Original Article

Composition of ready cooked foods sampled in southern Thailand

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This study investigated the nutrient composition of ready cooked foods commonly consumed in southern Thailand. Four samples of fourteen types; eight curry dishes, one sweet and sour curry, a soup dish, one stir-fried curry, one stir-fried dish and two single plate dishes were each purchased from 4 different shops around Hat Yai district. The edible part was blended and analysed for its nutrients content per 100 g edible portion. Cassia curry, Thai noodle salad, Ark shell curry and Fermented fish gut dish were a good source of vitamin B_1 (145 μg), vitamin C (2.20 mg), calcium (0.23 g) and iron (6.07 mg), respectively. Moisture, ash, fat, protein and carbohydrate were high in Mungbean noodle soup (92.6 g), Fermented fish gut dish (4.1 g), Cassia curry (9.9 g), Stingray stir-fried curry (16.7 g) and Thai noodle salad (24.2 g). Results also showed that the main ingredients and cooking process determined the nutritional values of the foods. A new set of 4 samples of Round noodle in southern curry was purchased, each separated into its edible components and nutrient values estimated using the Thai single ingredient databases. Their nutrient content was also calculated using the data of similar food obtained from this study. Considerable differences amongst the values from the 2 sets of calculation were observed. Problems inherent in using the single ingredient databases were highlighted. This work demonstrates a need to create a food composition database of whole cooked meals ready for serving that reflects real life consumption.

Key Words: food composition, cooked food, southern Thailand, nutrient, Thai food

Introduction

It is necessary to know the nutritional value of the daily diet in order to improve health, complete a clinical diagnosis and provide medication in any holistic method designed for health improvement. Food composition tables are published by various organizations including the Ministry of Public Health of Thailand and are widely used as references for dietary pattern analysis in different areas by researchers including nutritionists, school teachers, doctors, nurses, economists, and officers involved in agriculture. These databases mostly present the values of isolated ingredient of meals either in raw or cooked state. This limits the ability to obtain a true reflection of a real life situation, where most foods are consumed in the form of mixed dishes with multi-nutrient components. Analysis of the composition of real food *i.e.* food actually eaten either raw or cooked food, that is available, in various local areas has not been widely performed. These foods have their own characteristics and their composition varies according to the areas. Establishment of a database on the nutrient content of whole meals and overall diets would be an alternative tool for solving the disadvantages of the single ingredient databases. Many researchers have established various approaches to use the single component databases to calculate real life consumption. Similä *et al.* analysed the nutrient content pattern of Finnish foods using a food composition database to obtain information on an association of nutrients amongst food items.[1] Haytowitz *et al.* developed two new approaches one based on a point system and the other on nutrient consumption data to the Key Foods for setting priorities for the selection of foods to be analysed.[2] The use of this key was expected to produce the USDA nutrient database of standard references which maintains current and accurate data close to real life consumption.

Present living styles have a big effect on people's eating behavior. Thai people rely upon dishes sold along streets, super markets, and markets near their offices or those along their travel routes. Southern foods have their own characteristics including the style of cooking and the ingredients used, for example, *Parkia speciosa* Hassk. and *Parkia javanica* Merr. dishes. Data on the nutrient composition of our cooked foods ready for serving has not yet been published. Analysis of the nutrient composition of these kinds of foods will reflect real life consumption better than the analysis from the classical food composition tables using data from individual ingredients, mostly in the raw state.

In order to move research forward on real life food consumption data, this study was conducted to investigate the nutrient composition of some ready cooked foods commonly consumed by people in southern Thailand using

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Table 1. Details of food samples including local and common names together with their ingredients

