



## **Acceptance and Satisfaction on Thai Ethnic Foods using the Protein-Free Starchy Products**

**NARISA RUEANGSRI\*, URAIPORN BOORANASUKSAKUL and ALONGKOTE SINGHATO**

Faculty of Allied Health Sciences, Burapha University, Bang Saen, Chonburi 20131, Thailand.

### **Abstract**

High prevalence of chronic kidney disease has been reported in Thailand, and patients with this chronic disease need to restrict their dietary protein intakes because of their low glomerular filtration rate, including those from rice and starch. Unfortunately, there is a lack of protein-free starch available in Thai communities. Therefore, this study aimed to develop protein-free starchy products that were used as ingredients in Thai ethnic food menus. Five menus (Pad See Ew, Rad Na, Pad Thai, Kuay Jub, and Pad Kee Mao) incorporating the developed protein-free starchy products (with 3 formulae using the developed starchy products and 1 original formula per menu) were developed for conducting the sensory evaluation by 48 healthy participants. Results revealed all menus showed significant difference of satisfaction scores on food texture ( $p < 0.05$ ). In addition, Pad Se Ew, Pad Thai (formula 1), and Pad Kee Mao (all formulae) had the overall satisfaction scores at acceptable level. In conclusion, most of the Thai ethnic food menus made from the developed protein-free starchy products were acceptable to participants.



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### **Keywords**

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### **Introduction**


High prevalences of Non-Communicable Diseases (NCDs) have been reported in many countries which reduce the quality of life of patients and increase mortality rate.<sup>1,2</sup> It is well known that patients with NCDs are affected by long term unhealthy dietary habits and inadequate physical activity.<sup>3</sup> They need

to restrict their diet and aware of dietary planning according to the suggestions from professionals in health care to maintain their optimal health status. Chronic Kidney Disease (CKD) is one of NCDs most commonly found in Thailand.<sup>4</sup> It is the condition that reduces the ability of kidney in performing the filtration of plasma filtrate leading to the accumulation

**CONTACT** Narisa Rueangsri ✉ [narisa.nr@gmail.com](mailto:narisa.nr@gmail.com) 📍 Faculty of Allied Health Sciences, Burapha University, Bang Saen, Chonburi 20131, Thailand.



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of waste products in human body. Patients with CKD, especially at the End Stage of Renal Disease (ESRD) with low glomerular filtration rate (GFR) are usually suggested to restrict consumption of many nutrients such as potassium, sodium, phosphorus, and protein.<sup>5</sup> For protein, CKD patients with ESRD are suggested to lower intake of protein by 0.3-0.4 g per kilogram of body weight<sup>6</sup>; therefore they need to restrict intakes of food sources rich in protein such as meat, poultry, and dairy products in order to regulate the amounts of urea and nitrogen in blood.<sup>7</sup> Moreover, rice and starchy products are also considered as foods containing proteins that should be of concern when giving a dietary planning for patients who need to strictly limit the amount of protein intake.<sup>8,9</sup>

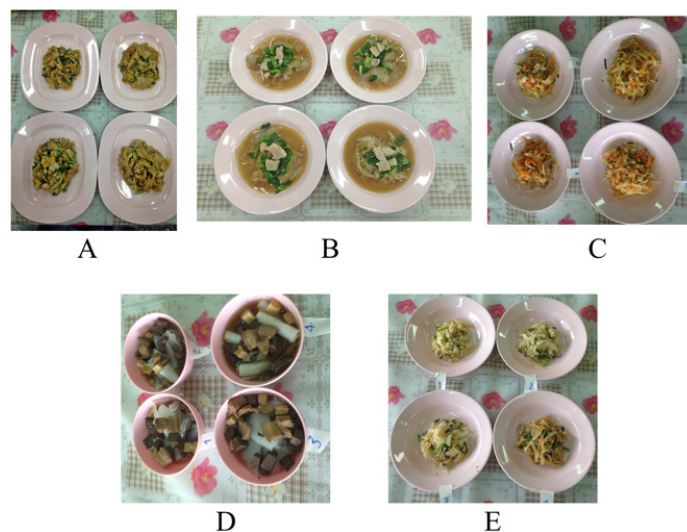
Thai people usually eat copious amount of rice as a staple food. In addition, it was found that proteins are also present in several foods that are the carbohydrate-based food, such as Thai traditional starchy products, i.e., rice vermicelli, rice stick noodles, wide rice noodles, etc., which are made from rice flour and they are used in the cookings of Thai traditional food menus that are commonly consumed among Thai people. Thus, almost of the Thai traditional starchy products (TTSP) are reported to contain proteins.<sup>10-12</sup> This means patients who intake Thai food menus using TTSP as ingredient

