Kasetsart J. (Nat. Sci.) 34 : 289 - 299 (2000)

Production of Snacks from Composite Flour of Full Fat Soy Flour and Addition of Nata de Coco

Somchai Prabhavat, Duangchan Hengsawadi and Tavidsa Lohana

ABSTRACT

Snacks were prepared from full fat soy flour or composite flour[1] (full fat soy flour adding 25% of rice flour) or composite flour[2] (full fat soy flour adding 25% of rice flour and 10% of defatted sesame flour) or composite flour[3] full fat soy flour adding 15% of mungbean flour, 25% of rice flour and 5% of defatted sesame flour). The 10, 20, 30 and 40% of nata de coco pressed cake were not added or added into full fat soy flour and each composite flour for snack preparation using a village texturizer. The average score from sensory evaluation of these snacks in terms of color, flavor, texture and acceptability showed that coated barbecue snacks made from composite flour[1] or composite flour[3] without or with adding 10% of nata de coco pressed cake were accepted in the level of like very much when compared with the rest of the samples ($p<0.05$). The protein and fat contents of four accepted coated barbecue snacks ranged from 24.10 - 26.39% and 23.59 - 26.49%, respectively. The crude fiber content of the accepted coated barbecue snacks made from composite flour[1] and composite flour[1] adding 10% of nata de coco pressed cake were increased from 1.69 to 2.47% (46.15%) and from 2.45 to 3.58% (46.12%) in snacks made from composite flour[3] and composite flour[3] adding 10% of nata de coco pressed cake, respectively. The increasing of crude fiber in the snacks were due to the added nata de coco pressed cake in the composite flour[1] and composite flour[3] before snack making. The protein quality of four accepted coated barbecue snacks showed higher chemical score of methionine + cystine ranged from 74 - 80%, compared to chemical score 69% of coated barbecue snack made from full fat soy flour. These were due to the added flours such as rice flour and defatted sesame flour which are rich in methionine + cystine content.

Key words : snacks, composite flour, full fat soy flour, rice flour, nata de coco, village texturizer

INTRODUCTION

Most snacks are fun to eat but are low in nutritive value. If they are taken in large quantity, they can suppress the appetite for the main meal. For this reason, snack with high protein and high fiber should be developed as a supplementary diet. However, these snacks must be produced to sell at reasonable price. Soybean and mungbean are considered to be cheap sources of protein. The protein and fat contents of soybean are 34.1 and 17.7%, respectively while the protein and fat contents of mungbean are 20 - 26% and 0.7 - 1.5%, respectively (Anon, 1987; Bressani and Elias, 1974). The protein quality of soybean and mungbean are deficient in some essential amino acids (methionine + cystine) but they are rich in an essential amino acid (lysine) (Anon, 1990; Bressani and Elias.

[1] Institute of Food Research and Product Development, Kasetsart University, Bangkok 10900, Thailand.

1974). Its protein quality can be improved by fortification with the protein source from sesame and cereals such as rice which are rich in methionine and cystine but deficient in lysine (Anon, 1990; Cheman *et al*., 1992; Surendranath *et al*., 1984). The increasing of fiber in high protein snack is also important to make nutritive snack by addition of nata de coco as the source of fiber should be considered. Nata de coco is one of the nontraditional coconut by-products which have gained popularity in both domestic and international markets. Nata production could play a vital role in the development of cottage industries in coconut based communities. It is cellulosic white to creamy-yellow substance formed by *Acetobacter aceti* sp. xylinum on the surface of sugar-enriched coconut water. The most popular utilization of nata de coco is as a dessert (nata de coco cooked in syrup or nata de coco preserve). It is also used as an ingredient in other food products such as ice cream, fruit cocktail and a new developed product which is candied nata (Sanchez, 1990). In Thailand, nata de coco is mostly consumed as dessert (nata de coco in syrup). The analysis from the Department of Science Service for Nata de coco containg 94.40% moisture, 34.5 mg/100g calcium, 0.05% fat, 0.20 mg/100g iron, 1.10% crude fiber, 22.00 mg/100g phosphorus, 0.68% protein, 0.01 mg/100g vitamin B_1, 0.77% ash, 0.02 mg/100g vitamin B_2, 3.00% carbohydrate and 0.22 mg/100g niacin. It indicates that nata de coco has high fiber content which is micro-fibril cellulose. This micro-fibril cellulose is more delicate and softer than other types of fiber found in fruits and vegetables. So nata de coco is a suitable health food for those who need to have weight control and those who have excretory problem. The village texturizer was developed by Meals for Millions Foundation (Anon, 1984; Prabhavat, 1989) and it is originally designed for vegetable protein production at village level. The expansion of dough upon sudden release of pressure, provides porous texture with crispness after drying.

