogeneous. The mixture was then poured into a container and heated by indirect steam at 85℃ for 10 min. Carrageenan and xanthan gum were then added, and the mixture was stirred for 5 min or until the carrageenan and xanthan gum had dissolved. The mixture was then poured into a 9×9 cm square stainless steel mold and stored at 4℃.

Table 1. The basic recipe for the Nam Dok Mai mango cheese analog

Ingredient	Amount (%)
Casein protein	33.00
Nam Dok Mai mango juice	46.00
Salted butter	16.50
Milk powder	3.00
Sodium citrate	0.50
Carrageenan	0.70
Xanthan gum	0.30

Consumer acceptability tests

Once the Nam Dok Mai mango cheese analog was prepared, we asked 50 consumers to rate it using the Just About Right (JAR) scale to rate its attributes in terms of flavor, milkiness, sourness, sweetness, saltiness, oiliness, stickiness, and toughness. The results obtained were used to determine factors for further study of appropriate formulas.

Appropriate formula for producing the Nam Dok Mai mango cheese analog

The results of the consumer acceptability tests for the basic formula were used to define variables and variable levels to plan the experiment using a completely randomization factorial design and to analyze the physical and chemical properties and sensory preferences. The details are shown below.

Physical analysis

The texture analyzers adapted from the method of Thaiphanit (2020) include firmness, stickiness, and adhesiveness. The samples were prepared to a size of 4.5×4.5 cm using a spherical stainless indenter with a diameter of 5 mm, which was pushed down by 13 mm at a speed of 2 mm/s.

Meltability was assessed by reducing the weight of the samples to 15.00±0.05 g and then placing them into a glass tube (200 mm in length, 40 mm in diameter). The samples were stored at 4℃ for 30 min and then heated in an oven at 110℃ for 60 min. Subsequently, they were placed horizontally to cool to room temperature (37℃), and then the distance of the sample to melt was measured (Maneerate, 2006).

Flowability was determined using the Schreiber test. The diameter of the samples was 41 mm, and the thickness was 4.80 mm. The samples were placed in the center of a Petri dish and compared with the Schreiber test image shown in Fig. 1. Samples were oven-dried at 232℃ for 10 min and then left to stand at room temperature (37℃) for 30 min. The total flow measurement was performed at six points (from A to F), and each point was divided into 11 ranges (from 0 to 10). The values from the six points were taken to find the average value, and the obtained value was compared with the standard value of cheese. If the value is equal to or greater than 4, it can be accepted (Maneerate, 2006).

The microstructure was analyzed using a scanning electron microscope (SEM) (Philips Model XL30) using a method adapted from Maneerate's method (Maneerate, 2006). Five samples of Nam Dok Mai mango cheese analog were cut into squares 0.5×0.5 cm in size. The prepared samples were dried using the freeze-drying meth-

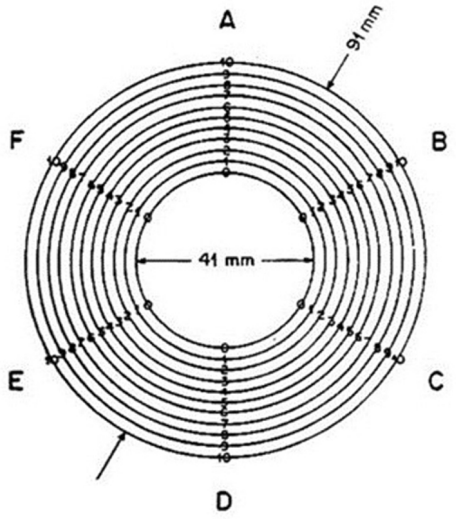

Fig. 1. Schreiber test.

od and coated with gold ions. The microstructures of the samples were studied under SEM at 200× magnification. The microstructures of the products were recorded.

Chemical analysis

Measurement of pH was performed using a pH meter (Model PH 700, EUTECH). Sweetness was measured using a refractometer (Model PAL 1 model, ATAGO). Moisture content was measured according to the Association of Official Agricultural Chemists method (AOAC International, 2019)

Subsequently, the appropriate formula was selected by considering the results of the physical and chemical analyses. The data were analyzed by clustering using hierarchical cluster analysis.

