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Evaluation of Thai Foods Prepared with Soluble Fiber Composite from Rice Bran and Barley Flour

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ABSTRACT

Soluble fiber composite from rice bran and barley, which substituted for coconut cream in Thai foods, was found to give acceptable Thai foods with lower saturated fat contents. It was possible to reduce the saturated fats in Kanom Ping Kaset, pumpkin pudding, layer cake, dip sauce for fried pot crust, taro custard and saute chicken curry by 47.78, 94.28, 59.75, 75.27, 61.3 and 60.61%, respectively. The Kanom Ping Kaset, at a 40% fiber gel substitution, showed an increased textural firmness and a cholesterol reduction of 20.49%. Pumpkin pudding, at a 100% substitution level, produced a softer semi-moist texture with a reduction of 94.28% saturated fat. Layer cake displayed a colorful and elastic product at lower substitution levels. However, at higher level it became less colorful with a tougher texture. The dip for fried pot crust increased suspension viscosity with increasing fiber gel substitution levels. Taro custard, even at 80% substitution, had good acceptability scores. The texture was preferable as it contained cereal, which gave the product more moisture. The saute chicken curry sauce became thicker when the fiber gel substitution was increased. The differences in texture and flavor, however, appeared to make small changes in the overall score of general acceptability or suitability of the fiber gel foods.

Key words: rice bran, barley flour, coconut cream, low-fat, fiber

INTRODUCTION

Dietary fat-reduction and caloric intake are considered important factors in maintaining good health. People with high blood cholesterol levels are considered to be at risk for heart disease. Cereal grains have been recognized to be effective in lowering serum cholesterol (Inglett and Newman, 1994). An analysis of several studies has shown the consistent efficacy of oats as a hypocholesterolemic agent in humans (Ripsin *et al*., 1992). The Food and Drug Administration has recently allowed rolled oats, oat flour and oat bran to claim health benefits provided that they are used to give at least 3 grams of soluble fiber [(1-3) (1-4) - beta D- glucan] per day and used as a part of a low-saturated fat, low-cholesterol diet (Food and Drug Administration, 1997a). Soluble fiber products, such as oat trim, have been widely used as fat replacement ingredients (Inglett, 1993). More recent activities are based on using biologically active soluble fibers as nutraceuticals and food supplements (Inglett, 1999). The technology for making these types of soluble fiber products was extended to making barley and rice soluble fiber products (Inglett, 2000). This study was made to determine the effect of using soluble fibers gel from rice bran and barley flour on the properties of

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some Thai foods. These Thai foods included those made with substantial amounts of lard and coconut fat.

MATERIALS AND METHODS

The composite of soluble fibers from rice bran and barley flour was obtained by co-processing rice bran and barley flour (Inglett, 2000). A 10% fiber gel was prepared by blending weights of 10% fiber with 90% water and heating to boiling before allowing it to gel in a refrigerator overnight. The 10% fiber gel was substituted on a weight for weight basis for 40, 60 and 80% of the butter / shortening in cookies. Coconut cream, which is used to prepare layer cake, dip sauce for fried pot crust, taro custard and saute chicken curry, was replaced with 10% fiber gel at 40, 60 and 80% of the coconut cream by weight, except for pumpkin pudding, the 10% fiber gel was substituted for 50, 75 and 100% of the coconut cream by weight.

Thai food formulations

Comparative food formulations are listed in Table 1. The comparison of components on a 100 g basis allows an examination of their butter and coconut cream contents. The amount of these fats in the various products are substituted by various amounts of soluble fiber gel. The exact preparation and ingredient components are listed under each product with their formulations. The Thai foods were prepared as follows:

Table 1 Standard formulae of 100 grams Thai dishes.

Products	Butter	Coconut cream	Egg	Sugar	Flour	Salt	Specific ingredients	Water	Others
Kanom Ping Kaset	25.9	-	10.1	22.2	40.4	-	-	-	1.4 (baking Soda and vanilla extract)
Pumpkin pudding	-	25.4	-	18.1	15.4	0.4	36.2 (pumpkin)	-	4.5 (grated coconut)
Layer cake	-	42.7	-	25.6	19.65	-	-	10.2 Jasmine water	1.85 (pandan leaf extract)
Dip for fried pot crust	-	43.3	-	12.4	-	1.2	18.5 (ground chicken)	12.4	7.2 (peanut, shallot, and spices)
Taro custard	-	31.9	27.7	23.8	-	-	13.8 (taro)	-	2.8 (pandan leaf extract)
Saute chicken curry	-	41.3	-	3.3	-	2.75 (fish sauce)	41.3 (sliced chicken)	-	11.35 (curry paste, Kaffir Lime leave and Basil leave)