The purpose of this research is to develop the low-cost high protein and high fiber snacks from full fat soy flour with improvement of texture, protein quality and fiber adding mungbean flour, rice flour, defatted sesame flour and nata de coco pressed cake using village texturizer. The accepted product not only adds the value to the nata de coco but also provides nutritive snack for snack food industries in the future.

MATERIALS AND METHODS

Preparation of full fat soy flour, mungbean flour, rice flour and defatted sesame flour

Each 4 kgs of selected soybean, mungbean, rice (Khao Dawk Mali 105 variety) and white sesame seed were used for the preparation of flours. The mungbean was cracked with a hand grinder into two parts and then the cracked mungbean, whole soybean, rice and sesame were separately washed 4 times with water until clean. The washed cracked mungbean was soaked in water at ambient temperature for 3 hours and its hull was removed by washing with water until the mungbean dhal was obtained. The soybean, mungbean dhal, rice and sesame were separately dried in a cabinet dryer at 50° - 60°C for 10, 12, 6 and 5 hours, respectively. The dried soybean was cracked with a hand grinder and its hull was removed by using a bamboo pan to get soybean dhal. The dried sesame seed was pressed with hydraulic press (Caver laboratory press, USA) 5 times at the pressure of 10 - 11 tons to remove the sesame oil and get the pressed sesame cake. These dried soybean dhal, mungbean dhal, rice and pressed sesame cake were separately ground with pin mill into flours (80 mesh) to obtain full fat soy flour, mungbean flour, rice flour and defatted sesame flour.

Preparation of composite flour from full fat soy flour

Three formulae of composite flour (composite flour^1, composite flour^2 and composite flour^3) were prepared from full fat soy flour adding mungbean flour, rice flour and defatted sesame flour (Table 5) and mixed well in polyethylene bag for 3 minutes to get 500 grams of different kinds of composite flour.

Preparation of nata de coco pressed cake

Fresh nata de coco was washed 4 times with water until clean. The washed nata de coco was ground with meat grinder. Then it was washed with water 4 times and the water was drained through fine sieve. The course ground nata de coco was collected to be further ground with blender and pressed heavily in fine cloth bag to remove water as much as possible. The semidried nata de coco pressed cake was obtained. Nata de coco, nata de coco pressed cake, and different types of flour were analyzed for chemical composition according to the method of A.O.A.C (1984). They were also analyzed for essential amino acid composition.

Preparation of high - protein high - fiber snack flours

50, 100, 150 and 200 g of nata de coco pressed cakes were added into 450, 400, 350 and 300 g of full fat soy flour and each formula of composite flour (composite flour^1, composite flour^2 and composite flour^3) were mixed well in Kenwood mixer for 3 minutes to get 500 g of snack flours.

Preparation of snacks

Twenty five grams of cane sugar, 10 g of salt powder and 2.5 g of pepper powder were dissolved in 135, 90, 30, 20 and 5 ml. of water, respectively, for adding into each 500 grams of full fat soy flour and each formula of snack flour, respectively. Then 500 g of snack flour was mixed with prepared ingredient solution in Kenwood mixer for 3 minutes. The dough was divided into 10 g portions, rolled into a ball shape and pressed into circular shape before putting in the cup of the village texturizer.

The cup and the lid were kept at 160^o - 180^{o}C. The lid was centered over the cup and pressed with the pressure of 400 psi and holding time for 10 seconds. Then, the lid was released from the cup. Moist snacks were cut into rectangular shapes (5×1 cm). Then they were dried in a cabinet dryer at 50° - 60°C for 2 hours. Five dried snacks samples (puffed, crisp texture) made from full fat soy flour and snacks flours formular number 1 - 4 were obtained. Then, they were packed separately in sealed polyethylene bags for organoleptic evaluation. The accepted samples from different sets of five snack samples were coated with barbecue flavor in rotary octa angle coated pot (the ratio of snack : soybean oil : barbecue flavor was 20:2:1 by weight) and hot air was blown to dry the barbecue coated snack. Then, they were packed separately in sealed polyethylene bags for organoleptic evaluation.

