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Production of High Protein Snacks from Sweet Potato

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ABSTRACT

Mae Joe and E-kaa sweet potato snacks were prepared by using a village texturizer. Mae Joe and E-kaa sweet potato snacks were fortified with various kinds of flour which were full fat soy flour, wheat flour, rice flour, cassava starch, mungbean flour, defatted sesame flour and defatted groundnut flour. The average scores from sensory evaluation of color, flavor, texture and acceptability showed that the Mae Joe and E-kaa sweet potato snacks which were fortified with 25% full fat soy flour, 20% wheat flour or 20% rice flour; 10% full fat soy flour, 10% defatted groundnut flour, 5% defatted sesame flour, 20% wheat flour or 20% rice flour and the E-kaa sweet potato snack fortified with 25% full fat soy 20% cassava starch; 20% mungbean flour, 5% defatted sesame flour and 20% cassava starch were not significantly different and were the best accepted when compared with the rest of the samples. The protein and fat content of the best accepted fortified Mae Joe sweet potato snacks ranged from 15.86 - 16.62% and 4.72 - 5.85%, while that of unaccepted unfortified Mae Joe sweet potato snack were 5.56 and 1.04%, respectively. The protein and fat content of the best accepted fortified E-kaa sweet potato snacks ranged from 11.06 - 16.95% and 2.16 - 5.44%, while that of unaccepted unfortified E-kaa sweet potato snack were 6.85 and 1.57%, respectively. These were due to high protein and fat content of the added flours. The protein quality of the best accepted fortified Mae Joe and E-kaa sweet potato snacks showed higher chemical score of methionine + cystine, 74-80%, compared to 66% for unfortified Mae Joe and E-kaa sweet potato snack including the best accepted E-kaa sweet potato snack fortified with 25% full fat soy flour and 20% cassava starch. These were due to the added flour such as rice flour, wheat flour, and defatted sesame flour which were rich in methionine + cystine but sweet potato flour, and added flour such as full fat soyflour, defatted groundnut flour, mungbean flour were low in methionine + cystine content.

Key words: production, snacks, sweet potato, village texturizer.

INTRODUCTION

At present, snack is popular in Thailand. Most snacks are fun to eat but are low in nutritive value. If they are eaten in large quantity, they can suppress an appetite for the main meal. For this reason snack with high nutritive value should be developed for use as a supplementary food to increase nutrient in the diet. But the snack must be acceptable at reasonable price. Sweet potatoes (*Ipomoea batatas* Lam) is considered to be the cheap source of carbohydrate and most of people are familiar with it and it is a good source of energy and an inexpensive source of carotene, ascorbic acid, niacin, thiamine, riboflavin, phosphorus, iron and calcium. The sweet potatoes can be used for canning, dehydration, freezing, starch industries, syrup industries, flour and feed etc. Its flour can be

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used very little in making bread for baking industry (Edmond, 1971). It contain about 27.4% carbonydrate, 1.4% protein and 0.4% fat. (Woolfe, 1987). Its protein quality is low due to the deficiency of methionine (Swaminathan and Bhagavan, 1966; Anon. 1990). Its protein quality can be improved by addition of protein source from cereal such as rice, wheat and protein content can be increased by addition of protein source from beans and oilseeds such as soybean, mungbean, groundnut and sesame. Village texturizer was developed by Meals for Millions Foundation (Prabhavat, 1989) and it was originally designed for vegetable protein production at village level. The expansion of dough upon suddend release of pressure, provides porous texture with crispiness after drying.

The purpose of this research is to develop the accepted low cost high protein sweet potato snack with improvement to protein quality by adding flour from soybean, mungbean, groundnut, sesame, rice flour, wheat flour and cassava starch by using the village texturizer. The accepted product not only adds the value to the low cost sweet potato produced in Thailand, but also provides nutritive snack to the children, especially in rural area.

MATERIAL AND METHODS

Preparation of the individual flours

1. Sweet potato flour.

Sweet potato flours from two varieties (Mae Joe and E-kaa sweet potatoes) were prepared as the following:

Each of 20 Kgs of selected two varieties of sweet potatoes were washed with water 4 times. They were peeled and sliced (4 × 4 mm) by using vegetable slicer (Juliennes). The sliced of two varieties of sweet potatoes were dried in a cabinet dryer at 50°C-60°C for 5 hours. They were ground into flour by using a pin mill. The two kinds of sweet potato flour (80 mesh) were obtained.