Cookie (Kanom Ping Kaset)

Ingredients : 155 g all purpose flour, 45 g cake flour, 90 g butter, 38 g shortening, one teaspoon baking soda, 50 g egg, 110 g sugar and one teaspoon vanilla extract. *Preparation* : the sifted flour was blended with baking soda before mixing with butter, shortening, and sugar until creamy. The egg and vanilla extract was added with continued mixing for 1 min. The flour was added, with spatula blending, before the mixture was poured onto a baking tray and baked at 177° C for 30 min. The 10% fiber gel was substituted for 40, 60 and 80% of the butter / shortening in the cookie mixture as follows: 90 g butter and 38 g shortening (control); 51.2 g fiber gel, 54 g butter and 22.8 g shortening (40% substitution); 76.8 g fiber gel, 36 g butter and 15.2 g shortening (60% substitution); 102.4 g fiber gel, 18 g butter and 7.6 g shortening (80% substitution).

Pumpkin Pudding (Khanom Fag Thong)

Ingredients: 400 g pumpkin, 100 g rice flour, 70 g arrow root flour, 200 g sugar, 280 g coconut cream, 4 g salt and 50 g grated coconut. *Preparation:* pumpkin was sliced into long 2.5-cm thick pieces, steamed until soft and mashed thoroughly. Pumpkin was mixed with rice flour and arrowroot flour followed by sugar and salt. The mixture was mixed with coconut cream or fiber gel in the following proportions: 280 g coconut cream (control); 140 g coconut cream (140 g fiber gel) (50%); 77.5 g coconut cream (202.5 g fiber gel) (75%); and (280 g fiber gel) (100%). The mixture was poured onto a baking pan and grated coconut sprinkled on the surface before steaming for 30 min.

Layer cake (Khanom Chan)

Ingredients: 75 g tapioca flour, 35 g arrowroot flour, 5 g rice flour, 250 g coconut cream, 150 g sugar, 60 g water and 10 g pandan leaf extract. *Preparation*: sugar was boiled with water to make syrup before mixing it in a bowl with rice, tapioca and arrowroot flours. The mixture was mixed well with coconut cream or the fiber gel in the following proportions: 1000 g coconut cream (control); 600 g coconut cream (400 g fiber gel) (40%); 400 g coconut cream (600 g fiber gel) (60%); and 200 g coconut cream (800 g fiber gel) (80%). The mixture was divided into two portions. For the first portion, pandan leaf extract was added and mixed thoroughly before pouring the first layer (white) onto a baking pan and steaming until cooked. The second portion was blended with a green coloring and poured on top of the baked white layer and then steamed until cooked. Alternate white and green layers were made to the desired level of the cake, keeping the last layer green.

Dip sauce for fried pot crust (Khao Tang Na Tang)

Ingredients for dipping sauce: 300 g ground chicken, 80 g ground roasted coconut, 700 g coconut cream, 85 g shallot, 200 g sugar, 20 g salt, 10 g coriander root, 6 g pepper, 8 g dried chili, 8.3 g coriander and 200 g water. *Preparation* : coriander root, pepper and chili were ground well in a mortar. In a separate container, the coconut cream and fiber gel, in the following proportions, were boiled: 700 g coconut cream (control); 420 g coconut cream (280 g fiber gel) (40%); 280 g coconut cream (420 g fiber gel) (60%); and 140 g coconut cream (560 g fiber gel) (80%). The spice blend was added to the boiled material, stirred well before the ground chicken, sugar, salt were added. After the mixture was removed from the heat, it was served with fried pot crust or crisp fried bread that had been fried over medium heat until golden brown on both sides.

Taro custard (Sangkaya Puak)

Ingredients : 500 g egg, 575 g coconut cream, 115 g sugar, 315 g coconut sugar, 250 g chopped taro and 50 g pandan leaf extract. *Preparation :* egg, sugar, coconut sugar and pandan leaf extract were blended for 4 min and coconut

cream added in the following proportions: 575 g coconut cream (control); 345 g coconut cream (230 g fiber gel) (40%); 230 g coconut cream (345 g fiber gel) (60%); and 115 coconut cream (460 g fiber gel) (80%). The mixture was poured through cheesecloth and collected on a tray before sprinkling with chopped taro and steaming for 25 min.

