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Use of Oat Derivative: Nu-Trim OB as Fat Substitute for Coconut Milk on Qualities of Thai Desserts

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ABSTRACT

Eight Thai desserts were substituted with 5 percent of Nu-Trim OB (oat bran) suspension for coconut milk. Sensory evaluation of products was performed by 25 panelists using a 9-point hedonic scale for color, appearance, odor, taste, texture and acceptability. The desserts were crispy pancake, taro conserve, steamed banana cake, coconut pudding, steamed glutinous rice with coconut cream, coconut jelly, coconut-cantaloupe ice cream and pumpkin in coconut milk. Total substitution of Nu-Trim OB for coconut milk was possible in most prepared formulas. Crispy pancake, taro conserve, steamed banana cake and coconut jelly were well accepted at the 100 percent substitution, and the steamed glutinous rice with coconut cream and coconut-cantaloupe ice cream could be possibly replaced at 80 percent, whereas coconut pudding and pumpkin in coconut milk were fully allowed at 60 percent. The principal effects of Nu-Trim OB used as coconut milk substitute depended on moisture content of the products and cooperation of specific ingredients, which might cause unfavorable characteristics. When texture of the highest substituted desserts compared to their control were detected by TA.XT2i/25 Texture Analyzer, crispy pancake as dry product became harder, while the taro conserve and steamed banana cake as semi-moistened products were tougher and coconut jelly as moistened product became too soft texture. Moreover, pumpkin in coconut milk as liquid dessert appeared to be unacceptable high viscosity at the high level of substitution. Chemical analysis of total fats and saturated fats in the desserts with accepted level of Nu-Trim OB substitution exhibited a distinctive reduction from their controls, which were at 83.4, 97.4, 85.4, 55.4, 73.1, 75.1, 74.6 and 49.9 percent, and at 95.5, 99.4, 86.3, 46.2, 80.4, 87.7, 79.8 and 58.3 percent, respectively.

Key words : Nu-trim OB, fat substitute, coconut milk, Thai desserts

INTRODUCTION

It is well recognized that healthful effects of cereal grain as oat products are associated with prevention of hypercholesterolemia, one of the primary factors contributing to atherosclerosis and heart diseases (Kahlon and Chow,1997; Raloff, 1991; Ripsin *et al*.,1992). Dietary fibers from oat bran have been primarily reported to have hypocholesterolemic activities in both animal and human (DeGroot, *et al*.,1963). Oat bran is presently not only the source of this key ingredient, but β-glucans, (1–3)(1–4)- β-D-glucans, a soluble fiber from oat also plays a potential role in these health improvement (Inglett and Grisamore,1991; Inglett, 1993; Inglett *et al*.1994).

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Dietary fat-reduction and controlled caloric intake are important for maintaining good health. Recently, the U.S. Food and Drug Administration (U.S. FDA,1998) has authorized a health claim related to oat products, stating that oat products, in conjunction with a diet low in saturated fat and cholesterol may reduce heart disease and must contain 0.75 g of β-glucans per reference amount.

Nu-Trim OB derived from oat bran, is a new β-glucan-rich hydrocolloid for increasing textural qualities and health benefits of functional foods. It acts as a fat substitute with high concentration of 8.6 percent β-glucan soluble fibers. Preparation in high yields involved a natural extraction process that removes most of the cellulose material from the oats'husk, making it easier for the body to absorb beneficial substance called β-glucans (Inglett,1998). Nu-Trim OB produces soft and smooth textured material of fat- like gel. It can provide more nutritious functional foods along with large reductions in calories and fat depending upon the amount of fat and carbohydrates replaced with Nu-Trim OB. In laboratory studies by Yokoyama *et al.* in 1998, they reported that Nu-Trim OB lowered cholesterol levels in hamsters by 27 percent, substantially more than unprocessed oats did and LDL cholesterol was reduced by 36 percent . Moreover, these oat soluble β-glucans have a beneficial effect on glycemic response by slowing the absorption of glucose from the intestine, therefore Nu-Trim could be an important factor in the treatment of type II diabetic patients (Hallfrisch and Behall,1998).