Organoleptic evaluation

The acceptability test was done for each set of five snack samples (made from snack flours formula 1-4) to find the best accepted coated barbecue snacks, by 10 panelists. Different characteristics in terms of color, flavor, texture and acceptability using Hedonic scale : score 9 - the extreme like, and score 1- extreme dislike were used. The difference in statistics was determined using ANOVA and DMRT at 95% significant level. The test was done 6 times in 6 different days. The accepted coated barbecue snacks were analyzed for chemical and essential amino acid compositions.

RESULTS AND DISCUSSION

The protein, fat, crude fiber and moisture contents of nata de coco pressed cake were 0.87, 0.58, 10.50, and 87.67% by weight, respectively, while the original fresh nata de coco were 0.31, 0.21, 1.30 and 98.05% by weight, respectively (Table 1). The protein, fat and crude fiber of nata de coco were 15.90, 10.77, and 66.67% on dry weight, respectively (Table 2). The increasing in protein, fat, and crude fiber of nata de coco in different form were due to the decreasing of water content in nata de coco. The protein contents of full fat soy flour, mungbean flour, rice flour, and defatted sesame flour were 45.19, 27.99, 8.50, and 36.96% on dry weight, respectively and the fat contents were 23.69, 1.44, 0.50, and 38.15% on dry weight, respectively and the crude fiber were 2.01, 1.48, 0.00, and 4.95% on dry weight, respectively (Table 3). The crude fiber content of each flour were lower than crude fiber of nata de coco due to the crude fiber of individual flour and nata de coco were in the range of 0.00 - 4.95% and 66.67% on dry weight, respectively.

Essential amino acid composition of each kind of flour with its limiting amino acid are shown in Table 4. This indicated that the protein of different sources were incompleted. The essential amino acid methionine + cystine were the limiting amino acid of protein from full fat soy flour and mungbean flour whose chemical scores were 69 and 66%, respectively but rich in essential amino acid lysine whose chemical score were 104 and 122%, respectively. The lysine were the limiting amino acid of rice flour and defatted sesame flour whose chemical score were 64 and 46%, respectively but rich in methionine + cystine content whose chemical score were 166 and 143%, repectively. The essential amino acid contents and texture of protein of snack from full fat soy flour could be improved by adding two or more different kinds of flour which were rich in methionine + cystine content such as rice flour and defatted sesame flour together to make composite flour before snack making using a village texturizer (Table 5).

Essential amino acids composition of four formulae of flours (full fat soy flour and composite flour$^{1-3}$) with its limiting amino acid are shown in Table 6. This indicated that the protein of full fat soy flour was deficient in essential amino acid methionine + cystine whose chemical score was 69%. The chemical score of the protein of the composite flour^{1}, composite flour^{2} and composite flour^{3} were increased in the range of 74 - 83% due to the addition of rice flour and defatted sesame flour (which were rich in essential amino acid

Table 1 Chemical composition of fresh nata de coco and nata de coco pressed cake on percent by weight.

Chemical composition (% by weight)	Fresh nata de coco	Nata de coco pressed cake
Moisture	98.05	87.67
Fat	0.21	0.58
Protein	0.31	0.87
Ash	0.00	0.03
Crude fiber	1.30	10.50
Carbohydrate	0.13	0.35
Energy, cal / 100 gram.	4	10

Table 2 Chemical composition of fresh nata de coco on percent dry weight.

Chemical composition (%) dry weight)	Fresh nata de coco
Moisture	98.05
Fat	10.77
Protein	15.90
Ash	0.15
Crude fiber	66.67
Carbohydrate	6.51
Energy, cal / 100 gram	187

methionine + cystine) into full fat soy flour to make composite flour before snack making.