2. Full fat soy flour.

Four kgs of selected soybeans were washed with water 4 times. The soybeans was dried in a cabinet dryer at 50°C-60°C for 10 hours and cracked into two parts by using a hand grinder and hull was removed. The soybean dhal was ground into flour (80 mesh).

3. Mungbean flour.

Four kgs of selected mungbean were cracked into two parts by using a hand grinder and then washed with water 4 times. Then it was soaked in water at ambient temperature for 3 hours. The hull of soaked cracked bean was removed by floatation during washing with water until the mungbean dhal was clean. It was dried in a cabinet dryer at 50°C - 60°C for 12 hours and then it was ground into flour (80 mesh).

4. Defatted groundnut flour and defatted sesame flour

Each of 4 kgs of selected groundnut and white sesame seed was separately washed with water 4 times. Then groundnut and sesame seed were dried in a cabinet dryer at 50°C - 60°C for 10 and 5 hours, respectively. The dried groundnut was cracked into two parts by pressing with drum stick and hull was removed. The dried groundnut dhal and dried sesame were separately pressed at the pressure 10 - 11 tons for 5 times by using a hydraulic press. The pressed cake of groundnut and sesame were separately ground into flour (80 mesh)

5. Rice flour

Four kgs of selected rice (Kao Dawk Mali 105 variety) were washed with water 4 times and was dried in a cabinet dryer at 50°C - 60°C for 6 hours. Then it was ground into flour (80 mesh).

6. Wheat flour and cassava starch were bought directly from the local market.

All individual flours were analyzed for chemical and essential amino acid composition. Chemical composition were analyzed by the laboratory of the Institute of Food Research and

Product Development, Kasetsart University using the method of A.O.A.C. (1984). Essential amino acids composition were analyzed by (1) Scientific and Technological Research Equipment Centre, Chulalongkorn University (2) Department of Science Service, Ministry of Science, Technology and Energy. (3) Nutrition Division, Health Department. Ministry of Public Health.

Formulation of fortified flours

Ten formulations of fortified sweet potato flour (Mae Joe variety or E-kaa variety) were prepared as shown in Table 3.

Preparation of snacks

Twenty grams of cane sugar, 6 grams of salt powder and 4 grams of pepper powder were dissolved in 180, 180, 190, 190, 190, 190, 180, 180, 180 and 180 mls of water, respectively for adding into each of 500 grams of nine fortified Mae Joe sweet potato flour and one unfortified Mae Joe sweet potato flour formula number 1-10. The same quantity of cane sugar, salt powder and pepper powder were also dissolved in 180, 180, 180, 180, 180, 190, 184, 184, 184 and 90 mls of water, respectively for adding into each of 500 grams of nine fortified E-kaa Sweet potato flour and one unfortified E-kaa sweet potato flour formula number 1-10. Then each of 500 grams of flour was mixed with prepared ingredients solution in kenwood mixer for 3 minutes. The dough was divided into 10 grams portions, rolled into a ball shape and pressed into circular shape before putting in the cup of the village texturizer.

The temperature of the cup and the lid was 190°O-200°C. Center the lid over the cup and press the lid with the pressure 400 psi and holding time for 10 seconds. Then the lid was released from the cup. Moist snacks were obtained and they were cut into rectangular shapes (5 × 1 cm). Then they were dried in a cabinet dryer at the temperature 50°-60°C for 2 hours. The dried Mae Joe sweet potato snacks and dried E-kaa sweet potato snacks (puffed, crisp texture) formula number 1-10 were obtained and they were packed separately in sealed polyethylene bags for determination of characteristics in terms of color, flavor, texture, outer appearance and acceptability.

Organoleptic Evaluation of the snacks

The acceptability test was done for each of the 10 formulae of Mae Joe sweet potato snacks and E-kaa sweet potato snacks, respectively by 10 panelists (researchers of the Institute of Food Research and Product Development, Kasetsart university.) for investigation of the different characteristics in terms of color, flavor, texture and acceptability by using Hedonic scale scoring : Score 9 - the extreme like, and score 1- extreme dislike. The difference in statistics was determined by using LSD (Least significant difference) at 95% significant level. The best accepted formulae of snacks were analyzed for chemical and essential amino acid composition.