Nowaday Thai people are more concern of dietary intakes related to health benefits. It is well-known that excessive fat and calorie consumption lead to several diseases such as obesity, hypertension, hypercholesterolemia, hypertriglyceridemia, diabetes mellitus, heart disease and others. Data from nutritional survey on daily food consumption of 618 people living in Bangkok showed fat consumption to be about 38.3 percent of total calorie intake (Vatanasuchart and Boonphun,1993) which was more than the Thai Recommemded Dietary Allowances,1989 set at the level of 30 percent of total calorie intake. As an option, reduction of fat and calorie intake could be achieved by modification of food supply through the use of fat substitutes.

Traditionally, fat-rich ingredient commonly used in both Thai meals and desserts is coconut milk or cream. It contains 35.5 percent of fat content, 31.2 percent of total saturated fats and only 2.82 percent of polyunsaturated fats (Department of Health, 1987). In case of high consumption of coconut milk, the containing saturated fats might cause health problems, which would lead to heart diseases. Consequently, the recommended consumption of saturated fat was limited to as low as 10 percent of total calorie intake (Food Act, B.E.2522). Thus it is interesting to do thorough research on the modification of low fat or low calorie Thai foods, particularly desserts containing high proportion of coconut milk through the use of Nu-Trim OB as substitute.

MATERIALS AND METHODS

Ingredients

Nu-Trim OB was obtained from the U.S. National Center for Agricultural Utilization Research Center. The compositions in percent are: moisture, 6.7; ash, 2.2; fat (ether extraction), 1.1; protein (nitrogen × 6.25), 9.7; crude fiber, 0.25; pH (10 percent solution), 5.5–6.5; β-glucan, 8.6 (87–15D/pmc/cjc/bc/r4–11/l). It is in dry powder form which can be converted to soft gel by blending into hot water with a 5 percent of Nu-Trim OB dispersion and refrigerate overnight before used (Inglett,1992). Preparation of coconut milk was done by mixing 2 kg grated coconut with 500 g water, then put into electric presser to obtain coconut

milk.

Eight kinds of popular Thai dessert containing high proportion of coconut milk were selected for this research. They were grouped into four categories according to their moisture contents. Dry or low moisture product was represented by crispy pancake (tong-pup). Semi-moistened products were taro conserve (puek-kuan), steamed banana cake (khanom-kuay), coconut pudding (tako saku) and steamed glutinous rice with coconut cream (kaoniew moon), whereas moistened products were coconut jelly (vun-sangkaya) and coconut-cantaloupe ice cream. Liquid product such as pumpkin in coconut milk (fuktong kaengbuad) was included. The standard formulas of eight desserts were developed and represented as control samples showing in Table 1. Coconut milk was substituted with Nu-Trim OB at 60, 80 and 100 percent of coconut milk on weight basis for crispy pancake, taro conserve, steamed banana cake and coconut jelly. Whereas coconut pudding, steamed glutinous rice with coconut cream, coconut-cantaloupe ice cream and pumpkin in coconut milk, containing high amounts of coconut milk as

Table 1 Standard formula of Thai desserts for 100 g.

Products	Coconut milk	Sugar	Egg	Flour	Salt	Specific ingredients	Water	Others[1]
Crispy pancake	37.40	20.33	4.07	36.58	0.40	1.22 (sesame seed)	--	--
Taro conserve	25.61	23.05	--	--	0.13	51.22 (mashed taro)	--	--
Steamed banana cake	20.67	23.85	--	11.13	0.60	39.75 (mashed banana)	--	4.00
Coconut pudding	36.10	11.91	--	3.97	0.36	10.83 (saku)	28.88	7.95
Steamed glutinous rice with coconut cream	33.71	14.61	--	--	1.12	50.56 (glutinous rice)	--	--
Coconut jelly	17.12	25.25	10.70	--	0.09	1.03 (agar powder)	45.38	0.43
Coconut cantaloupe ice cream	43.23	12.97	--	--	0.29	43.23 (cantaloupe)	--	0.29
Pumpkin in coconut milk	44.40	11.10	--	--	0.09	44.40 (pumpkin)	--	--

1 Including shredded coconut, lotus seed and pandanus leaf extract, vanilla extract and gelatin powder, respectively.

2 Addition of 40 percent water to the prepared coconut milk.

a major ingredient in the formulas, would be replaced with Nu-Trim OB at levels of 40, 60 and 80 percent, respectively.