Saute chicken curry (Pha Naeng Gai)

Ingredients : 750 g sliced chicken, 750 g coconut cream, 150 g curry paste, 60 g cane sugar, 50 g fish sauce, 50 g basil leaves and 4 g sliced kaffir lime leaves. *Preparation :* fried chicken was cooked and remove from the pan. In the pan, the spice mixture was heated with the coconut cream in the following proportions: 750 g coconut cream (control); 450 g coconut cream (300 g fiber gel) (40%); 300 g coconut cream (450 g fiber gel) (60%); and 150 g coconut cream (600 g fiber gel) (80%). The chicken, kaffir lime leaves, sugar and fish sauce were added to this mixture, and allowed to simmer over low heat until the curry was thick before the basil leaves were added.

Sensory evaluations

A sensory panel, composed of 25 trained members, was set to evaluate the bakery and Thai food products for the flavor, texture characteristics, color, appearance, odor and taste by using a 9 hedonic scale. The scale is verbally anchored with nine categories, as follows: like extremely, like very much, like moderately, like slightly, neither like nor dislike, dislike slightly, dislike moderately, dislike very much and dislike extremely. Significant differences (International Rice Research Institute. Irristat version 90-1, Department of Statistics, Los Banos, Philippines) were measured by ANOVA and Duncan Multiple Range Test (DMRT). The products with the acceptability score higher than 6 were analyzed for proximate composition and saturated fat (AOAC, 1994).

RESULTS AND DISCUSSION

Sensory evaluation of Thai foods

The acceptability for using fiber gel to replace the butter and coconut cream in various kinds of Thai food is shown in Table 2. The cookie (Kanom Ping Kaset) prepared with 40, 60 and 80% replacement levels indicated noticeable differences in the major anchored categories at the 40% and higher levels. At the 40% level, the texture was firm but with some decrease in taste quality compared to the control.

Pumpkin pudding prepared at 50, 75 and 100% replacement with the fiber gel composite showed much better performance than the cookie. The 50% replacement product was not significantly different from the control. At the higher replacement of fiber gel of 100% substitution for coconut cream was still acceptable for all of the characteristics. It should be noted that the pudding texture at 100% substitution was softer than the other levels of substitution.

Layer cake at the 40% substitution was not statistical changes in taste. Taste was accepted at the 60% level compared to the control, however, the score was higher than 6.0. For 40% substitution level product, it was colorful and elastic. The products with the higher substitution levels showed less color and tougher texture.

Dipping sauce for fried pot crust at the 40% substitution level showed a small statistical difference in taste compared to the control. The dipping sauce became thicker when the amount of fiber gel was increased.

Taro custard with the 40% substitution level showed a little statistical significant difference in taste compared to the control. However, at 80% substitution level the taro custard had characteristics and acceptability scores higher than 6. There was little difference even at high substitution levels from the control.

Saute chicken curry at the 40% substitution level did not show much statistical difference in

Table 2 Sensory evaluation of Thai food products with soluble fiber substitution for fat.[1/]