Study to evaluate sensory preferences

The Nam Dok Mai mango cheese analog that was selected was tested for consumer preferences. Panelists were given a 9-point hedonic scale and were asked to consider the appearance, Nam Dok Mai mango flavor, milk flavor, sweetness, saltiness, sourness, oiliness, stickiness, toughness, and overall preference for the product. The study was conducted in compliance with the requirements of the Good Clinical Practice/International Council for Harmonisation guidelines for clinical trials. The study received expedited review from the Rajamangala University of Technology Thanyaburi Review Board on September 18, 2021 (Protocol number RMUTT_REC No. Exp 45/64).

Physical, nutritional, microbial, and sensory properties of the Nam Dok Mai mango cheese analog

The physical analysis included the firmness (g), stickiness (g), and adhesiveness (g/s), which were measured using a texture analyzer (Thaiphanit, 2020). Meltability (cm) and flowability were assessed by the Schreiber test (Maneerate, 2006). The microstructure was analyzed by SEM (Maneerate, 2006). The nutritional analysis included the protein, fat, carbohydrate, dietary fiber, ash, β-carotene, calcium, and moisture contents (AOAC International, 2019). The microbial analysis included *Salmonella* spp., *Staphylococcus aureus*, and *Listeria monocytogenes* (AOAC International, 2019).

Sensory acceptance of the Nam Dok Mai mango cheese analog

The method as evaluate sensory preferences but use the number of consumers as 100 people by distributing samples along with questionnaires.

RESULTS

Acceptability of the basic formula of the Nam Dok Mai mango cheese analog

The consumer preference test was performed using the JAR scale to measure the acceptability level according to the set criterion. It was found that for all properties, the acceptability was in the range of 30%～66%, which was lower than the set criterion (70%); Therefore, we must consider the net effect value again. If any attribute has a score lower than −20, it means that the attribute should be adjusted further. And if it is higher than 20, it means that that characteristic should be reduced. But if the score is between −20 and 20, then there is no need to adjust that characteristic. The direction of adjustment is as fol-

Table 2. Sensory evaluation of Nam Dok Mai mango cheese analogue using the Just About Right (JAR) scale (N=50)

Attribute	Opinion level					Net effect
	Too soft	Soft	JAR	Dark	Too dark	
Nam Dok Mai mango flavor	2.00	14.00	64.00	14.00	6.00	4.00
Milk flavor	12.00	38.00	46.00	4.00	0.00	−46.00
Sourness	40.00	26.00	28.00	4.00	2.00	−60.00
Sweetness	0.00	14.00	66.00	20.00	0.00	6.00
Saltiness	16.00	26.00	56.00	2.00	0.00	−40.00
Oiliness	12.00	32.00	52.00	4.00	0.00	−40.00
Toughness	20.00	44.00	30.00	4.00	2.00	−58.00
Stickiness	22.00	44.00	30.00	4.00	0.00	−62.00

Table 3. Experimental design by factorial completely randomized design

Treatment	pH of Nam Dok Mai mango juice	Salt fresh butter (%)	Carrageenan (%)
1	3.00	18.00	0.80
2	3.00	19.50	0.80
3	3.00	18.00	0.90
4	3.00	19.50	0.90
5	2.50	18.00	0.80
6	2.50	19.50	0.80
7	2.50	18.00	0.90
8	2.50	19.50	0.90

lows, the properties of Nam Dok Mai mango flavor and sweet taste were no need to improve these properties. But the properties of milk flavor, sourness, saltiness, oiliness, stickiness, and toughness were required adjustment in an increasing direction, as shown in Table 2.

Appropriate formula for the production of the Nam Dok Mai mango cheese analog

According to the study of the acceptability of the basic formula in terms of milk taste, sour taste, salty taste, oiliness, stickiness, and toughness, all these factors required improvement. Therefore, the basic formula was adjusted. Three factors were adjusted: (1) the pH value of the Nam Dok Mai mango juice was converted to two levels: 2.50 and 3.00; (2) the proportion of salted butter was converted to two levels: 18.0% and 19.5% by weight; and (3) the carrageenan content was converted to two levels: 0.8% and 0.9% by weight. A total of eight formulations were arranged using the factorial CRD method, as shown in Table 3.

The physical and chemical properties of the new formulations were analyzed, including the firmness, stickiness, adhesiveness, meltability, flowability, moisture content, pH, and sweetness. The results are shown in Table 4.