Physical and chemical evaluation

A sensory panel with 25 members in acceptability and preference testing evaluated the eight Thai desserts for the following characteristics: color, appearance, odor, taste, and texture using 9-point hedonic scale. Samples with acceptability score more than 6 were analyzed for proximate composition (AOAC, 1994) and total saturated fats (Jham *et al*., 1992). The texture was detected by TA.XT2i/25 Texture Analyzer, Stable Micro System using 2 mm. diameter cyclinder stainless probe and HDP/BSK blade set with knife edge and viscosity of product was measured using Brookfield TC 500 with Rheocale V 1.0. The statistical analysis was assessed by ANOVAS and DMRT test (Pagano,1981).

The preparation of the eight desserts are listed as follow:

Crispy pancake (tong-pup)

Ingredients: 200 g rice flour, 250 g cassava flour (or tapioca flour), 150 g palm sugar, 100 g white sugar, 460 g coconut milk, 50 g egg, 5 g salt, and 15 g black sesame seed.

Methods: Mix all ingredients together except sesame seed. Mix until become homogenous. Set aside for 15 min. Then add sesame seed and bake it in tong-pup electric heater.

Taro conserve (puek-kuan)

Ingredients: 400 g mashed steamed taro,200 g coconut milk, 180 g sugar, and 1 g salt.

Methods: Mix all ingredients together and cook in a brass wox until thickened. Then put into mold as desired shape.

Steamed banana cake (khanom-kuay)

Ingredients: 500 g mashed banana, 70 g rice flour, 70 g cassava flour, 150 g sugar, 260 g coconut milk, 7.5 g salt, and 50 g shredded coconut.

Methods: Mix mashed banana, flour, sugar and salt together. Stir it until softened. Then add coconut milk and mix thoroughly. Put the mixture into 20 small cups and sprinkle over with shredded young coconut meat. Steam over boiling water for 15 min.

Coconut pudding (tako saku)

Ingredients for saku: 150 g small size sago, 400 g water, 140 g sugar, 70 g boiled lotus seed, and 40 g pandanus leaf extract.

Methods: Wash saku and drain water. Cook saku in water with continuous stirring until become translucent and thickened. Add sugar and pandanus leaf extract. Cook until sticky and transfer into small plastic molds with 3/4 of portion size. Let it cool.

Ingredients for topping: 500 g coconut milk, 5 g salt, 55 g rice flour and 25 g sugar.

Methods: Mix all ingredients and stir until dissolved. Cook until thickened, while stirring continuously. Pour over saku mixture and let it set and firm.

Steamed glutinous rice with coconut cream (kaoneiw moon)

Ingredients: 450 g glutinous rice, 300 g coconut milk, 130 g sugar, and 10 g salt.

Methods: The glutinous rice was soaked for 3 hours, then steamed over boiling water for 30 min. At the meantime, mix coconut milk, sugar and salt together and bring to boil, then pour the mixture over the hot cooked glutinous rice in a bowl. Mix thoroughly and cover for 30 min, serve with ripened mango or other desired toppings.

Coconut jelly (vun-sangkaya)

Ingredients for algar suspension: 12 g algar powder, 45 g sugar, and 530 g water.

Ingredients for coconut suspension: 200 g coconut milk, 125 g duck eggs, 250 g palm sugar, 1 g salt, and 5 g vanilla flavor.

Methods: Combine coconut milk, eggs, palm

sugar and salt, mix thoroughly and set aside. Mix algar powder, sugar and water and bring to boil, then add the coconut milk mixture, stir and continue boiling for a minute. Transfer into mold as desired shape and let it set at room temperature.

Coconut-cantaloupe ice cream

Ingredients: 600 g coconut milk (addition of 40 percent water), 600 g blended fresh cantaloupe, 180 g sugar, 4 g salt, and 4 g gelatin powder.

Methods: Combine coconut milk, sugar, salt and gelatin powder and bring to boil, while stir gradually and mix with cantaloupe. Cool in refrigerator. Transfer into ice cream freezer.

Pumpkin in coconut milk (fuktong kaengbuad)

Ingredients: 500 g small sliced pumpkin, 500 g coconut milk (addition of 40 percent water), 100 g palm sugar, 25 g white sugar, and 1 g salt.