#†	Local Name	Common Name‡	Ingredients
1.	Kang Kheelek	Cassia curry	*Cassia siamea* leaves/flowers; coconut milk, chili paste; fish/pork
2.	Kang Khanun	Jackfruit curry	*Artocarpus heterophyll*; coconut milk, chili paste; shrimp/chiken
3.	Kang Hoicrang	Ark shell curry	*Area granosa*; coconut milk; chili paste; *Piper sarmentosum* leaves
4.	Kang Munkheenu	*Coleus sp*. curry	*Coleus parvifolius* Benth; coconut milk; chili paste; pork/shrimp
5.	Kang Yuagklau	Banana young stem curry	Young stem of banana; coconut milk, chili paste; chicken/fermented beef
6.	Kang Taipla	Fermented fish gut curry	Fermented fish gut; fish meat; chili paste; bamboo shoots, green yard long beans, egg plants, green chili pepper, leech leaves
7.	Kang Taepo	Swamp cabbage curry	*Ipomoea reptans*; coconut milk; chili paste; *Garcinea sp*./wet tamarind; salty fish/pork
8.	Kang Yodmakham	Tamarind curry	*Tamarindur indica* leaves; coconut milk; chili paste; shrimp/fish
9.	Kang Somsubarod	Pineapple curry	*Ananas comosus*; sweet and sour chili paste; fish meat
10.	Kang Judwunsen	Mungbean noodle soup	Mungbean noodle; mushroom; celery cabbage/carrot; fish ball and pork
11.	Pad Plakrabain	Stingray stir-fried curry	*Dasyatis uarnak*; chili paste, leaves of Basil (*Ocimum basilicum*)/raw pepper seed (*Piper nigrum*)
12.	Pad Sataw	*Parkia sp*. stir-fried dish	Seeds of *Parkia speciosa* Hassk.; green chili pepper; onion; pork and shrimp
13.	Tao Khao	Thai noodle salad	Rice noodle, sweet and sour sauce; blanched swamp cabbage (*Ipomoea reptans*) and mungbean sprout; fresh cucumber; half of medium boiled egg; fried shrimp and tofu
14.	Knumjean	Round noodle in southern style curry	Round noodle; coconut milk, chili paste, meat of fish

† Number 1-8: curry dishes; 9: sweet and sour curry; 10: a soup dish; 11: a stir-fried curry; 12: stir-fired dish; 13-14: single plate dishes.
‡ Scientific names are used where common names are not available.

the Hat Yai district community as a representative area for sampling. The city of Hat Yai has the biggest population in southern Thailand and as most people eat out because the food is generally cheaper to buy than cook, there are thousands of small food sellers all producing similar foods. The second aim of this study is to highlight the advantages of creating a food composition database of whole cooked meals ready for serving for the use in estimating their nutrient values in real life situation.

Materials and methods

Sample preparation

Fourteen types of local food, commonly consumed amongst southern Thai people were each purchased to obtain 4 samples from 4 different shops. The individual shops were chosen at random from their location which made them easily accessible to many people around the Hat Yai district community. The samples were eight curry dishes, one sweet and sour curry, a soup dish, one stir-fried curry, one stir-fried dish, and two single plate dishes. The edible parts of each food were blended and subjected to analysis in duplicate.

Physical analysis

Each food was photographed and weighed for its gross, edible and non-edible weight. A photograph of each purchased food was taken as the customer received it from the merchant in a plastic bag, and as it was after being spread on a plate. These photos should be useful for food recall in any future dietary survey.

Nutrient analysis

The edible part of each purchased food was blended and analysed for their vitamin B_1, vitamin C, calcium, iron, moisture, ash, fat, protein, and carbohydrate content. VitaminB_1 was determined using the thiochrome method.[3] Vitamin C was determined by a titration method.[4] Mineral analysis was performed after ash digestion with acid. Calcium was determined in an ash hydrolysate by a titration method.[5] Iron in the ash hydrolysate was determined by a spectrophotometric method.[6] Moisture was determined using the direct oven drying method at 100 ^{o}C for 1-2 h until a constant weight was obtained.[7] The ash was determined gravimetrically after burning at 525 ^{o}C.[8] For total fat, Soxhlet extraction with ether was used.[9] Total protein was determined using the Kjeldähl method.[10] Carbohydrate was calculated by difference.

Quality control of the analysis

Quality control of the analysis was performed along with the sample analysis using a known brand named infant milk powder formula. Criteria for rejection of the analysis values was a difference from the mean $\pm$ 2 standard deviation of each nutrient. Within-run and between-run precision of the analysis were investigated for each nutrient together with its percentage recovery by the method of analysis.