The results of the organoleptic evaluation for different characteristics in term of color, flavor, texture and acceptability of snacks made from full fat soy flour or composite flour[1] or composite flour[2] or composite flour[3] adding 0, 10, 20, 30 and 40% of nata de coco pressed cake by weight are shown in Table 7, 8, 9 and 10, respectively. It appeared that the snacks made from full fat soy flour without adding nata de coco pressed cake were more acceptable than the other samples ($p <$

Table 3 Chemical composition of each individual flour.

Kinds of flour	Chemical composition (% dry weight)						
	Moisture (%)	Fat (%)	Protein (%)	Ash (%)	Crude fiber (%)	Carbo hydrate (%)	Energy Cal/ 100 gram
Full fat soy flour (FFSF)	7.11	23.69	45.19	7.26	2.01	21.85	481
Mungbean flour (MBF)	6.77	1.44	27.99	3.42	1.48	65.67	388
Rice flour (RF)	10.51	0.50	8.50	0.62	0.00	90.38	400
Defatted sesame flour (DFSF)	4.09	38.15	36.96	5.08	4.95	14.86	551

Table 4 Essential amino acid composition of each individual flour and FAO/WHO standard.

Essential amino acid	Amino acid, mg / gm of protein of				FAO/ WHO[3]
	FFSF	MBF	RF	DFSF	
Isoleucine	35	37	35	30	40
Leucine	70	77	78	62	70
Lysine	57 (104)[1]	67 (122)[1]	35 (64)[2]	25 (46)[2]	55
Methionine + Cystine	24 (69)[2]	23 (66)[2]	58 (166)[1]	50 (143)[1]	35
Phenylalanine + Tyrosine	82	90	90	77	60
Threonine	37	33	34	34	40
Tryptophan	16	14	18	16	10
Valine	37	43	50	38	50

1 (-) Chemical score (in parenthesis) = $\frac{\text{amino acid content in protein of flour} \times 100}{\text{amino acid content in FAO / WHO standard}}$

2 (-) Limiting amino acid with chemical score.

3 Source : Food Composition Table for Use in East Asia (FAO, 1972).

Teble 5 Composition of four formulae of flours (full fat soy flour and composite flour [1 - 3]) for preparation of snacks.

Formula	Composition (%)			
	FFSF	MBF	RF	DFSF
1	100	-	-	-
2	75	-	25	-
3	65	-	25	10
4	55	15	25	5

0.05) but the snacks made from composite flour[1], composite flour[2] and composite flour[3] adding 0% and 10% of nata de coco pressed cake by weight were more acceptable than the rest of snack samples from every each group of composite flour ($p < 0.05$) and the score were in the level of like very much.

The organoleptic evaluation of the accepted snacks (coated with barbecue flavor) are shown in Table 11 and 12. It appeared that snacks made from composite flour[1], composite flour[1] adding 10% of

Table 6 Essential amino acid composition of four formulae of flours (full fat soy flour and composite flour [1-3]) and FAO/WHO standard.

Essential amino acid	Amino acid, mg / gm of protein of flour formula				FAO/ WHO[3]
	1	2	3	4	
Isoleucine	35	35	35	35	40
Leucine	70	71	70	71	70
Lysine	57 (104)[1]	56 (102)[1]	52 (95)[1]	55 (100)[1]	55
Methionine + Cystine	24 (69)[2]	26 (74)[1]	29 (83)[1]	28 (80)[1]	35
Phenylalanine + Tyrosine	82	82	82	83	60
Threonine	37	37	37	36	40
Tryptophan	16	16	16	16	10
Valine	37	38	38	39	50

1 (-) Chemical score (in parenthesis) = $\frac{\text{amino acid content in protein of flour} \times 100}{\text{amino acid content in FAO / WHO standard}}$

2 (-) Limiting amino acid with chemical score.

3 Source : Food Composition Table for Use in East Asia (FAO, 1972).

Table 7 Organoleptic evaluation of snacks made from full fat soy flour (FFSF) with out or with adding 10, 20, 30 and 40% of nata de coco pressed cake by weight.

Characteristics	Snacks from (FFSF) adding nata de coco pressed cake (%)				
	0	10	20	30	40
Color	7.20[a]	6.40[b]	7.00[a]	6.20[b]	4.73[c]
Flavor	5.93[a]	5.33[b]	5.20[b]	5.33[b]	4.93[b]
Texture	7.07[a]	6.20[b]	6.20[b]	5.60[b]	4.53[c]
Acceptability	6.60[a]	5.73[b]	5.73[b]	5.40[b]	4.60[c]

The figures on the same row with the same letter are not different ($p > 0.05$).

nata de coco pressed cake, composite flour[3], composite flour[3] adding 10% of nata de coco pressed cake were the accepted coated barbecue snacks when compared with the other samples ($p < 0.05$).