RESULTS AND DISCUSSIONS

Qualities of individual and composite flour

The percentage yield for Mae Joe sweet potato flour and E-kaa sweet potato flour were 20.70% and 21.50% by weight of whole tubers, respectively. The percentage yield for full fat soy flour, mungbean flour, defatted groundnut flour, defatted sesame flour and rice flour were 81.50%, 78.50%, 57.00%, 56. 25% and 97.50% by weight of raw material, respectively. The protein content of Mae Joe sweet potato flour, E-kaa sweet potato flour, full fat soy flour, mungbean flour, defatted groundnut flour, defatted sesame flour, rice flour (Khao Dowk Mali 105 variety), wheat flour were 6.16, 7.07, 45.55, 27,96, 44.25, 36.96, 8.45 and 12.51%, respectively. However, the protein con-

tent of cassava starch was only 0.02%. The fat content for the above mentioned samples were 0.76, 0.94, 25.73, 2.77, 31.48, 38.15, 1.12 and 0.96%, respectively, except cassava starch which contained only 0.00% as shown in Table 1.

Essential amino acid composition of all individual flour with their limiting amino acid were shown in Table 2. This indicated that the protein of different sources were incomplete. The methionine + cystine were the limiting amino acid of protein from sweet potato, full fat soy flour, mungbean flour and defatted groundnut flour which their chemical score were in the range of 63-69% but rich in lysine which their chemical score were in the range of 73-113%. The defatted sesame flour, rice flour and wheat flour were rich in methionine + cystine which their chemical score were in the range of 123-140% but low in lysine content which their chemical score were in the range of 38-60%. The essential amino acid content of snacks from two varieties of sweet potato flours could be improved by adding two or more flours together to make composite flours before snack making by using village texturizer as shown in Table 3.

The result of the organoleptic evaluation of Mae Joe sweet potato snacks were shown in Table 4 and 5. It appeared that the Mae Joe sweet potato snacks formula number 1,2,7 and 8 were satisfactorily accepted with average scores at the level of "moderately like."

The results of the organoleptic evaluation of E-kaa sweet potato snacks were shown in Table 6,

Table 1 Chemical composition of various kind of flours.

Kinds of flours	Chemical composition (% Dry weight)						
	Moisture (%)	Fat (%)	Protein (%)	Ash (%)	Crude fiber (%)	Carbo-hydrate (%)	Energy cal/100 gram
Mae Joe Sweet potato flour (SPF_M)	6.29	0.76	6.16	2.34	1.99	88.75	386
E-kaa Sweet potato flour (SPF_E)	8.43	0.94	7.07	2.95	2.59	86.45	383
Full fat soy flour (FFSF)	6.14	25.73	45.55	5.68	1.03	22.01	502
Mungbean flour(MBF)	9.14	2.77	27.96	3.48	1.11	64.68	395
Defatted groundnut flour (DFG F)	4.08	31.48	44.25	3.59	2.84	17.84	532
Defatted sesame flour (DFSF)	4.09	38.15	36.96	5.08	4.95	14.86	551
Rice flour (RF) (Khao Dawk Mali 105 variety)	7.67	1.12	8.45	0.02	0.00	90.41	406
Wheat flour (WF)	12.37	0.96	12.51	0.59	0.16	85.78	402
Cassava starch (CS)	11.84	0.00	0.02	0.23	0.00	99.75	399

Table 2 Essential amino acid compositions of various kind of flours and FAO/WHO standard.

Essential amino acid	Amino acid, mg/gm of protein of								FAO/WHO[3]
	SPF_M	SPF_E	FFSF	MBF	DFGF	DFSF	RF	WF	
Isoleucine	40	41	36	35	36	31	38	36	40
Leucine	62	65	69	55	75	60	79	69	70
Lysine	41(75)[1]	40(73)[1]	62(113)[1]	57(104)[1]	41(75)[1]	29(53)[2]	33(60)[2]	21(38)[2]	55
Methionine+ Cystine	23(66)[2]	24(69)[2]	23(66)[2]	23(66)[2]	22(63)[2]	49(140)[1]	47(134)[1]	43(123)[1]	35
Phenylalanine+ Tyrosine	82	92	83	90	96	78	88	75	60
Threonine	48	52	38	37	32	38	32	28	40
Tryptophan	11	15	15	11	12	16	14	11	10
Valine	55	59	37	38	13	38	54	41	50

[1] (-) Chemical score in parenthesis

[2] (-) Limiting amino acid with chemical score

[3] Source: Food Composition Table for use in East Asia (FAO, 1972)

$$\text{Chemical score} = \frac{\text{amino acid content in flour}}{\text{amino acid content in FAO/WHO Standard}} \times 100$$

Table 3 Composition of ten formulae of Mae Joe or E-kaa sweet potato snack flours.