Data analysis

The mean value of the duplicate analysis of each food sample was used in the calculation for the mean ± standard deviation of 4 different shop samples according to conventional statistical methods.

Result and discussion

The local name of each food sample, a description of its ingredients, their common name and scientific name are given in Table 1. Table 2 presents weights (g) of edible and non-edible portions of the purchased foods together with their prices. Wide variations in gross and edible weights of each type of purchased food from 4 shops were observed. Variations were due to serving size, recipe and ingredients. For Cassia curry, for example, the difference amongst the shops was from the age and amounts of leaves and flowers. Its meat component also varied between shops *i.e.* 3 shops used fish while the other used minced pork. In the Jackfruit curry, variations in the age of the jackfruit pulp and seeds, and the meat component was also observed between shops, (3 shops used shrimp and the other used chicken). In economic considerations the more you pay the more you get to eat, for most foods, with the exception of the three dishes; Stingray stir-fried curry, Fermented fish gut curry and *Parkia sp.* stir-fried dish. On the same price basis, these three dishes gave less to eat. The first two dishes contained fish as a main component, so they cost more. The third dish contained seeds of *Parkia speciosa* Hassk. and this is a costly vegetable.

Tables 3 and 4 show the amounts of each nutrient analysed. Comparison of the μg vitamin B_1 content (Table 3) amongst the dishes revealed that Cassia curry and the *Parkia sp.* stir-fried dish provided good sources of the vitamin. *Coleus sp.* curry, Stingray stir-fried curry and Fermented fish gut curry provided a medium source. Foods that contained less than 50 μg vitamin B_1% were Pineapple curry, Thai noodle salad, Ark shell curry, Swamp cabbage curry, Banana young stem curry, and Round noodle dish. Thailand food composition tables report that raw cassia leaf and *Parkia sp.* contain similar high amounts of vitamin B_1 at 0.11 mg%. This data also confirms that these dishes were a good source of vitamin B_1.

Thai noodle salad (Table 3) contained the highest amount of vitamin C, followed by *Coleus sp.* curry, *Par*

Table 2. Price and weight in grams of edible and non edible portions, of food samples

#	Common Name	Price (Baht)	Edible Weight (g)†	Non-edible Weight (g))†
1.	Cassia curry	10.0±0.0 (0-0)	221±17 (199-238)	ND
2.	Jackfruit curry	11.0±1.2 (10-12)	239±21 (224-271)	10.6±7.5 (5.7-21.7)
3.	Ark shell curry	12.3±2.1 (10-15)	236±48. (206-307)	0.42±0.83 (0-1.66)
4.	*Coleus sp*. curry	13.8±2.5 (10-15)	257±49 (194-307)	1.59±3.04 (0-6.15)
5.	Banana young stem curry	13.8±2.5 (10-15)	283±76 (229-396)	10.1±12.4 (0-27.4)
6.	Fermented fish gut curry	15.0±0.0 (15-15)	270±31 (248-316)	0.35±0.57 (0-1.19)
7.	Swamp cabbage curry	13.8±2.5 (10-15)	283±71 (191-359)	11.4±13.2 (0-24.7)
8.	Tamarind curry	13.8±2.5 (10-15)	221±38 (165-244)	3.28±4.07 (0-8.40)
9.	Pineapple curry	14.3±1.5 (12-15)	275±27 (244-302)	5.60±6.16 (0.48-14.6)
10.	Mungbean noodle soup	11.3±2.5 (10-15)	270±62 (208-352)	ND
11.	Stingray stir-fried curry	12.3±2.1 (10-15)	203±36 (171-237)	7.07±5.38 (3.48-14.9)
12.	*Parkia sp*. stir-fried dish	17.5±5.0 (15-25)	157±20 (138-186)	ND
13.	Thai noodle salad	13.3±2.1 (11-15)	210±35 (168-242)	ND
14.	Round noodle in southern style curry	13.3±2.1 (11-15)	284± 9 (243-346)	ND

†All values were means ± standard deviation from 4 shops each determined in duplicate. Values in the brackets give the range. ND means not detectable in any sample.