receive excessive dietary proteins from both meat and starchy products. In CKD patients with low GFR are advised to strictly regulate the amount of protein intake to prevent uremia and to maintain their health status.<sup>13</sup> Unfortunately, there are limited food choices available in Thai communities, especially with regard to carbohydrate-based food which is protein-free that can be used in the cookings of the Thai traditional and ethnical food menus which are familiar and acceptable to people. This study, therefore, aimed to develop the Thai ethnic food menus made from the developed non-protein starchy products, and investigates their acceptability and satisfaction among Thai people.

## Materials and Methods

### Survey on the most Acceptable and Popular Thai Ethnic Foods made from Starchy Products

Thai ethnic foods to be used as the tested samples developed from protein free-starchy products were selected by questionnaires which included the list of Thai ethnic foods commonly consumed in the community and easily produced in household cooking. A total of 512 participants were asked to choose their most favorite Thai ethnic foods from questionnaires.<sup>14</sup> The top 5 most selected menus chosen as the food samples were Pad See Ew (fried noodle with pork with soy sauce), Rad Na (fried noodle with pork and kale soaked in gravy), Pad Thai



**Fig. 1. The Thai ethnic foods used as the food samples in the study.**  
A; Pad See Ew, B; Rad Na, C; Pad Thai, D; Kuay Jub, and E; Pad Kee Mao

(fried noodle Thai style with pork), Kuay Jub (crunchy pork soup), and Pad Kee Mao (spicy stir-fried flat noodle with pork and holy basil leaves) (Fig 1).

### Development of Protein Free-Starchy Products and Food Samples

The top 5 most selected food menus using the developed protein-free starchy products were prepared at the Clinical Nutrition Laboratory, Faculty of Allied Health Sciences, Burapha University, Bangsaen, Thailand. The developed protein-free starchy products were used in the cookings of 3 formulae for each menu based on the different amounts of tapioca flour so that the participants' satisfactions on these formulae could be compared with the original formula (commercial product). Pad See Ew (PSE); Stir fried flat noodle and pork with preserved soy bean paste, Rad Na (RN); Noodles in Thick Gravy, Pad Thai (PT); Fried noodle Thai style with pork, Kuay Jub (KJ); Boiled Chinese pasta square, and Pad Kee Mao (PKM); Spicy stir fried flat noodle with prawn and holy basil leaves were cooked as formulae 1, 2, and 3 with 25%, 50% and 75%, respectively, of tapioca flour which were protein free. All recipes and cooking methods were conducted according to the Thai cooking handbook.<sup>15</sup>

### Development of Sensory Evaluation Questionnaires

Seven-level hedonic-scaled questionnaires were developed to ask participants' sensory satisfaction towards the developed Thai ethnic foods made from the protein-free starchy products (Fig 2). Six questions addressed on participants' satisfaction on foods' appearance, taste, flavor, color, texture, and overall satisfaction. The scorings for the questionnaire scales were: very much liked=6 points, liked a lot=5 points, liked=4 points, liked and did not liked= 3 points, disliked= 2 points, much disliked= 1 point, very much disliked= 0. Food samples which the mean of overall satisfaction scores >4.0 were considered as acceptable to participants.<sup>16</sup>

All developed questionnaires were reviewed and revised by experts in nutrition at the Institute of Nutrition, Mahidol University. The revised questionnaires, information on amount of ingredients in food samples, and study protocols were ethnically approved by the Burapha University Institutional Review Board (BUU-IRB). All participants signed the informed consent forms before participating in this study.