Formula Number	Composition, %							
	SPF_M or SPF_E	FFSF	MBF	DFGF	DFSF	WF	RF	CS
1	55	25	-	-	-	20	-	-
2	55	25	-	-	-	-	20	-
3	55	25	-	-	-	-	-	20
4	55	-	25	-	-	20	-	-
5	55	-	25	-	-	-	20	-
6	55	-	20	-	5	-	-	20
7	55	10	-	10	5	20	-	-
8	55	10	-	10	5	-	20	-
9	55	10	-	10	5	-	-	20
10	100	-	-	-	-	-	-	-

and 7. It appeared that the E-kaa sweet potato snacks formula number 1,2,3,6,7,8 were satisfactorily accepted with average scores at the level of "moderately like."

The chemical composition of the best four accepted fortified Mae Joe sweet potato snacks were show in Table 8. The protein and fat content of unfortified Mae Joe sweet potato snack were 5.56 and 1.04% which were increase to 15.86-16.62% and 4.72-5.85%, respectively for the best four accepted fortified Mae Joe sweet potato snacks. The protein and fat content of unfortified E-Kaa sweet potato snack were 6.85 and 1.57% which were increased to 11.06-16.95% and 2.16-5.44%, respectively for the best six accepted fortified E-kaa sweet potato snacks as shown in Table 9. These were due to higher protein and fat content of the added full fat soy flour, defatted groundnut flour, and defatted sesame flour. The only mungbean flour which was lower in fat content but higher in protein content.

The essential amino acid composition of the

Table 4 Organoleptic evaluation of Mae Joe sweet potato snack formula number 1,2,3,4,5 and 6 compare with formula number 10 (from Mae Joe sweet potato flour alone).

Characteristics	Mae Joe sweet potato snack formula number						
	10	1	2	3	4	5	6
Color	4.40d	7.20a	7.00ab	6.40bc	6.00c	6.50ab	5.90cd
Flavor	6.10bc	6.60ab	6.80a	5.70cd	5.70cd	5.40d	5.90cd
Texture	5.40b	6.60a	6.70a	5.40b	5.00bc	5.30b	4.60c
Acceptability	5.30b	6.40a	6.70a	5.30b	5.00b	5.30b	4.80b
Average score	5.30bc	6.70a	6.80a	5.70b	5.43bc	5.63bc	5.23c

The figures on the same row with the same letter showed no significant difference in statistics at 95% level.

Table 5 Organoleptic evaluation of Mae Joe sweet potato snack formula number 7,8 and 9 compare with formula number 10 (from Mae Joe sweet potato flour alone).

Characteristics	Mae Joe sweet potato snack formula number			
	10	7	8	9
Color	4.30b	6.90a	7.10a	6.80a
Flavor	6.00a	6.50a	6.40a	6.10a
Texture	4.70c	6.70a	6.20ab	5.50bc
Acceptability	4.60c	6.70a	6.20ab	5.60b
Average score	4.90c	6.70a	6.48ab	6.00b

The figures on the same row with the same letter showed no significant difference in statistics at 95% level.

four best accepted fortified Mae Joe sweet potato snacks and the six best accepted fortified E-kaa sweet potato snacks were shown in Table 10 and 11. The chemical score of the limiting amino acid methionine + cystine of unfortified Mae Joe and E-kaa sweet potato snack formula number 10, the best accepted fortified E-kaa sweet potato snack formula number 3 were 66%. The chemical score of methionine + cystine of he best four accepted fortified Mae Joe sweet potato snacks formula number 1,2,7,8 and the five best accepted fortified E-kaa sweet potato snack formula number 1,2,6,7 and 8 were in creased to 74-80%. These were due to high methionine + cystine content of the rice flour, wheat flour and defatted sesame flour which were added.