Methods: Combine all ingredients together in a pot. Bring to boil and continue for 2 min. and set aside.

RESULTS AND DISCUSSION

This studies were obtained on determining the application of Nu-Trim OB as a coconut milk substitute and nutrifying ingredient in eight Thai desserts. The sensory evaluation of substitution of Nu-Trim OB for coconut milk are shown in Table 2. Preparation of the desserts could be possibly substituted with Nu-Trim OB upto 100 percent level. The results showed that levels of Nu-Trim OB substitution at 60, 80 and 100 percent in either taro conserve, steamed banana cake or coconut jelly were not significantly different in color and appearance. Also odor and taste of taro conserve and steamed banana cake had no significant difference among 60, 80 and 100 percent of Nu-Trim OB substitution. When compared to the control, steamed banana cake with all level of Nu-Trim OB substitution were not significantly different in appearance, odor, texture and acceptability, but showed little difference in taste at 100 percent level. Crispy pancake with 60 and 80 percent of Nu-Trim OB substitution revealed no significant difference in appearance, odor, taste, texture and acceptability.

Coconut pudding and pumpkin in coconut milk appeared quite low scores of characteristics and acceptability when substituted at 80 percent of Nu-Trim OB. Steamed glutinous rice with coconut cream substituted with Nu-Trim OB at 60 and 80 percent were not significantly different in color, appearance, odor, taste and acceptability. In particular, steamed banana cake and coconut-cantaloupe ice cream showed the most acceptable and satisfactory with no difference in acceptability score of all substitution when compared to their controls. Apparently, Nu-Trim OB and mashed banana held similarity in texture and color, therefore the Nu-Trim OB substituted steamed banana cake could not be differentiated by the panelists from the control. Likewise viscous texture of Nu-Trim OB during frozen stage would produce good characteristics of ice cream mixed with cantaloupe.

Fat substitutes can be broadly grouped into either lipid-based materials or carbohydrate- and protein-based materials. For the most parts, lipid-based fat substitutes have functional and sensory properties similar to those of the fats, but their application are limited due to the toxicology and metabolism of these compounds, while most of the carbohydrate-and protein-based substitutes are either approved or near approval. In particular carbohydrate-based fat substitutes such as oatrim or Nu-Trim OB from oat, prepared by incorperating water into a gel-type structure, can result in lubricant or flow properties similar to those texture of fats, but they are rather limited in carrying lipid-associated flavor and the water contents of the gel may reduce product shelf life (Hassel,1993; Inglett, *et al*., 1994).

Table 2 Sensory evaluation of Thai desserts using Nu-Trim OB as coconut milk substitute 1.

Products	Color	Appearance	Odor	Taste	Texture	Acceptability
Crispy pancake						
Control	7.98[a]	7.92[a]	8.18[a]	8.04[a]	8.06[a]	8.22[a]
60 percent	7.54[b]	7.62[b]	7.42[b]	7.50[b]	7.72[b]	7.46[b]
80 percent	7.12[c]	7.52[b]	7.02[b]	7.36[b]	7.52[b]	7.16[b]
100 percent	6.76[c]	6.92[c]	6.02[c]	6.68[c]	7.00[c]	6.20[c]
Taro conserve						
Control	7.62	7.65	7.77[a]	7.77[a]	7.56[a]	7.63[a]
60 percent	7.62	7.62	7.52[ab]	7.56[ab]	7.40[a]	7.38[a]
80 percent	7.58	7.50	7.33[b]	7.50[b]	7.21[ab]	7.27[a]
100 percent	7.48	7.50	7.17[b]	7.31[b]	6.85[b]	6.88[b]
	(P>0.01)	(P>0.01)				
Steamed banana cake						
Control	7.00[b]	7.26	7.46	7.66[a]	7.42	7.52
60 percent	7.56[a]	7.44	7.28	7.50[ab]	7.20	7.30
80 percent	7.50[a]	7.44	7.14	7.44[ab]	7.26	7.24
100 percent	7.52[a]	7.44	7.20	7.22[b]	6.94	7.02
		(P>0.01)	(P>0.01)		(P>0.01)	(P>0.01)
Coconut pudding						
Control	7.94[a]	7.74[a]	7.76[a]	7.68[a]	7.44[a]	7.60[a]
40 percent	7.06[b]	6.96[b]	6.94[b]	7.10[b]	6.66[b]	6.88[b]
60 percent	6.18[c]	6.44[c]	6.62[b]	6.84[b]	6.42[b]	6.42[c]
80 percent	5.80[d]	5.94[d]	5.78[c]	6.02[c]	5.46[c]	5.54[d]
Steamed glutinous rice with coconut cream						
Control	7.92[a]	7.70[a]	7.60[a]	7.70[a]	7.58[a]	7.72[a]
40 percent	7.52[b]	7.44[a]	7.06[b]	7.16[b]	7.24[b]	7.28[b]
60 percent	7.00[c]	6.88[b]	6.46[c]	6.78[c]	6.44[d]	6.52[c]
80 percent	7.10[c]	6.96[b]	6.60[c]	6.68[c]	6.86[c]	6.70[c]
Coconut jelly						
Control	6.70[b]	6.72[b]	7.38[a]	7.28[a]	7.22[a]	7.38[a]
60 percent	7.32[a]	7.32[a]	6.68[b]	6.98[ab]	6.96[ab]	6.82[b]
80 percent	7.34[a]	7.54[a]	6.24[c]	6.74[bc]	6.64[b]	6.66[b]
100 percent	7.24[a]	7.36[a]	6.48[bc]	6.58[c]	6.62[b]	6.54[b]