The hierarchical clustering analysis divided the formulations into two groups, as shown in Fig. 2. Hierarchical cluster analysis was performed using eight samples of Nam Dok Mai mango cheese analog products and a product from the market as a control. It was found that samples 1, 2, 3, and 4 were not significantly different from a product from the market (control), and these samples were clustered as Group 1. They had smooth and delicate textures, were not grainy, and could be easily cut into slices. The samples clustered into Group 2 (samples 5, 6, 7, and 8) had soft textures, looked like cream cheese, had coarse-grained textures, and could not be cut into slices. Consequently, the four samples in Group 1 were tested for consumer preferences using a 9-point hedonic scale. Fifty consumers were asked to consider the appearance, Nam Dok Mai mango flavor, milk flavor, sweet taste, salty taste, sour taste, oiliness, stickiness, toughness, and overall preference. It was found that there were no significant differences ($P \geq 0.05$) in the scores between the samples. The results are shown in Table 5.

The microstructures of the Nam Dok Mai mango cheese analog products were studied under SEM at 200× magnification, as shown in Fig. 3. It was found that a product from the market (control) had more layers and larger pores inserted into the protein network than the Nam Dok Mai mango cheese analog (treatment 1∼4), as shown in Fig. 3A. Regarding the properties of the microstructure of the product, the Nam Dok Mai mango cheese analog had a tight protein network, and the pores found in the structure look like scattered small holes.

Physical, nutritional, and microbial properties of the Nam Dok Mai mango cheese analog

The physical, nutritional, and microbial properties of 100 g of Nam Dok Mai mango cheese analog were studied. The results are shown in Table 6. Regarding the physical properties, the firmness, stickiness, adhesiveness, meltability, and flowability were 74.91 g, 9.78 g, 4.16 g/s, 9.93 cm, and 1.22, respectively.

In the study of the nutritional value of the Nam Dok Mai mango cheese analog products, it was found that 100 g of the Nam Dok Mai mango cheese analog provided 356.20 kcal of energy, 7.58 g of protein, 26.80 g of fat,

Table 4. Average physical and chemical quality analysis of the Nam Dok Mai mango cheese analogs

Treatment	Firmness (g)	Stickiness (g)	Adhesiveness (g/s)	Meltability (cm)	Flowability	Moisture content (%)	pH	Sweetness (°Brix)
Control	56.80±3.15	16.38±2.75	10.09±0.25	5.37±0.15	0.00±0.00	31.15±2.33	4.41±0.75	11.10±0.20
1	82.03±16.22	10.89±1.04	4.27±0.70	9.10±0.79	1.00±0.86	41.97±1.97	4.80±0.32	14.97±0.92
2	65.80±2.97	11.31±3.02	5.05±1.32	10.06±0.60	1.37±0.80	44.30±0.61	4.83±0.15	13.93±0.55
3	77.79±12.55	8.27±0.88	3.59±0.04	9.67±1.15	1.16±0.88	43.77±1.38	4.82±0.47	14.57±0.11
4	74.91±7.27	9.78±1.00	4.16±0.26	9.93±0.30	1.22±0.25	42.90±1.05	4.77±0.10	16.00±0.43
5	20.87±0.72	10.78±1.99	6.40±1.32	8.60±0.72	0.61±0.35	42.60±2.78	4.19±0.17	15.43±0.42
6	20.49±3.44	11.91±1.34	6.50±0.76	8.07±0.11	0.84±0.29	43.30±0.53	4.09±0.10	12.90±0.50
7	14.44±0.91	7.84±1.61	4.14±1.11	8.17±1.13	2.83±1.30	48.13±8.63	4.36±0.50	14.53±0.87
8	18.55±1.95	8.02±1.11	4.38±0.90	8.30±1.13	1.89±1.11	42.07±1.85	4.14±0.49	14.60±1.11

Values are presented as mean±SD.

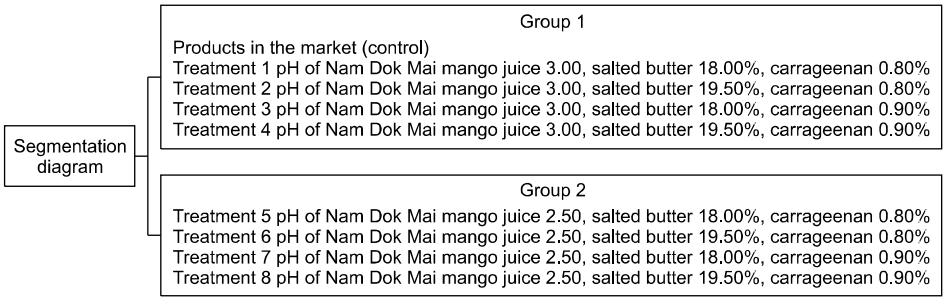

Fig. 2. Segmentation diagram based on hierarchal cluster analysis.