Table 3. Values of vitamins and minerals in food samples per 100 g of edible portion

#	Common name	Vitamins†		Minerals†	
		Vitamin B_1 (μg%)	Vitamin C (mg%)	Calcium (g%)	Iron (mg%)
1.	Cassia curry	145 ±93 (60-232)	1.10 ± 0.70 (0.2-1.7)	0.14 ± 0.12 (0.03-2.27)	2.04 ± 0.60 (1.42-2.85)
2.	Jackfruit curry	17 ± 7 (9-24)	0.30 ± 0.40 (0-0.8)	0.11 ± 0.07 (0.06-0.21)	1.84 ± 0.33 (1.48-2.25)
3.	Ark shell curry	33 ±11 (21-48)	0.11 ± 0.08 (0-0.18)	0.23 ± 0.11 (0.07-0.31)	3.46 ± 2.08 (1.39-6.10)
4.	*Coleus sp*. curry	78 ±23 (44-90)	1.20 ± 0.82 (0.29-2.24)	0.07 ± 0.09 (0.02-0.21)	2.03 ± 0.36 (1.69-2.42)
5.	Banana young stem curry	14 ±19 (0-40)	0.43 ± 0.16 (0.22-0.61)	0.03 ± 0.01 (0.02-0.04)	2.31 ± 0.54 (1.83-3.07)
6.	Fermented fish gut curry	53 ±11 (44-70)	0.40 ± 0.32 (0.15-0.86)	0.02 ± 0.01 (0.01-0.04)	6.07 ± 2.52 (3.28-9.38)
7.	Swamp cabbage curry	26 ±27 (0-50)	0.66 ± 0.70 (0.15-1.69)	0.03 ± 0.02 (0.02-0.06)	4.89 ± 3.08 (2.18-7.78)
8.	Tamarind curry	17 ±30 (0-62)	0.31 ± 0.19 (0.14-0.51)	0.04 ± 0.01 (0.03-0.05)	2.83 ± 0.55 (2.02-3.26)
9.	Pineapple curry	41 ±10 (32-51)	0.08 ± 0.05 (0.03-0.16)	0.10 ± 0.07 (0.01-0.17)	1.15 ± 1.42 (0-2.92)
10.	Mungbean noodle soup	20 ±23 (0-39)	0.45 ± 0.10 (0.30-0.51)	0.02 ± 0.01 (0.01-0.03)	1.43 ± 0.59 (0.78-2.20)
11.	Stingray stir-fried curry	71 ±41 (32-127)	0.13 ± 0.05 (0.06-0.18)	0.19 ± 0.12 (0.04-0.29)	1.82 ± 1.48 (0-3.39)
12.	*Parkia sp*. stir-fried dish	135 ±11 (129-151)	1.18 ± 0.60 (0.79-2.08)	0.04 ± 0.01 (0.04-0.06)	4.61 ± 1.26 (2.96-5.77)
13.	Thai noodle salad	36 ±29 (0-70)	2.20 ± 1.60 (0.91-4.21)	0.04 ± 0.02 (0.02-0.07)	2.64 ± 1.26 (1.47-4.42)
14.	Round noodle in southern style curry	9 ± 6 (0-12)	0.15 ± 0.15 (0-0.30)	0.02 ± 0.01 (0.01-0.02)	3.44 ± 2.33 (1.42-6.70)

†All values were means ± standard deviation from 4 shops each determined in duplicate. Values in the brackets give the range.

Table 4. Result of proximal analysis of food samples in g per 100 g of edible portion†