### Selection of Panelist for the Sensory Analysis

This study was conducted at Faculty of Allied Health Sciences, Burapha University, Bang Saen Campus. Forty-eight participants were recruited by following inclusion criteria: no medical history on food allergy, both male and female with age between 20-60 years, can read and write Thai. Exclusion criteria include: having medical condition affecting to sensory perception, medical history of color blindness, suffering from oral problems, pregnancy or lactating, having medical history of non-communicable disease.

### Sensory Analysis

All the protein-free-starchy products and cookings of the selected menus were prepared at the Clinical Nutrition Laboratory, Faculty of Allied Health Sciences, Burapha University. All 5 menus were prepared from starchy products as 4 formulae per each menu (3 formulae using protein-free starch and 1 original formula). Once completed, all participants were invited to the prepared room for conducting the sensory evaluation to determine their acceptance and satisfaction on the appearance, taste, flavor, color, texture, and overall satisfaction. The blinded samples of 5 menus (4 samples per menu) were served to each participant. Water and paper blots were prepared on a plastic tray, and participants were asked to take the whole sample and also asked to rinse their mouths with water between samplings.

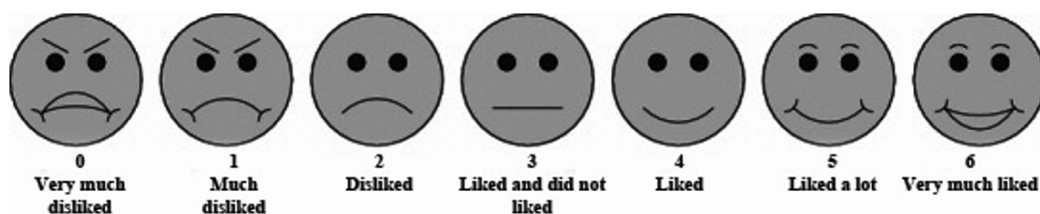


Fig. 2: Seven-level hedonic scale

**Table 1: Baseline data of the participants**

| Characteristics                    | Outcome      |
|------------------------------------|--------------|
| Sex                                |              |
| Male, n (%)                        | 5 (10)       |
| Female, n (%)                      | 43 (90)      |
| Age, mean (SD)                     | 39.83 (9.06) |
| Medical history of food allergy    |              |
| Yes, n (%)                         | 0 (0)        |
| No, n (%)                          | 48 (100)     |
| Medical history of current illness |              |
| Yes, n (%)                         | 0            |
| No, n (%)                          | -100         |

**Data Analysis**

The acceptance and satisfaction scores of participants were reported as means using the One-Way ANOVA to compare the difference of the scores. Statistical analysis was performed by using the Predictive Analytics Software Statistic (PASW) version 22 (SPSS Inc, Chicago, Il). Statistical significance was established at  $p < 0.05$ .

**Results and Discussion****Baseline data of participants**

Most of participants (90%) were female with average age of 39.83 years old. None of participants were reported to have food allergy and medical history of current illness (Table 1).

**Table 2: Means of participants' satisfaction scores on Pad See Ew (PSE)**

| Aspects of satisfaction | PSE 1                       | PSE 2                       | PSE 3                       | PSE 4                      | p value |
|-------------------------|-----------------------------|-----------------------------|-----------------------------|----------------------------|---------|
|                         | 25% tapioca flour Mean (SD) | 50% tapioca flour Mean (SD) | 75% tapioca flour Mean (SD) | Original formula Mean (SD) |         |
| Appearance              | 4.16 (0.91)                 | 3.73 (1.04)                 | 4.26 (0.78)                 | 4.30 (0.91)                | 0.06    |
| Color                   | 4.36 (0.85)                 | 4.13 (0.89)                 | 4.00 (0.83)                 | 4.23 (0.89)                | 0.41    |
| Texture                 | 3.53 (0.62)                 | 3.70 (0.87)                 | 4.46 (0.73)                 | 4.70 (0.53)                | <0.00*  |
| Flavor                  | 4.46 (0.62)                 | 4.06 (0.82)                 | 4.23 (1.04)                 | 4.03 (0.88)                | 0.19    |
| Taste                   | 4.06 (0.78)                 | 4.20 (0.99)                 | 4.23 (1.07)                 | 4.16 (0.74)                | 0.9     |
| Overall                 | 4.46 (0.68)                 | 4.36 (0.61)                 | 4.50 (0.68)                 | 4.60 (0.62)                | 0.58    |