Table 5. Consumer preference test scores for the Nam Dok Mai mango cheese analogues

Attribute	The average of preference score			
	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Appearance^{ns}	7.70±0.93	7.86±0.99	7.78±0.91	7.78±0.89
Nam Dok Mai mango flavors^{ns}	7.64±1.06	7.78±1.01	7.44±1.18	7.54±1.01
Milk flavors^{ns}	7.22±1.25	7.62±1.05	7.40±1.16	7.50±0.95
Sourness^{ns}	7.36±1.02	7.62±1.21	7.62±1.07	7.40±1.11
Sweetness^{ns}	7.08±1.26	7.34±1.30	7.12±1.57	7.30±1.34
Saltiness^{ns}	7.24±1.45	7.56±1.18	7.54±1.22	7.46±1.05
Oiliness^{ns}	7.32±1.09	7.44±1.36	7.52±1.09	7.32±1.10
Toughness^{ns}	6.66±1.69	7.04±1.64	7.28±1.32	7.08±1.34
Stickiness^{ns}	6.76±1.65	7.20±1.43	7.36±1.31	7.12±1.42
Overall preference^{ns}	7.36±1.02	7.68±1.28	7.82±1.10	7.72±0.90

Values are presented as mean±SD.
^{ns}No statistically significant differences ($P \geq 0.05$).