Common name	Moisture (g%)	Ash (g%)	Fat (g%)	Protein (g%)	Carbohydrate (g%)
1. Cassia curry	78.0 ± 4.0 (74.0-81.6)	2.2 ± 0.4 (1.8-2.6)	9.9 ± 3.6 (6.1-13.9)	4.7 ± 0.7 (3.8-5.5)	5.2 ± 0.9 (3.9-6.0)
2. Jackfruit curry	85.1 ± 5.7 (77.0-90.3)	2.1 ± 0.4 (1.9-2.7)	4.9 ± 2.0 (2.6-7.4)	4.3 ± 2.9 (2.4-8.6)	3.5 ± 2.4 (0.4-5.6)
3. Ark shell curry	78.9 ± 4.1 (73.0-82.4)	2.5 ± 0.7 (1.9-3.3)	6.7 ± 4.4 (3.3-13.1)	8.2 ± 2.6 (4.8-10.6)	3.9 ± 1.9 (1.8-6.4)
4. *Coleus sp.* curry	77.2 ± 1.8 (74.8-79.3)	2.1 ± 0.5 (1.7-2.7)	6.0 ± 4.5 (2.5-12.4)	5.7 ± 1.8 (3.2-7.5)	9.1 ± 6.8 (0-14.3)
5. Banana young stem curry	79.5 ± 3.4 (75.2-83.1)	1.8 ± 0.3 (1.5-2.2)	7.7 ± 3.7 (3.8-11.3)	4.8 ± 1.4 (2.8-6.3)	6.2 ± 1.2 (4.4-7.1)
6. Fermented fish gut curry	83.7 ± 3.7 (80.9-88.7)	4.1 ± 0.8 (3.2-5.1)	1.9 ± 1.6 (0.5-4.2)	4.7 ± 1.1 (3.7-6.2)	5.7 ± 1.2 (3.9-6.7)
7. Swamp cabbage curry	76.1 ± 2.3 (74.6-79.6)	3.3 ± 0.6 (2.7-3.9)	7.5 ± 1.8 (5.5-9.7)	4.6 ± 1.6 (3.1-6.2)	8.6 ± 2.6 (5.0-10.8)
8. Tamarind curry	78.7 ± 5.0 (71.5-82.2)	2.0 ± 0.6 (1.7-2.9)	6.2 ± 3.0 (3.6-10.5)	5.3 ± 2.9 (3.7-9.6)	7.9 ± 2.9 (4.6-11.4)
9. Pineapple curry	85.5 ± 0.9 (84.4-86.3)	1.9 ± 0.4 (1.5-2.5)	0.6 ± 0.4 (0.2-1.1)	8.7 ± 4.9 (4.0-15.6)	3.9 ± 3.1 (0-7.6)
10. Mungbean noodle soup	92.6 ± 1.6 (90.7-94.7)	1.4 ± 0.7 (0.7-2.3)	0.9 ± 0.3 (0.6-1.2)	2.1 ± 0.6 (1.2-2.7)	3.1 ± 1.7 (0.8-4.6)
11. Stingray stir-fried curry	75.9 ± 5.2 (69.8-81.0)	2.9 ± 0.7 (2.1-3.8)	3.4 ± 1.2 (1.8-4.6)	16.7 ± 4.4 (11.1-21.3)	2.7 ± 2.3 (0-2.5)
12. *Parkia sp.* stir-fried dish	68.2 ± 2.0 (66.1-69.9)	3.3 ± 0.6 (2.6-4.1)	9.2 ± 2.1 (6.6-11.1)	7.5 ± 1.9 (4.9-9.5)	11.8 ± 1.5 (10.0-13.3)
13. Thai noodle salad	64.5 ± 2.6 (61.0-66.5)	1.8 ± 0.3 (1.4-2.0)	5.8 ± 0.7 (5.0-6.7)	3.8 ± 2.3 (0.8-6.3)	24.2 ± 3.1 (21.0-27.6)
14. Round noodle in southern style curry	75.2 ± 2.7 (72.9-78.8)	1.7 ± 0.4 (1.1-2.0)	4.2 ± 1.4 (2.2-5.2)	2.6 ± 0.2 (2.4-2.9)	16.4 ± 1.5 (14.9-17.7)

†All values were means ± standard deviation from 4 shops each determined in duplicate. Values in the brackets give the range.