	Appearance	Color	Odor	Taste	Texture	Acceptability
Cookie* (Kanom Ping Kaset)						
0	7.63^{a}	7.50^{a}	7.78^{a}	7.75^{a}	7.70^{a}	7.72^{a}
40 %	6.82^{b}	6.95^{b}	6.57^{b}	6.55^{b}	5.72^{c}	5.88^{b}
60 %	6.47^{bc}	7.03^{b}	6.32^{b}	6.03^{c}	4.75^{c}	4.85^{c}
80 %	6.28^{c}	6.90^{b}	5.95^{c}	5.60^{c}	3.83^{d}	4.05^{d}
Pumpkin pudding						
0	7.47^{a}	7.43^{a}	7.65^{a}	7.65^{a}	7.53^{a}	7.53^{a}
50 %	7.40^{a}	7.53^{a}	7.15^{b}	7.22^{b}	7.22^{ab}	7.20^{a}
75 %	7.50^{a}	7.25^{a}	6.97^{bc}	7.00^{bc}	6.93^{bc}	6.75^{b}
100 %	7.50^{a}	7.22^{a}	6.60^{c}	6.85^{c}	6.55^{c}	6.55^{b}
Layer cake (Khanom chan)						
0	7.77^{a}	7.75^{a}	7.75^{a}	7.59^{a}	7.57^{a}	7.7^{a}
40 %	6.64^{b}	6.66^{b}	6.77^{b}	7.18^{a}	7.02^{b}	6.8^{b}
60 %	5.52^{c}	5.27^{c}	6.05^{c}	6.68^{b}	6.02^{c}	6.0^{c}
80 %	5.43^{c}	4.80^{c}	5.36^{d}	5.68^{c}	5.18^{d}	4.9^{d}
Dip sauce for fried pot crust						
0	7.68^{a}	7.44^{a}	7.5^{a}	7.65^{a}	7.71^{a}	7.74^{a}
40 %	7.06^{b}	7.03^{b}	7.03^{b}	7.00^{b}	6.74^{b}	6.76^{b}
60 %	6.88^{bc}	7.00^{b}	6.85^{bc}	6.91^{b}	6.24^{c}	6.44^{b}
80 %	6.65^{c}	6.94^{b}	6.15^{c}	6.62^{b}	5.97^{c}	5.97^{c}
Taro custard						
Control	6.98^{a}	7.18^{a}	7.43^{a}	7.30^{a}	7.30^{a}	7.50^{a}
40 %	6.66^{a}	7.02^{a}	6.77^{b}	6.77^{b}	6.80^{b}	6.77^{b}
60 %	6.73^{a}	7.00^{a}	6.57^{c}	6.55^{c}	6.48^{c}	6.43^{c}
80 %	6.61^{a}	6.93^{a}	5.80^{d}	6.05^{d}	6.09^{d}	5.75^{d}
Main dish (Saute chicken curry)						
Control	8.05^{a}	8.00^{a}	8.00^{a}	7.9^{a}	8.05^{a}	8.20^{a}
40 %	7.25^{b}	7.43^{b}	7.18^{b}	7.2^{b}	6.97^{b}	7.20^{b}
60 %	6.72^{c}	6.88^{c}	6.65^{c}	6.88^{c}	6.30^{c}	6.47^{c}
80 %	6.38^{d}	6.60^{c}	6.18^{d}	6.38^{d}	5.82^{d}	5.95^{d}

In a column, means followed by the same superscript are not significantly different at $p < 0.05$ by ANOVA and DMRT.

[1/] prepared by blending 10 % soluble fiber composite (rice bran and barley flour) in hot water (by weight) and refrigerated overnight before use.

taste compared to the control. However, at 80% substitution level, the chicken curry had characteristics and acceptability scores higher than 6. The curry paste, however, became thicker when the amount of fiber gel was increased.

The Thai foods containing the highest level of fiber gels with the acceptability scores higher than 6 were analyzed for proximate compositions and saturated fat. The results were expressed as grams per 100 gram (Table 3). The proximate

Table 3 Proximate composition of reduced fat content of foods (gram per 100 gram).

Product	Moisture	Fat	Protein	Ash	Fiber	CHO	Calorie
Kanom Ping Kaset							
0	7.42	25.41	6.33	1.18	0.54	59.12	490.49
40 % fiber substitute	8.13	13.27	5.90	1.15	0.92	70.63	425.55
Pumpkin pudding							
0	46.35	7.81	4.90	1.05	2.29	37.60	240.29
100 % fiber substitute	52.22	1.78	4.03	1.07	2.36	38.54	186.30
Layer cake							
0	37.74	7.41	2.07	0.57	0.60	51.61	281.41
60 % fiber substitute	44.16	4.26	1.73	0.60	1.20	48.05	237.46
Dip sauce for fried pot crust							
0	55.15	17.31	9.57	1.22	3.38	13.37	247.55
80 % fiber substitute	64.47	6.76	8.37	1.13	6.35	12.92	146.00
Taro custard							
0	52.92	11.98	5.31	1.04	0.84	27.91	240.70
60 % fiber substitute	58.31	8.75	5.04	0.95	1.47	25.48	200.83
Saute chicken curry							
0	61.37	12.6	16.28	1.42	1.22	7.11	206.96
60 % fiber substitute	68.42	5.07	11.48	1.36	1.10	12.57	141.83

analysis of the food products showed reduction in their fat contents with most foods showing an increase in fiber content. Since Kanom Ping Kaset was similar to cookie in having eggs as an ingredient, the substitution caused the cholesterol content of 52.37 mg in the control product to become 41.64 mg (20.49% reduction) after adding 40% fiber gel as substitution for coconut cream.