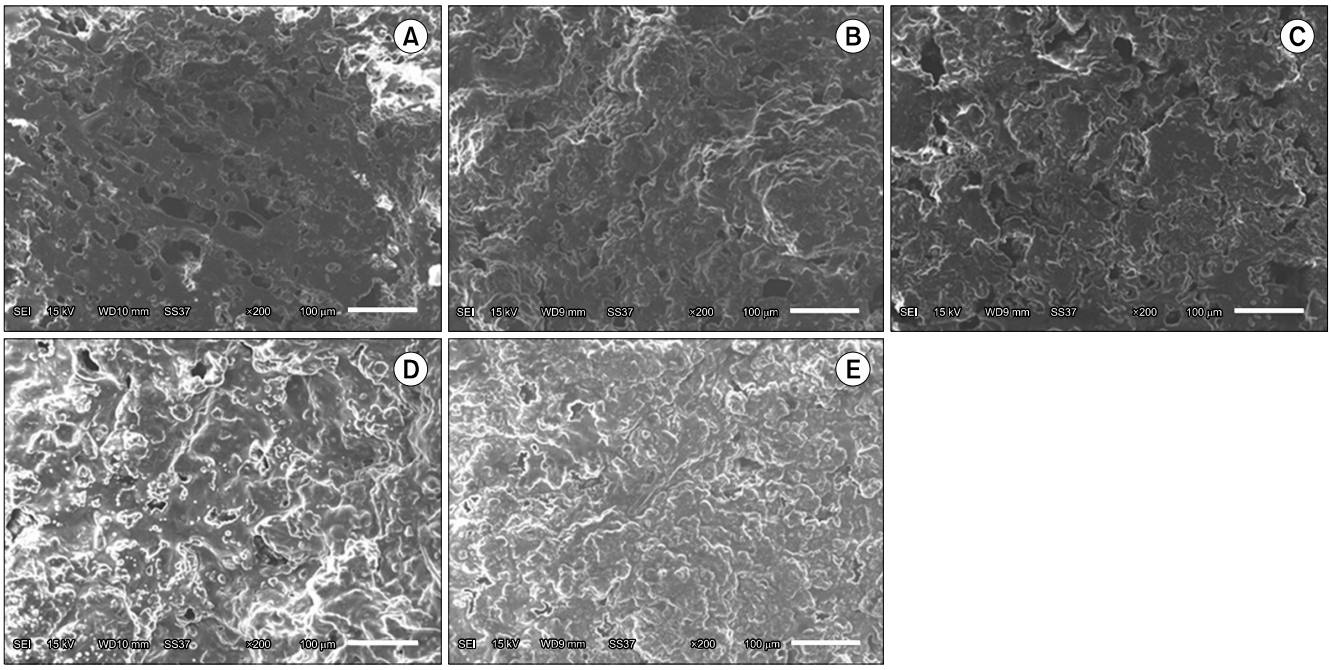

Fig. 3. The microstructures of various cheese analogs. (A) Commercially available cheese analog (control). (B) Nam Dok Mai mango cheese analog treatment 1 (pH of Nam Dok Mai mango juice 3.00, 18.0% salted butter, 0.8% carrageenan). (C) Nam Dok Mai mango cheese analog treatment 2 (pH of Nam Dok Mai mango juice 3.00, 19.5% salted butter, 0.8% carrageenan). (D) Nam Dok Mai mango cheese analog treatment 3 (pH of Nam Dok Mai mango juice 3.00, 18.0% salted butter, 0.9% carrageenan). (E) Nam Dok Mai mango cheese analog treatment 4 (pH of Nam Dok Mai mango juice 3.00, 19.5% salted butter, 0.9% carrageenan).

21.17 g of carbohydrates, 1.15 g of dietary fiber, 21.50 μg of vitamin A, 129.00 μg of β-carotene, and 148.41 mg of calcium.

In the analysis of the microbiological properties of the Nam Dok Mai mango cheese analog product, it was found that *Salmonella* spp., *L. monocytogenes*, and *S. aureus* were

Table 6. The results of the physical, nutritional, and microbial properties of 100 g of Nam Dok Mai mango cheese analog

Quality value	Amount
Physical	
Firmness (g)	74.91
Stickiness (g)	9.78
Adhesiveness (g/s)	4.16
Meltability (cm)	9.93
Flowability	1.22
Nutritional value	
Total energy (kcal)	356.20
Energy from fat (kcal)	241.20
Total fat (g)	26.80
Saturated fat (g)	18.75
Cholesterol (mg)	39.55
Protein (g)	7.58
Carbohydrate (g)	21.17
Dietary fiber (g)	1.15
Sugar (g)	19.71
Sodium (mg)	348.54
Vitamin A (μg)	21.50
β-Carotene (μg)	129.00
Vitamin B1 (mg)	<0.03
Vitamin B2 (mg)	0.07
Calcium (mg)	148.41
Iron (mg)	0.29
Ash (g)	1.76
Moisture (%)	42.90
Microorganism	
Salmonella spp. (per 25 g)	Not detected
Staphylococcus aureus (CFU/g)	<10est
Listeria monocytogenes (per 25 g)	Not detected

CFU, colony-forming unit.

within the range of accepted food standards for pathogenic microorganisms.

Sensory acceptance of the Nam Dok Mai mango cheese analog product

According to the study of consumer preferences using the central location test (CLT) and 9-point hedonic scale, it was found that the consumers rated the appearance, overall preference, Nam Dok Mai mango flavor, sweetness, sourness, and oiliness at moderate levels. When the consumers received nutritional information about the Nam Dok Mai mango cheese analog product, 76 consumers (76%) said they would buy the product.

DISCUSSION

The consumer preference test was performed using the JAR scale to measure the acceptability level according to set criteria. If the JAR level equal to 70% indicates that there is no need to improve the properties of the product (Wangcharoen, 2013). However, if the JAR level is lower than 70%, it must be considered the net effect value. If any attribute has a net effect value lower than −20, it means that the attribute should be adjusted further. And if it is higher than 20, it means that that characteristic should be reduced. But if the score is between −20 and 20, then there is no need to adjust that characteristic (Liamkaew and Chompreeda, 2018).

The microstructures of the Nam Dok Mai mango cheese analog products were studied under SEM. It was found that a product from the market (control) had more layers and larger pores inserted into the protein network compared to the Nam Dok Mai mango cheese analog (treatment 1∼4), as shown in Fig. 3A. Therefore, fat was distributed widely in the protein network (Maneerate, 2006). A tight protein network was observed the all of Nam Dok Mai mango cheese analog. This structure is formed by coagulation during milk precipitation and by the addition of emulsifiers, which creates uniform condensation among fat, protein, and water (Phosanam, 2006). The pores found in the structure are lipids that are inserted into the protein network, which look like small holes scattered throughout the protein network. It was observed that the fat was distributed better in the Nam Dok Mai mango cheese analog compared to the control product (Maneerate, 2006).