Table 2 Continued.

Products	Color	Appearance	Odor	Taste	Texture	Acceptability
Coconut cantaloupe ice cream						
Control	7.92[a]	7.66[a]	7.26	7.54	7.34	7.40
40 percent	7.56[b]	7.22[b]	7.30	7.46	7.26	7.34
60 percent	7.36[bc]	7.02[bc]	7.10	7.48	6.94	7.24
80 percent	7.22[c]	6.86[c]	7.00	7.12	7.00	6.94
			(P>0.01)	(P>0.01)	(P>0.01)	(P>0.01)
Pumpkin in coconut milk						
Control	7.62[a]	7.46[a]	7.48[a]	7.56[a]	7.46[a]	7.60[a]
40 percent	7.56[a]	7.30[a]	7.20[ab]	7.30[ab]	7.12[ab]	7.30[ab]
60 percent	7.34[a]	7.30[a]	6.94[b]	7.10[b]	6.78[b]	6.88[b]
80 percent	6.78[b]	6.52[b]	6.10[c]	5.94[c]	5.94[c]	5.86[c]

[1] In a column, means followed by same or without superscripts are not significantly different at P>0.05 and at P>0.01 as shown within parenthesis by ANOVA and DMRT.

For this research, eight Thai desserts were chosen because they were expected that their specific ingredients from cereals, roots, fruits or others (Table 1) could help the substituted products conceal odor and flavor of oat bran with addition to distract no lipid-associated flavor of Nu-Trim OB. However substitution of 100 percent Nu-Trim OB for coconut milk in taro conserve, crispy pancake, steamed banana cake and coconut jelly could be achieved, whereas steamed glutinous rice with coconut cream and coconut cantaloupe ice cream were accepted at 80 percent of the substitution. But coconut pudding and pumpkin in coconut milk were accepted at 60 percent of the substitution. This was based on the obtained acceptability scores equal to or more than 6.

The results of this study were associated with recent report on use of or oatrim as fat replacer for coconut milk in three desserts (Vatanasuchart *et al*.,1998). Oatrim is also a soluble fiber derived from oat flour and bran, containing 4.5–5.5 percent β-glucans possessing the same functional and nutritional qualities as Nu-Trim OB (Inglett *et al*.,1994). It was found that oatrim could totally replace for coconut milk in mungbean converse and coconut cream spread with good acceptability. When compared to the standard formulas, these two desserts with 60 percent of oatrim replacement showed no significant difference (p>0.05) in color, taste, texture and acceptability. Beside that maximum use of oatrim for butter replacer was at 70 percent in banana cake and brownie. Other study of using oatrim or Trimchoice as a tradename for fat substitute in shortbread cookies showed substitution at 35 percent having the least negative effects on the physical attributes and had breaking force and toughness values most similar to the traditional full- fat shortbread cookie.(Sanchez *et al.*, 1995).