Characteristics of the best accepted sweet potato snacks.

Mae Joe sweet potato snacks

The color of snack formula number 1 and 2 were yellowish brown and greenish brown, re-

Table 6 Organoleptic evaluation of E-kaa sweet potato snack formula number 1,2,3,4,5 and 6 compare with formula number 10 (from E-kaa sweet potato flour alone).

Characteristics	E-kaa sweet potato snack formula number						
	10	1	2	3	4	5	6
Color	4.70d	6.90a	6.30abc	6.70ab	5.90bc	5.40cd	6.10abc
Flavor	5.70b	6.30ab	6.40ab	6.50a	6.00ab	5.70b	6.00ab
Texture	3.40c	6.20a	5.80ab	6.30a	5.30ab	4.80b	5.40ab
Acceptability	3.80c	6.20a	5.90ab	6.20a	5.50ab	5.00b	5.30ab
Average score	4.40d	6.40ab	6.10ab	6.43a	5.68bc	5.23c	5.70abc

The figures on the same row with the same letter showed no significant difference at 95% level.

Table 7 Organoleptic evaluation of E-kaa sweet potato snack formula number 7,8 and 9 compare with formula number 10 (from E-kaa sweet potato flour alone).

Characteristics	E-kaa sweet potato snack formula number			
	10	7	8	9
Color	4.70c	6.90a	6.50ab	6.00b
Flavor	5.60a	6.30a	6.10a	5.80a
Texture	4.30b	6.20a	6.10a	4.90b
Acceptability	4.40b	6.10a	6.10a	5.10b
Average score	4.75c	6.38a	6.20a	5.45b

The figures on the same row with the same letter showed no significant difference at 95% level.

spectively but the color of snack formula number 7 and 8 were yellowish white. The odor of snack formula number 1 was roasted sweet potato and roasted sweet potato together with roasted rice for snack formula number 2. The odor of snack formula number 7 and 8 was roasted groundnut. In terms of flavor, snack formula number 1, 2, 7 and 8 were optimum salty, sweet, hot and fatty taste. In terms of texture, the snack formula number 1, 2, 7 and 8 were good crisp, puffy, porous and a little bit hard. The addition of 2 or more individual flours and cassava starch in to Mae Joe sweet potato flour (SPF_M) before making snacks could improve the texture of snacks in increasing their softness, porosity and crispness.

Table 8 Chemical composition of the best four formulae of accepted Mae Joe sweet potato snacks made from composite flour compare with snack made from Mae Joe sweet potato flour (SPF_M) alone (formula number 10).

Chemical composition (% Dry weight)	Mae Joe sweet potato snack formula number				
	10	1	2	7	8
Moisture, %	7.74	7.49	6.65	6.04	6.35
Fat, %	1.04	4.72	5.11	5.85	5.06
Protein, %	5.56	16.57	16.48	16.62	15.86
Ash, %	3.66	4.14	3.69	3.52	3.59
Crude fiber, %	2.43	2.29	2.16	1.58	1.45
Carbohydrate, %	87.31	72.28	72.56	72.43	74.04
Energy, Cal/100 gram	381	398	402	409	405

Table 9 Chemical composition of the best six formulae of accepted E-kaa sweet potato snacks made from composite flour compare with snack made from E-kaa sweet potato flour (SPF_E) alone (formula number 10).

Chemical composition (% Dry weight)	E-kaa sweet potato snack formula number						
	10	1	2	3	6	7	8
Moisture, %	8.22	6.66	6.71	6.43	7.76	6.93	6.43
Fat, %	1.57	5.21	5.24	4.79	2.16	5.29	5.44
Protein, %	6.85	16.95	15.80	14.82	11.11	11.06	16.16
Ash, %	4.17	3.79	4.44	3.67	3.48	3.96	4.26
Crude fiber, %	2.85	1.45	1.80	1.75	1.71	2.02	1.84
Carbohydrate, %	84.56	72.60	72.72	74.97	81.54	77.67	72.30
Energy, Cal/100 gram	380	405	401	402	390	403	403

E-kaa sweet potato snacks

The color of snack formula number 1, 2 and 3 were light brown but the color of snack formula number 6, 7 and 8 were yellowish brown. The odor of snack formula number 1, 2 and 3 were roasted sweet potato together with roasted soybean. The odor of snack formula number 6 was roasted sweet potato together with roasted mungbean. The odor of snack formula number 7 and 8 was roasted sweet potato together with roasted groundnut. In terms of flavor, snack formula number 1,2,3,7 and 8 were optimum salty, sweet, hot and fatty taste but snack formula number 6 was optimum salty, sweet and hot taste. In terms of texture, the snack formula number 1, 2, 3, 6, 7 and 8 were good crisp, puffy, porous and a little bit hard. The addition of 2 or more of individual flours and cassava starch into E-kaa sweet potato flour (SPF_E) before making snacks could improve the texture of snacks in increasing their softness, porosity and crispness.