The chemical composition of four accepted snacks (coated with barbecue flavor) made from full fat soy flour or composite flour[3] without or with adding 10% of nata de coco pressed cake are shown in Table 13. The protein and fat content of

Table 8 Organoleptic evaluation of snacks made from composite flour[1] with out or with adding 10, 20, 30 and 40% of nata de coco pressed cake by weight.

Characteristics	Snacks from composite flour[1] adding nata de coco pressed cake (%)				
	0	10	20	30	40
Color	7.13[a]	6.80[a]	6.53[ab]	6.40[b]	5.60[c]
Flavor	6.53[a]	6.47[a]	6.33[ab]	5.73[bc]	5.53[c]
Texture	7.33[a]	7.00[a]	6.33[b]	5.60[c]	4.20[d]
Acceptability	7.20[a]	6.93[a]	6.20[b]	5.33[c]	4.47[d]

The figures on the same row with the same letter are not different ($p > 0.05$).

Table 9 Organoleptic evaluation of snacks made from composite flour[2] with out or with adding 10, 20 30 and 40% of nata de coco pressed cake by weight.

Characteristics	Snacks from composite flour[2] adding nata de coco pressed cake (%)				
	0	10	20	30	40
Color	7.33[a]	7.00[ab]	6.67[bc]	6.27[c]	5.47[d]
Flavor	6.33[a]	6.27[a]	6.33[a]	6.07[b]	5.27[c]
Texture	6.87[a]	6.40[ab]	6.07[bc]	5.47[c]	3.93[d]
Acceptability	6.73[a]	6.47[a]	6.07[ab]	5.67[b]	4.13[c]

The figures on the same row with the same letter are not different ($p > 0.05$).

Table 10 Organoleptic evaluation of snacks made from composite flour[3] with out or with adding 10, 20 30 and 40% of nata de coco pressed cake by weight.

Characteristics	Snacks from composite flour[3] adding nata de coco pressed cake (%)				
	0	10	20	30	40
Color	7.00[a]	7.00[a]	6.40[a]	5.73[b]	5.27[b]
Flavor	6.60[a]	6.53[ab]	6.20[ab]	5.87[bc]	5.47[c]
Texture	7.27[a]	7.13[a]	6.60[a]	5.00[b]	4.27[b]
Acceptability	6.93[a]	6.80[a]	6.47[a]	5.07[b]	4.53[b]

The figures on the same row with the same letter are not different ($p > 0.05$).

four accepted coated barbecue snacks were in the ranges of 24.10 - 26.39% and 23.59 - 26.49% on dry weight, respectively. The crude fiber content of four accepted coated barbecue snack made from composite flour[1] and composite flour[3] were 1.69 and 2.45% on dry weight, respectively, while that of the crude fiber contents of coated barbecue snacks made from composite flour[1] adding 10% of nata de coco pressed cake and composite flour[3] adding 10% of nata de coco pressed cake were 2.47 and 3.58%, respectively. The increasing of crude fiber content in the accepted coated barbecue snack were in the range of 46.12 - 46.15% due to the addition of 10% of nata de coco pressed cake into composite flour before snack making using the village texturizer.

The essential amino acid composition of four accepted coated barbecue snacks are shown in Table 14. The chemical score of the limiting amino acid methionine + cystine of coated barbecue snack made from full fat soy flour (FFSF) was 69% while that of the chemical score of essential amino acid methionine + cystine of four accepted coated barbecue snacks made from composite flour[1] composite flour[3], composite flour[1] adding 10% of nata de coco pressed cake and composite flour[3]

Table 11 Organoleptic evaluation of the accepted coated barbecue snack made from full fat soy flour (FFSF) adding 10 and 20% of nata de coco pressed cake; composite flour[1] (CF^1) or composite flour[2] (CF^2) or composite flour[3] (CF^3) adding 10% of nata de coco pressed cake by weight.