The saturated fat contents were summarized as shown in Table 4. Since pumpkin pudding, layer cake, dip for fried pot crust, taro custard and saute chicken curry use coconut as ingredient, the saturated fat contents were found to reduce after substitution with fiber gel. Each product had a different amount of saturated fat depending on the percentage of fiber substitution used. For example, the saturated fat in pumpkin pudding was reduced from 7.69 mg to 0.44 mg after 100% fiber substitution (94.28% reduction). Layer cake (prepared with coconut cream, hydrogenated coconut) had a 59.75% reduction of saturated fat after using 60% fiber substitution. At 80% fiber gel usage for the dip of fried pot crust, the saturated fat content was reduced from 13.02% to 3.22%. As for taro custard, the saturated fat content was reduced from 9.07% to 3.51% using a 60% fiber gel replacement while saute chicken curry showed a decrease of saturated fat from 12.54% to 4.94% using a 60% fiber gel substitution.

Coconut cream is the principle source of saturated fat in the Thai diet and is partially responsible for increase in hypercholesterolemia conditions in Southeast Asia. Using soluble fiber gels on the nutritive value of Thai foods that are made with substantial amounts of butter and coconut fat showed similar sensory properties. Six Thai foods, ordinarily high in saturated fat, were found to have reduced fat contents after replacement of with the fiber gel.

Table 4 Cholesterol content and % reduction of Thai foods (per 100 grams).

Thai foods	Cholesterol (mg)	% reduction of cholesterol
Kanom Ping Kaset		
Control	52.37	20.49
40 % fiber substitute	41.64	

Table 5 Saturated fat content and % reduction of Thai foods (per 100 grams).

Thai foods	Saturated fat (g)	% Reduction of saturated fat
Pumpkin pudding		
0	7.69	94.28
100 % fiber substitute	0.44	
Layer cake		
0	9.79	59.75
60 % fiber substitute	3.94	
Dip sauce for fried pot crust		
0	13.02	75.27
80% fiber substitute	3.22	
Taro custard		
Control	9.07	61.30
60 % fiber substitute	3.51	
Saute chicken curry		
0	12.54	60.61
60 % fiber substitute	4.94	

CONCLUSION

Some Thai foods could be prepared with reduced amounts of saturated fat by using a soluble fiber gel. The soluble fiber gel is a composite that is prepared from rice and barley flours. Saturated fat content reductions were 47.78, 94.28, 59.75, 75.27, 61.30 and 60.61% for Kanom Ping Kaset, pumpkin pudding, layer cake, dip sauce for pot crust, taro custard and saute chicken curry, respectively. The substitution of the fiber gel for saturated fat in these formulations produced some differences in texture and flavor of the foods. However, these differences appeared to make small changes in the overall acceptability or suitability of the foods themselves.

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LITERATURE CITED

Association of Official Analytical Chemists. 1990.

Official Methods of Analysis. 15th ed. AOAC, Arlington, Virginia. 1298 p.

Food and Drug Administration. 1997a. Food labeling: health claims; soluble fiber from whole oats and risk of coronary heart disease. **Federal Register** 62: 15343-15344.

Inglett, G.E.1993. Amylodextrin containing beta-glucan from oat flours and bran. **J. of Food Chem**. 47: 133-136.

Inglett, G.E. 1999. Nutraceuticals: the key to healthier eating. **Chem. Tech.: Innovation in Chemistry and Technology** 29: 38-42.

Inglett, G.E. 2000. Soluble Hydrocolloid Food Additives and Method of Making. **U.S. Patent** Number 6,060,519.9 May. Alexandria, VA, USA: United States Patent & Trademark Office.

Inglett, G.E. and R.K. Newman, 1994. Oat beta-glucan-amylodextrins : Preliminary preparations and biological properties. **Plant Foods Hum. Nutr**. 45: 53-61.

International Rice Research Institute. **Irristat** version 90-1. Department of Statistics, Los Banos, Philippines.

Ripsin, C.M., J.M. Keenan and D.R. Jacobs. 1992. Oat products and lipid lowering. **J. Amer. Med. Asso.** 267: 3317-3325.