Table 5. Comparison of the nutrient values estimated by the ready cooked food data with that by the food composition tables[11,12]

Source for Data Estimation	Edible weight (g)	Component per edible weight of round noodle in southern curry†								
		Vitamins		Minerals		Proximal Analysis				
		B$_1$ (μg)	C (mg)	Calcium (g)	Iron (mg)	Moisture (g)	Ash (g)	Fat (g)	Protein (g)	Carbohydrate (g)
The ready cooked food data‡	330 ± 45	29 ± 4	0.49 ±0.07	0.07 ± 0.01	11.4 ± 1.6	249± 34	5.62 ± 0.77	13.9 ± 1.9	8.59 ± 1.17	54.2 ± 7.4
	13.7%	13.8%	14.3%	14.3%	13.6%	13.7%	13.7%	13.7%	13.6%	13.6%
	(268-374)	(24-34)	(0.40-0.56)	(0.05-0.07)	(9.2-12.9)	(201-281)	(4.55-6.35)	(11.2-15.7)	(6.96-9.72)	(43.9-61.3)
The food composition tables§	330 ± 45	83 ± 12	1.23 ± 0.34	0.03 ± 0.00	5.81 ± 0.87	241 ± 31	0.16 ± 0.02	34.9 ± 9.6	15.2 ± 2.7	36.7 ± 5.2
	13.7%	14.5%	27.6%	13.3%	14.9%	13.0%	12.5%	27.5%	17.7%	14.0%
	(268-374)	(66-92)	(0.73-1.50)	(0.03-0.04)	(4.55-6.54)	(199-275)	(0.14-0.19)	(20.9-42.5)	(11.6-18.1)	(29.7-42.0)

† All values are the mean ± standard deviation of the calculation from 4 shops. Presented percentages are the % coefficiency of variation, sd/mean x100. Values in the brackets give the range. ‡ Values were calculated from the nutrient values of the Round noodle in southern curry (Tables 3 and 4), multiplied by its edible weight and divided by a hundred. § Each food item was weighed for its edible portion, its cooking ingredient *i.e.* round noodle, fish meat and coconut milk. This weight was used for the calculation of the presented component as follows: 1). the nutrient values of each ingredient in the food composition tables [11, 12] was multiplied with its weight and divided by a hundred, and 2). all the obtained values were summed to obtain the nutrient values of the whole food.

kia sp. stir-fried dish and Cassia curry. Foods with vitamin C levels of less than 1 mg% were Swamp cabbage curry, Mungbean noodle soup, Banana young stem curry, Fermented fish gut curry, Jackfruit curry, Tamarind curry, Round noodle dish, Stingray stir-fried curry, Ark shell curry and Pineapple curry. The ingredients of Thai noodle salad contained large amounts of fresh cucumber, blanched mungbean shoot and swamp cabbage. These vegetables were exposed to less cooking. It has been reported that these vegetables are good sources of the vitamin; 20, 19 and 14 mg% respectively.[11, 12]

Results of the minerals analysis *i.e.* calcium and iron in the ash hydrolysates of each food type are also shown in Table 3. Calcium levels were highest in Ark shell curry, followed by Stingray stir-fried curry, Cassia curry, Jackfruit curry, Pineapple curry and *Coleus sp.* curry. All the rest had less than 0.05 g% with the least of 0.02 g% present in Fermented fish gut curry, Mungbean noodle soup and Round noodle dish. The highest amounts of iron were found in Fermented fish gut curry, followed by other dishes in the range of 1.15 mg% in Pineapple curry to 4.89 mg% in Swamp cabbage curry. When the individual ingredients of each food were considered, it was seen that the main ingredient determined the total amount of nutrient in the sample. For example ark shell and piper leaves, the main ingredients of Ark shell curry, have higher calcium levels of 134 mg and 601 mg of calcium per 100 g of their edible portion respectively than do ingredient of other dishes according to the single food analysis databases of the Ministry of Public Health.[11, 12] In the round noodle dish, with only 0.02 g% calcium the round noodle and fish meat ingredients had very little calcium (7 mg% and 31 mg%) respectively.[12] Similar reasoning can be applied to the level of iron in Fermented fish gut curry with the main ingredients of green yard-long bean, egg plant and meat of the short bodied mackerel containing 26, 1.2 and 1.5 mg% of iron[11, 12] respectively determining the whole iron level of the dish.

Results of proximal analysis are shown in Table 4. The moisture content was related to the food characteristic, that is soup or curry dishes had higher values more than the stir-fried types. Mungbean noodle soup had the highest value of moisture and the lowest, Thai noodle salad and *Parkia sp*. stir-fried dish. There was very little variation in moisture content of the rest, for if the highest and the 2 lowest figures were removed it was found that the average moisture content was about 80 % with a range of 75 to 85%.