CONCLUSION

The protein content and protein quality of Mae Joe sweet potato snacks and E-kaa sweet potato snacks could be improved by addition of protein flours (full fat soy flour, mungbean flour, defatted groundnut flour, defatted sesame flour), wheat flour and rice flour before snacks making. The protein and fat content of the best four accepted

Table 10 Essential amino acid composition of the best four formulae of accepted Mae Joe sweet potato snacks made from composite flour compare with snack made from Mae Joe sweet potato flour (SPF_M) alone (formula number 10).

Essential amino acid	Mae Joe sweet potato snack formula number					FAO/WHO[3]
	10	1	2	7	8	
Isoleucine	40	43	32	32	40	40
Leucine	58	67	62	65	65	70
Lysine	40(73)[1]	49(89)[1]	48(87)[1]	41(75)[1]	43(78)[1]	55
Methionine+ Cystine	23(66)[2]	26(74)[1]	26(74)[1]	28(80)[1]	28(80)[1]	35
Phenylalanine +Tyrosine	57	67	58	70	74	60
Threonine	42	36	35	32	32	40
Tryptophan	15	14	15	14	15	10
Valine	50	44	39	40	46	50

[1] (-) = Chemical score in parenthesis.

[2] (-) = Limiting amino acid with chemical score.

[3] Source: Food Composition Table for use in East Asia (FAO, 1972)

$$\text{Chemical score} = \frac{\text{amino acid content in snack}}{\text{amino acid content in FAO/WHO Standard}} \times 100$$

Table 11 Essential Amino acid composition of the best six formulae of accepted E-kaa sweet potato snacks made from composite flour compare with snack made from E-kaa weet potato flour (SPF_E) alone (formula number 10).

Essencial amino acid	E-kaa sweet potato snack formula number							FAO/WHO[3]
	10	1	2	3	6	7	8	
Isoleucine	41	40	40	40	43	48	48	40
Leucine	78	70	70	72	70	75	79	70
Lysine	40(73)[1]	47(85)[1]	50(91)[1]	55(100)[1]	45(82)[1]	42(76)[1]	43(78)[1]	55
Methionine+ Cystine	23(66)[2]	26(74)[1]	26(74)[1]	23(66)[2]	27(77)[1]	28(80)[1]	28(80)[1]	35
Phenylalanine +Tyrosine	81	68	70	75	80	80	80	60
Threonine	56	40	48	44	41	42	40	40
Tryptophan	17	15	15	16	16	11	15	10
Valine	59	42	52	50	50	53	54	50

1(-) = Chemical score in parenthesis.

2(-) = Limiting amino acid with chemical score.

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

$$\text{Chemical score} = \frac{\text{amino acid content in snack}}{\text{amino acid content in FAO/WHO Standard}} \times 100$$

fortified Mae Joe sweet potato snacks (formula number 1,2,7,8) were 15.86 - 16,62% and 4.72-5.85%, respectively, while that of unaccepted unfortified Mae Joe sweet potato snack (formula number 10) were only 5.56 and 1.04%, respectively. The protein and fat content of the best six accepted fortified E-kaa sweet potato snack (formula number 1,2,3,6,7,8) were 11.06 - 16.95%, and 2.16-5.44%, respectively, while that of unaccepted unfortified E-kaa sweet potato snack (formula number 10) were 6.85 and 1.57%, respectively. The protein quality of the best accepted fortified Mae Joe and E-kaa sweet potato snacks were improved due to the chemical score of limiting amino acid methionine + cystine were increased to 74-80% while those of unfortified unaccepted Mae Joe and E-kaa sweet potato snacks and the best accepted fortified E-kaa sweet potato snack formula number 3 were only 66%.

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