According to the analysis of nutritional properties, the Nam Dok Mai mango cheese analog product contains β-carotene. When ingested, the body converts β-carotene molecules into vitamin A for producing rhodopsin in the retina. In addition, β-carotene can reduce cell degeneration from free radicals, help brighten the skin, slow down aging, and stimulate the body's immune cells (Buadilok, 2020). The Nam Dok Mai mango cheese analog product also contains calcium, an important mineral for the body. Calcium is responsible for helping with the functioning of various systems, such as keeping bones strong (Panyakhamlerd et al., 1997).

According to the analysis of microbiological properties of the Nam Dok Mai mango cheese analog product, the levels of *Salmonella* spp., *L. monocytogenes*, and *S. aureus* were within the range of the food standards for pathogenic microorganisms according to the Notification of the Ministry of Public Health (2021).

According to the study of consumer preferences using the CLT and 9-point hedonic scale, it was found that the consumers rated the appearance, overall preference, Nam Dok Mai mango flavor, sweetness, sourness, and oiliness of the cheese analog at moderate levels. When the consumers received nutritional information about the Nam Dok Mai mango cheese analog product, 76 consumers (76%) decided to buy the product. This shows that nutrition labels are important for consumer purchasing decisions. This is because foods with nutritional information have been shown to benefit the health conscious,

make known the type and amount of nutrients to be obtained, and can also be used to assess which products provide the most benefits. Nutritional value is an important factor for today's consumers when choosing products. Therefore, nutrition labels are an important aspect to which manufacturers should pay attention.

ACKNOWLEDGEMENTS

The authors would like to thank the Faculty of Home Economics Technology, Rajamangala University of Technology Thanyaburi, Thailand for generous laboratory workplaces.

FUNDING

None.

AUTHOR DISCLOSURE STATEMENT

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Concept and design: OO, SP. Analysis and interpretation: OO, ST, SP. Data collection: ST. Writing the article: OO, ST, SP. Critical revision of the article: OO. Final approval of the article: all authors. Statistical analysis: OO, ST. Overall responsibility: OO.

REFERENCES

Aini N, Prihananto V, Sustriawan B, Romadhon D, Ramadhan RN. The formulation of cheese analogue from sweet corn extract. Int J Food Sci. 2019. 2019:8624835. https://doi.org/10.1155/2019/8624835

AOAC International. Official methods of analysis. 21st ed. Association of Official Agricultural Chemists International. 2019.

Badem A, Uçar G. Cheese analogues. J Food Dairy Technol. 2016. 4:44-48.

Buadilok N. Development of high lycopene edible film from gac aril. Master's thesis. Rajamangala University of Technology Thanyaburi. 2020.

Liamkaew R, Chompreeda P. Sensory acceptability tests of corn milk beverage mixed with cereals. APHEIT Int J. 2018. 7:82-91.

Maneerate J. Process development of mozzarella cheese made from raw milk preserved by lactoperoxidase system (LP-system). Master's thesis. Suranaree University of Technology. 2006.

Ministry of Public Health. No. 416. Determines the quality or standard conditions and methods for analyzing of pathogenic microbial food. 2021 [cited 2022 May 8]. Available from: https://www.ratchakitcha.soc.go.th/DATA/PDF/2563/E/237_1/9.PDF

Ngamrabam R, Aungsuratana AO, Saridnirun P. Potential of "NAM DOK MAI" mango production through supply chain for export in Ratchaburi province. Veridian E-J. 2018. 11:2563-2579.

Panyakhamlerd K, Chaikittisilpa S, Taechakraichana N, Limpaphayom K. Calcium and postmenopausal osteoporosis. Chula Med J. 1997. 41:845-859.

Phosanam A. Factors affecting texture of imitation cheese from rice flour. Master's thesis. Kasetsart University. 2006.

Tasuk T. Nam Dok Mai mango production management by farmers in Wang Thong district of Phitsanulok province. Master's thesis. Sukhothai Thammathirat Open University. 2013.

Thaiphanit S. Development of soft cheese-like product enriched with coconut protein concentrate. Thai Sci Technol J. 2020. 28: 2173-2184.

Villalobos-Chaparro S, Salas-Muñóz E, Gutiérrez-Méndez N, Nevárez-Moorillón GV. Sensory profile of Chihuahua cheese manufactured from raw milk. Int J Food Sci. 2018. 2018: 8494105. https://doi.org/10.1155/2018/8494105

Wangcharoen W. Sensory assessment by using a Just About Right scale. Food J. 2013. 43:18-24.