Fermented fish gut curry produced the highest ash value of 4.1%. *Parkia sp.* stir-fried dish and Swamp cabbage curry had equal amount of ash at 3.3 g%. Other dishes were in the range of 1.4 g% to 2.9 g% as shown in Table 4.

The highest fat content was found in Cassia curry. *Parkia sp.* stir-fried dish, Banana young stem curry, Swamp cabbage curry, Ark shell curry, Tamarind curry, *Coleus sp.* curry, Thai noodle salad all had 6 g% or more. The rest, Jackfruit curry, Round noodle dish, Stingray stir-fried curry, Fermented fish gut curry, Mungbean noodle soup had 5 g% or less, with Pineapple curry having the lowest at 0.6 g% (Table 4). Foods containing coconut milk gave higher fat contents than did stir-fried dishes. Fermented fish gut curry, Mungbean noodle soup, and Pineapple curry had low fat values respectively since they contained no coconut milk content.

Stingray stir-fried curry was the best source of protein correlated with its large content of fish meat as a main ingredient. Pineapple curry, Ark shell curry, and *Parkia sp.* stir-fried dish had 8 or 9 g%. The rest had very little protein, ranging from 2 to 5 g%. The protein content of each dish was provided by their ingredients including either pork, shrimp, fish, chicken or ark shell (Table 1). The food composition tables of Thailand[11, 12] report protein values for each type of meat in the raw state as follows: 19.6, 20.1, 15.7-20.5, 23.6, 12.9 g% for pork, shrimp, fish, chicken and ark shell respectively.

The best source of carbohydrate was Thai noodle salad. The next highest was Round noodle dish followed by *Parkia sp.* stir-fried dish. *Coleus sp.* curry, Swamp cabbage curry and Tamarind curry were in the range of 7 to 9 g%. The rest, Banana young stem curry, Fermented fish gut curry, Cassia curry, Ark shell curry, Pineapple curry and Jackfruit curry had 6 g% or less and the lowest of 3 g%, Mungbean noodle soup and Stingray stir-fried curry. The food composition tables of Thailand report that rice noodle contains up to 79.7 g% carbohydrate content, the cooked rice noodle 16.0 g%, and round noodle 18.2 g%. Although cooked mungbean noodle had a carbohydrate content of 19.3 g% that was higher than the cooked rice noodle and round noodle, the value obtained for Mungbean noodle soup was not reflected in its individual component data. This was because it had less mungbean noodle in the dish compared with the amount of noodles in the Thai noodle salad and Round noodle dish. Curry paste used in Thai cooking has an average carbohydrate content of 13.8 g%. Vegetables used in dishes also contributed to their overall carbohydrate content. According to the Food composition tables of Thailand, the carbohydrate content of jackfruit, piper leaves, pineapple, cassia leaves, egg plant, banana young stems, tamarind leaves, swamp cabbage, *Parkia sp*. and *Coleus sp.* were: 1.7, 14.2, 11.6, 14.3, 6.3, 2.0, 9.4, 1.9, 15.5 and 17.0 g% respectively.[11, 12]

A new set of 4 samples of Round noodle in southern curry was obtained and their nutrient values were calculated using the values determined previously in Tables 3 and 4. The individual components of these samples were then carefully separated and weighed and used to calculate their nutrient values using the data published by the Thai Ministry of Public Health.[11,12] The results are shown in Table 5. The two methods provided significantly different results. The Round noodle in southern curry was chosen because it is an interesting mixed type of diet, containing a good variety of ingredients that can be separated and weighed to allow for easy application of the database. When the 2 sets of values were compared, those obtained using the data of Tables 3 and 4 show considerable less variation than those obtained using the published data. In the classical way to estimate nutrient values, there is a need to identify the exact kind of cooking ingredient in order to select the correct item listed in the table. An accurate measure of the weight of each ingredient is also necessary for the calculation and there are often problems of accurately identifying either the ingredients or even their weights. This practice is simple if the evaluation is performed before cooking, but it is not possible for the cooked food that is ready to eat especially for an Asian dish. Moreover the published database values are mostly in the form of fresh/raw state and any loss during cooking is not accounted for. A database obtained from whole ready cooked foods such as has been introduced here will simplify the process of estimating the nutrient values that will account for any nutrient lost by cooking, and only the weight of the edible food is required for the calculation. Application of the values using this different type of database will provide better data for improving health. Increasing the number of samples of each food item will provide a distinctive mean and the range of nutrient content for that particular dish and also that particular area of the survey. This practice will compensate for the problem of not knowing the specific ingredients used to prepare the dish, the difficulty to select the correct items from the classical databases and also any error on other assumptions made by researchers, and the loss of nutrients and nutrients interactions during the cooking process. The absence of some ingredients in the published food composition database also affects the reliability of the calculation of nutrient values of the relevant food and this can also be solved by the use of a new database for ready cooked foods.