Characteristics	Snack made from				
	FFSF adding nata de coco pressed cake		CF^1 adding 10% of nata de coco pressed cake	CF^2 adding 10% of nata de coco pressed cake	CF^3 adding 10% of nata de coco pressed cake
	10%	20%			
Color	6.53^{ab}	6.40^{b}	6.93^{ab}	7.00^{a}	6.80^{ab}
Flavor	6.67^{a}	6.73^{a}	7.07^{a}	6.53^{a}	6.93^{a}
Texture	6.40^{b}	6.53^{b}	7.27^{a}	6.67^{ab}	7.40^{a}
Acceptability	6.53^{b}	6.60^{b}	7.27^{ab}	6.60^{b}	7.00^{a}

The figures on the same row with the same letter are not different ($p > 0.05$).

Table 12 Organoleptic evaluation of the accepted coated barbecue snack made from full fat soy flour (FFSF) or composite flour[1] (CF^1) or composite flour[2] (CF^2) or composite flour[3] (CF^3).

Characteristics	Snack made from			
	FFSF	CF^1	CF^2	CF^3
Color	6.67^{b}	7.13^{ab}	6.67^{b}	7.27^{a}
Flavor	6.73^{a}	6.93^{a}	6.87^{a}	7.00^{a}
Texture	6.80^{ab}	6.87^{a}	6.27^{b}	7.00^{a}
Acceptability	6.67^{ab}	6.73^{ab}	6.20^{b}	6.80^{a}

The figure on the same row with the same letter are not different ($p > 0.05$).

Table 13 Chemical composition of four accepted coated barbecue snacks made from composite flour[1] (CF^1) or composite flour[3] (CF^3) without or with adding 10% of nata de coco pressed cake.

Chemical composition (% dry weight)	Coated barbecue snack made from			
	CF^1	CF^3	CF^1+10% of nata de coco pressed cake	CF^3+10% of nata de coco pressed cake
Moisture	6.43	6.28	6.51	6.35
Fat	26.49	25.04	25.86	23.59
Protein	26.39	24.23	25.91	24.10
Ash	5.43	5.15	5.49	5.21
Crude fiber	1.69	2.45	2.47	3.58
Carbohydrate	40.00	43.13	40.27	43.52
Energy, cal / 100 gram	504	495	498	483

Table 14 Essential amino acid composition of four accepted coated barbecue snack made from composite flour[1] (CF^1) or composite flour[3] (CF^3) without or with adding 10% of nata de coco pressed cake and FAO/WHO standard.

Essential amino acid	Amino acid composition of protein of coated barbecue snack made from					
	FFSF	CF^1	CF^3	CF^1+10% of nata de coco pressed cake	CF^3+10% of nata de coco pressed cake	FAO/ WHO[3]
Isoleucine	35	35	35	34	34	40
Leucine	70	71	71	70	70	70
Lysine	57(104)[1]	54(98)[1]	53(96)[1]	53(96)[1]	52(95)[1]	55
Methionine + cystine	24(69)[2]	26(74)[1]	28(80)[1]	26(74)[1]	28(80)[1]	35
Phenylalanine + Tyrosine	82	82	83	82	83	60
Threonine	37	37	36	37	36	40
Tryptophan	16	16	16	16	16	10
Valine	37	38	39	38	39	50

1 (-) Chemical score (in parenthesis) = $\frac{\text{amino acid content in protein of flour} \times 100}{\text{amino acid content in FAO / WHO standard}}$

2 (-) Limiting amino acid with chemical score.

3 **Source** : Food Composition Table for Use in East Asia (FAO, 1972).

adding 10% of nata de coco pressed cake were increased to the range of 74 - 80%. The increasing of chemical score of four accepted coated barbecue snacks were due to the added flours such as rice flour and defatted sesame flour which were rich in essential amino acid methionine + cystine content before snack making to improve the protein quality of four accepted coated barbecue snacks.