Texture of the desserts were obtained by measurement of shearing force, crispness, penetration force and viscosity as shown in Table 3. The taro conserve (semi-moistened products) became tougher than steamed banana cake when

the substitution with Nu-Trim OB was increased, especially to the highest of 100 percent Nu-Trim OB. Although their acceptability showed a very good score with little change from their controls. The coconut jelly as moistened products resulted too soft texture. The crispy pancake as dry products showed no significant difference in the maximum force of shearing in all samples with Nu-Trim OB substitution from their control. The force in gram per second representing crispness of crispy pancake distinctively decreased at 80 and 100 percent of Nu-Trim OB substitution. The product with 100 percent was described the toughest texture, although the data showed no sighnificant difference from the lower substitution. This might be affected by the low moisture and less combined specific ingredient in the formula of crispy pancake, coordinated with low fat content at the higher substitution. The pumpkin in coconut milk as liquid product became much more viscous or thick suspension when Nu-Trim OB substitution was risen. It seemed that the poor characteristics of the coconut milk suspension from pumpkin in coconut milk and the coconut topping from coconut pudding were resulted from the separated preparation of coconut milk . For the better process at achieving the 100 percent substitution, Nu-Trim OB as a coconut milk substitute should be homogenously incorperated with the other ingredients, particularly a specific ingredient.

Samples with sensory an acceptability score more than 6 and the controls were analyzed for proximate composition (Table 4) and total saturated fat (Table 5). Total fats and energy contents of Thai desserts with Nu-Trim OB substitution distinctively reduced from their controls, which were 83.4, 97.4, 85.4, 55.4, 73.1, 75.1, 74.6 and 49.9 percent and 13.7, 22.9, 7.1, 21.4, 15.5, 27.5, 45.4 and 22.4 percent in crispy pancake, taro conserve, steamed banana cake, coconut pudding, steamed glutinous

Table 3 Texture measurement [1].

Product texture	Control	Percent of Nu-Trim OB substitution level			
		40	60	80	100
Shearing force (g)[2]					
Crispy pancake (P>0.01)	805.56[a]	-	696.98[a]	664.86[a]	702.03 [a]
Crispness (g/sec)[2]					
Crispy pancake	744.31[a]	-	710.47[a]	454.53[b]	359.31[b]
Penetration force(g)[2]					
Taro conserve	20.57[b]	-	21.84[b]	24.33[ab]	27.60[a]
Steamed banana (P>0.01)	31.38[a]	-	32.02[a]	32.54[a]	22.03[a]
Coconut jelly	35.94[a]	-	26.91[b]	26.54[b]	25.01[c]
Viscosity (cps)[3]					
Pumpkin in coconut milk	182.40	280.80	418.40	818.70	-

1 In a row, means followed by same superscripts are not significantly different at P>0.05 and P>0.01 shown in the parenthesis by ANOVA and DMRT.

2 Performed by TA.XT2i /25 Texture Analyzer, Stable Micro Systems using: 2 mm diameter cylinder stainless probe and HDP/ BSK blade set with knife edge.

3 Detected by Brookfield TC 500 with Rheocale V1.0, controlling temperature of water bath at 28°C.

rice with coconut cream, coconut jelly, coconut cantaloupe ice cream, pumpkin in coconut milk, respectively. The analysis data showed a decrease in energy content, ranging from the lowest of 7.1 percent in steamed banana cake, to the highest of 45.4 percent in coconut cantaloupe ice cream. Despite the distinctive reduction in total fat contents in all substituted products with Nu-Trim OB, the desserts such as crispy pancake, steamed banana cake and steamed glutinous rice with coconut milk showed little decrease in energy contents when compared to the others. This might be due to the amount of flour or other carbohydrate sources used in the formulas. The high carbohydrate constituent could lead to high energy content, even though Nu-Trim OB was used as a fat replacer. Interestingly, all products exhibited a great decrease in total saturated fats at 95.5, 99.4, 86.3, 46.2, 80.4, 87.7,

Table 4 Proximate composition of Thai desserts with Nu-trim OB substitution for coconut milk (per 100 g sample).