In conclusion, analysis of the nutrient composition of the ready cooked foods, purchased from 4 shops selected for their convenience of access to many people in different areas around the Hat Yai district showed that Cassia curry, Thai noodle salad, Ark shell curry and Fermented fish gut dish, were a good source of vitamin B_1, vitamin C, calcium and iron respectively. The moisture, ash, fat, protein and carbohydrate content were high in Mungbean noodle soup, Fermented fish gut dish, Cassia curry, Stingray stir-fried curry and Thai noodle salad, respectively. The protein content of Stingray stir-fired curry was 2-4 times higher than other dishes of higher or similar price. Cassia curry, the cheapest dish, is the best source of vitamin B_1 and fat. The main ingredients and the cooking process determined the nutritional values of the ready cooked foods.

The possible future application of such data for ready cooked foods in estimating the nutrient values of dishes as they will be consumed requires more samples of each dish, a bigger variety of dishes, more sampling regions, together with a good knowledge of the recipe, weights of the ingredients, nutrient values of each ingredient and also as a whole dish for consumption. This information together with manipulation of data from the published food composition tables will facilitate the task of dietary pattern analysis that are much closer to real life consumption, with much less chance of any ambiguity.

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References

1. Similä M, Ovaskainen ML, Virtanen MJ, Valsta LM. Nutrient content patterns of Finnish foods in a food composition database. J Food Comp Anal 2006; 19: 217-224.
2. Haytowitz DB, Pehrsson PR, Holden JM. The identification of key foods for food composition research. J Food Comp Anal 2002; 15: 183-194.
3. Helrich, K. Official Methods of the Association of Official Analytical Chemists (AOAC). 15th ed. Virginia USA: Association of Official Analytical Chemists, Inc., 1990; 1049-1051.
4. Helrich, K. Official Methods of the Association of Official Analytical Chemists (AOAC). 15th ed. Virginia USA: Association of Official Analytical Chemists, Inc., 1990; 1058-1059.
5. Helrich, K. Official Methods of the Association of Official Analytical Chemists (AOAC). 15th ed. Virginia USA: Association of Official Analytical Chemists, Inc., 1990; 779.
6. Helrich, K. Official Methods of the Association of Official Analytical Chemists (AOAC). 15th ed. Virginia USA: Association of Official Analytical Chemists, Inc., 1990; 778.
7. Williams, S. Official Methods of Analysis of the Association of Official Analytical Chemists (AOAC). 14th ed. Virginia USA: Association of Official Analytical Chemists, Inc., 1984; 152.
8. Williams, S. Official Methods of Analysis of the Association of Official Analytical Chemists (AOAC). 14th ed. Virginia USA: Association of Official Analytical Chemists, Inc., 1984; 153.
9. Williams, S. Official Methods of Analysis of the Association of Official Analytical Chemists (AOAC). 14th ed. Virginia USA: Association of Official Analytical Chemists, Inc., 1984; 251-252.
10. Vogel, AI. A text book of quantitative inorganic analysis. 3rd ed. London: Longman, 1961; 256.
11. Nutrition Division, Department of Health, Ministry of Public Health. Nutritive values of Thai foods. Bangkok: Ministry of Public Health, 1987.
12. Nutrition Division, Department of Health, Ministry of Public Health. Nutritive values of Thai foods. Bangkok: Ministry of Public Health, 1992.