Characteristics of four accepted coated barbecue snacks

The color of four accepted coated barbecue snacks, made from composite flour[1], composite flour[1] adding 10% of nata de coco pressed cake, composite flour[3], and composite flour[3] adding 10% of nata de coco pressed cake, respectively, were light brown. Their flavor were optimun salty, sweet and fatty taste with babecue flavor. In terms of texture, the coated barbecue snacks were soft crisp, puffy and porous. The color of coated barbecue snack, made from full fat soy flour with or without adding 10% of nata de coco pressed cake, were dark brown. Its flavor was the same as four accepted coated barbecue snacks and its texture was hard crisp and a little bit porous. The addition of 25% of rice flour and 15% of mungbean flour into full fat soy flour to make composite flour before snack making could improve the texture by increasing their softness, porousity and crispness of four accepted coated barbecue snack but the addition of nata de coco into composite flour before snack making should not more than 10% in the form of nata de coco pressed cake to increase the fiber content in the accepted coated barbecue snacks.

CONCLUSION

The result from the preparation of snacks from full fat soy flour, composite flour[1], composite flour[2] and composite flour[3] without or with adding nata de coco pressed cake in these flours before snack making using village texturizer indicated that four accepted coated barbecue snacks, made from composite flour[1] without or with adding 10% of nata de coco pressed cake and composite flour[3] without or with adding 10% of nata de coco pressed cake, were accepted in color, flavor, texture and acceptability. Their protein and fat contents were in the range of 24.10 - 26.39% and 23.59 - 26.49% on dry weight, respectively. The crude fiber content of the acepted coated barbecue snacks made from composite flour[1] without or with adding 10% of nata de coco pressed cake were increased from 1.69 to 2.47 (46.15%) and from composite flour[3] without or with adding 10% of nata de coco pressed cake were increased from 2.45 to 3.58 (46.12%). The protein quality of four accepted coated barbecue snacks were improved due to the chemical score of essential amino acid methionine + cystine increased to the range of 74 - 80% while that of the chemical score of essential amino acid methionine + cystine of coated barbecue snack made from full fat soy flour was only 69%. So the addition of 25% of rice flour, 5% of defatted sesame flour (rich in methionine + cystine) and 15% of mungbean flour into full fat soy flour to make composite flour without or with adding 10% of nata de coco pressed cake before snack making could improve the protein quality, color and texture of four accepted products.

ACKNOWLEDGEMENT

This project was the one of “Development of products from coconut project” and supported by Thailand Research Fund (TRF).

LITERATURE CITED

Anonymous. 1984. The Village Texturizer. Meals for Millions Foundation. Santamonica, California, USA. 76 p.

A.O.A.C. 1984. Official Methods of Analysis of

the Association of Official Analytical Chemists.14th ed. Association of Official Analytical Chemists. The William Byrd Press, Inc. Arlington. Verginia. 1141 p.

Nutrition Division. Health Department. Ministry of Public Health. 1987. Nutrient content of Thai foods in 100 g. of edible portion. 48 p. (In Thai and English).

Nutrition Division. Health Department. Ministry of Public Health. 1990. Amino acid content of Thai foods. 39 p. (In Thai).

Bressani, R. and L.G. Elias. 1974. Legume foods, pp 230 - 297. *In* A.M. Altschul (ed.). New protein foods. Volume 1 A. Technology. Academic Press. New York and London.

Cheman, Y.B., N.B. Mohamad Abdul Karim, and T.K. Tan. 1992. Evaluation of flour high - protein rice - soy snack formulations. J. Fd. Sci. Technol. 27 : 715 - 719.

FAO. 1972. Food Composition Table for Use in East Asia. FAO and U.S. Department of Health, Education and Welfare. U.S. Government Printing Office. USA. 334 p.

Prabhavat, S. 1989. The effect of moisture in full fat soy flour and temperature of village texturizer on the production of Kaset Protein, pp. 363-373. *In* Proceedings of the 27 th Kasetsart University. Annual conference. Jan. 30 - Feb. 1, 1989. Bangkok, Thailand (In Thai).

Sanchez, P.C. 1990. Nata de coco, pp. 185 - 199. *In* M.S. Abacan, (ed.). Coconut as Food. Phillipine Coconut Research and Development Foundation, Inc. (PCRDF), Quezon city. Phillipines.

Surendranath, M.R., G. Azumoddin, D.A. Ramayya, and S.D.Thirumala Rao. 1984. Preparation of low - fat, high - protein sesame seed. J. Fd. Sci. Technol. 21 : 425 - 426.

Received date : 13/08/98
Aecepted date : 5/05/99