Thai desserts	Moisture (g)	Fat (g)	Protein (g)	Carbohydrate (g)	Ash (g)	Fiber (g)	Energy (kcal)
Crispy pancake							
Control	2.11	15.81	4.23	75.31	1.27	1.27	460.45
100 percent	1.84	2.62	3.70	89.81	1.15	0.88	397.62
Taro conserve							
Control	37.81	9.81	2.70	47.12	1.11	1.45	287.57
100 percent	42.70	0.26	2.24	52.62	1.01	1.17	221.78
Steamed banana cake							
Control	46.29	7.05	1.12	43.27	1.09	1.18	241.01
100 percent	42.05	1.03	0.48	53.16	0.93	2.35	223.83
Coconut pudding							
Control	57.45	10.92	1.76	28.13	0.79	0.94	217.84
60 percent	61.42	4.87	1.22	30.64	0.60	1.25	171.27
Steamed glutinous rice with coconut cream							
Control	39.91	7.63	3.33	46.92	1.15	1.06	269.67
80 percent	43.40	2.05	2.92	49.44	1.00	1.19	227.89
Coconut jelly							
Control	62.54	6.98	1.96	27.57	0.76	0.19	180.94
100 percent	67.82	1.74	1.67	27.22	0.75	0.80	131.22
Coconut cantaloupe ice cream							
Control	67.39	11.24	1.81	18.21	0.69	0.66	181.24
80 percent	77.17	2.85	0.96	17.38	0.55	1.09	99.01
Pumpkin in coconut milk							
Control	67.58	8.29	1.43	21.16	0.90	0.64	164.97
60 percent	72.11	4.15	0.88	21.78	0.76	0.32	127.99

79.8 and 58.3 percent from the controls, respectively, which would be claimed as low saturated fat Thai dessert products.

CONCLUSION

Eight Thai desserts were almost totally substituted with 5 percent of Nu-Trim OB suspension for coconut milk. The consumers accepted those fat substituted products with good satisfaction and maximum use at 100 percent of Nu-Trim OB were found in crispy pancake , taro converse, steamed banana cake and coconut jelly. Whereas steamed glutinous rice with coconut cream and coconut cantaloupe ice cream could be likely replaced with Nu-Trim OB at the highest percent of 80 percent level for coconut cream, in addition coconut pudding and pumpkin in coconut milk

Table 5 Reduction of total fats and saturated fats in Thai desserts with Nu-Trim OB substitution for coconut milk.

Thai desserts	Total fats (g/100 g)	Percent reduction	Total saturated fats (g/100 g)	Percent reduction
Crispy pancake				
Control	15.81	83.4	12.76	95.5
100 percent	2.62		0.58	
Taro conserve				
Control	9.81	97.4	8.39	99.4
100 percent	0.26		0.05	
Steamed banana cake				
Control	7.05	85.4	5.93	86.3
100 percent	1.03		0.81	
Coconut pudding				
Control	10.92	55.4	7.94	46.2
60 percent	4.87		4.27	
Steamed glutinous rice with coconut cream				
Control	7.63	73.1	6.68	80.4
80 percent	2.05		1.31	
Coconut jelly				
Control	6.98	75.1	5.11	87.7
100 percent	1.74		0.63	
Coconut cantaloupe ice cream				
Control	11.24	74.6	9.66	79.8
80 percent	2.85		1.95	
Pumpkin in coconut milk				
Control	8.29	49.9	7.14	58.3
60 percent	4.15		2.98	

were accepted at 60 percent of the substitution. Consequently, this very high substitution of Nu-Trim OB in the desserts responded to the dramatic reduction of energy contents, total fats and particular saturated fats, resulting in reduced or low fat products as attempted purpose. From the findings, It was therefore concluded that Nu-Trim OB was suitable fat substitute for coconut milk in the Thai desserts. Despite it was well acceptable to the consumers, the principal effect of Nu-Trim on textural properties were involved at the high substitution of the products, which contained seperated part of coconut milk in preparation process. Lastly, recommendations for future research in this area should concern the selection of products for coconut milk substitution, regarding to moisture content, texture and flavor-enhanced specific ingredients and proper percent of Nu-Trim OB suspension for each of desserts, so that the modifying low calorie or fat products would be characteristically similar to the traditional ones as much as possible.

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