\*Significant difference

**Table 3: Means of participants' satisfaction scores on Rad Na (RN)**

| Aspects of satisfaction | RN 1                        | RN 2                        | RN 3                        | RN 4                       | p value |
|-------------------------|-----------------------------|-----------------------------|-----------------------------|----------------------------|---------|
|                         | 25% tapioca flour Mean (SD) | 50% tapioca flour Mean (SD) | 75% tapioca flour Mean (SD) | Original formula Mean (SD) |         |
| Appearance              | 3.23 (0.85)                 | 3.50 (0.73)                 | 3.53 (0.77)                 | 3.93 (0.90)                | 0.01*   |
| Color                   | 3.80 (0.92)                 | 4.03 (0.99)                 | 3.56 (0.81)                 | 4.10 (0.84)                | 0.09    |
| Texture                 | 2.03 (1.09)                 | 2.63 (0.76)                 | 3.80 (0.96)                 | 4.06 (0.90)                | <0.00*  |
| Flavor                  | 2.76 (1.04)                 | 3.20 (1.12)                 | 3.53 (0.81)                 | 3.80 (1.15)                | <0.00*  |
| Taste                   | 3.83 (0.79)                 | 4.10 (0.60)                 | 3.76 (0.81)                 | 4.06 (0.58)                | 0.18    |
| Overall                 | 2.50 (0.68)                 | 3.26 (1.14)                 | 3.86 (0.89)                 | 4.26 (0.63)                | <0.00*  |

\*Significant difference

**Acceptance and satisfaction scores of the participants**

The 3 modified formulae with different amounts of protein-free tapioca flour of each menu were tested for satisfaction scores that were compared with the original formula (total=4 formulae per menu). For PSE, results revealed that there was significant difference on the texture of food samples with the original formula earning the highest satisfaction score. In addition, the overall satisfaction scores of all recipes were above 4.00 which indicated that they were all acceptable to the participants (Table 2).

For RN, results revealed that there were significant differences on the appearance, texture, flavor, and overall satisfaction of food samples ( $p < 0.05$ ). In

addition, the overall satisfaction scores of all three recipes using modified starchy products (RN 1, RN 2, and RN 3) were not above 4.00, which indicated that they were unacceptable to participants (Table 3).

For PT, results revealed that there were significant differences on the appearance, texture, and overall satisfaction of food samples ( $p < 0.05$ ). In addition, the overall satisfaction score of PT 1 was above 4.00 which indicated that this formula was acceptable to participants (Table 4).

For KJ, results revealed that there was significant difference on the texture of food samples with KJ 3 earning the highest score ( $p < 0.05$ ). In addition,

**Table 4: Means of participants' satisfaction scores on Pad Thai (PT)**

| Aspects of satisfaction | PT 1                        | PT 2                        | PT 3                        | PT 4                       | p value |
|-------------------------|-----------------------------|-----------------------------|-----------------------------|----------------------------|---------|
|                         | 25% tapioca flour Mean (SD) | 50% tapioca flour Mean (SD) | 75% tapioca flour Mean (SD) | Original formula Mean (SD) |         |
| Appearance              | 4.30 (0.46)                 | 3.83 (0.59)                 | 3.90 (0.48)                 | 3.70 (0.59)                | <0.00*  |
| Color                   | 4.13 (0.86)                 | 4.10 (0.71)                 | 4.20 (0.66)                 | 4.16 (0.59)                | 0.95    |
| Texture                 | 3.60 (0.72)                 | 3.66 (0.80)                 | 3.53 (0.73)                 | 1.53 (0.77)                | <0.00*  |
| Flavor                  | 4.16 (0.59)                 | 3.80 (0.76)                 | 3.76 (0.72)                 | 3.70 (0.91)                | 0.08    |
| Taste                   | 3.66 (0.54)                 | 3.63 (0.71)                 | 3.60 (0.72)                 | 3.83 (0.79)                | 0.58    |
| Overall                 | 4.36 (0.55)                 | 3.96 (0.66)                 | 3.83 (0.74)                 | 2.43 (0.89)                | <0.00*  |

\*Significant difference

**Table 5: Means of participants' satisfaction scores on Kuay Jub (KJ)**

| Aspects of satisfaction | KJ 1                        | KJ 2                        | KJ 3                        | KJ 4                       | p value |
|-------------------------|-----------------------------|-----------------------------|-----------------------------|----------------------------|---------|
|                         | 25% tapioca flour Mean (SD) | 50% tapioca flour Mean (SD) | 75% tapioca flour Mean (SD) | Original formula Mean (SD) |         |
| Appearance              | 3.66 (0.88)                 | 3.70 (0.79)                 | 3.76 (0.92)                 | 3.80 (0.81)                | 0.92    |
| Color                   | 3.53 (0.81)                 | 3.76 (0.77)                 | 3.90 (0.92)                 | 3.76 (0.93)                | 0.42    |
| Texture                 | 2.53 (1.00)                 | 3.30 (0.59)                 | 3.93 (0.86)                 | 2.80 (0.88)                | <0.00*  |
| Flavor                  | 3.30 (0.79)                 | 3.53 (0.77)                 | 3.83 (0.94)                 | 3.70 (1.23)                | 0.16    |
| Taste                   | 3.10 (0.71)                 | 3.33 (0.88)                 | 3.66 (1.09)                 | 3.20 (1.09)                | 0.12    |
| Overall                 | 3.10 (0.66)                 | 3.26 (0.94)                 | 3.73 (1.04)                 | 3.40 (1.06)                | 0.06    |

\*Significant difference

the overall satisfaction score of all recipes were not above 4.00 which indicated that they were unacceptable to participants (Table 5).

For PKM, results revealed that there were significant differences on the color, texture, and overall satisfaction scores of food samples ( $p < 0.05$ ). In addition, the overall satisfaction score of all recipes were above 4.00 which indicated that they were acceptable to participants, except the original formula (Table 6).

### Discussion

Nowadays, many studies have developed the carbohydrate-based menus of several traditional foods to improve the nutritional value and food quality.<sup>17,18</sup> The findings of this study revealed mixed results of participants' satisfaction scores on several menus of Thai traditional foods made from protein-free starchy products. All of the recipes made from the developed protein-free starchy products received significant different satisfaction scores on the texture of food samples that implicated the amount of tapioca flour affected the texture of food.<sup>19,20</sup> In addition, RN was the food recipe that showed significant difference of satisfaction scores on most of aspects. Also, no RN formulae developed from protein-free starchy products received acceptable level on the overall satisfaction scores. In contrast, PSW was the only food menu that participants expressed satisfaction for all formulae, while PT received satisfaction score for PT 1. Moreover, KJ was the only recipes that no acceptable level of overall satisfaction scores from

participants, while PKM received overall satisfaction scores for PKM 1, 2, and 3 formulae. The results supported findings in a previous study revealing that the amounts of flour in food affected the food quality<sup>21</sup> and similar to previous study revealing on the quality of food improvement by using the developed the gluten free pasta.<sup>22,23</sup>

Although the unrefined grain and whole grain products are well known as the healthy food with rich nutrients,<sup>24</sup> and previous studies had developed whole grain products for investigating the satisfaction of participants.<sup>25,26</sup> For people with CKD, low intake of protein from meat and carbohydrate-based foods (including whole grain and unrefined grain) are strongly suggested.<sup>27</sup> Therefore, the developed protein-free starchy products could be used in place of whole and unrefined grain and should be appropriate for CKD patients. The limitation of the study was that the sensory evaluation was conducted only in healthy people. Therefore, similar investigations on the acceptability and satisfaction of foods made from protein-free starchy products among patients with CKD as well as the long-term clinical outcome are suggested for further studies. In conclusion, the Thai ethnic food recipes made from the developed protein-free starchy products in PSE (1, 2, and 3), PT 1, and PKM (1, 2, and 3) satisfied and were acceptable to participants.

### Acknowledgement

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