

นิพนธ์ต้นฉบับ

การพัฒนาและการยอมรับต่อตำรับอาหารสูตรลดโซเดียมตามหลักทฤษฎีอาหารธาตุเจ้าเรือนของการแพทย์แผนไทย

นริศ เรืองศรี, วท.ม. (อาหารและโภชนาการเพื่อการพัฒนา)*,
อุไรภรณ์ บุณยสุภกุล, วท.ม. (อาหารและโภชนาการเพื่อการพัฒนา)*,
สมเจตน์ คงคอน, วท.ม. (การแพทย์แผนไทยประยุกต์)**,
อลงกต สิงห์โต, วท.ม. (อาหารและโภชนาการเพื่อการพัฒนา)*

*คณะสหเวชศาสตร์ มหาวิทยาลัยบูรพา,

**คณะแพทย์แผนไทยและแพทย์ทางเลือก มหาวิทยาลัยราชภัฏอุบลราชธานี

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บทคัดย่อ

ที่มาของปัญหา : ตามทฤษฎีการแพทย์แผนไทยกล่าวว่า โครงสร้างร่างกายและระบบทางสรีรวิทยาของมนุษย์เกิดจากการรวมกันของธาตุต่างๆ ได้แก่ ปิตตะ (ธาตุไฟ) วาตะ (ธาตุลม) และเสมหะ (ธาตุน้ำ) โดยทำงานร่วมกันอย่างสมดุลในภาวะที่ร่างกายมีความปกติ นอกจากนี้มนุษย์แต่ละคนยังมีธาตุหลักของตนเอง เรียกว่า ธาตุเจ้าเรือน ซึ่งสามารถจำแนกได้จากบุคลิกและลักษณะภายนอกของแต่ละบุคคลตามทฤษฎีธาตุปัจจุบันของการแพทย์แผนไทย โดยบุคคลนั้นจำเป็นต้องรับประทานอาหารที่มีส่วนประกอบและรสชาติที่ส่งเสริมการทำงานของธาตุเจ้าเรือนของตนเอง เพื่อบำรุงธาตุเจ้าเรือนให้ทำงานเป็นปกติ จากการศึกษาก่อนหน้านี้พบว่า การรับประทานอาหารตามธาตุเจ้าเรือนมีส่วนลดการเจ็บป่วยได้อย่างไรก็ตาม อาหารท้องถิ่นของไทยหลายเมนูยังพบว่ามีส่วนประกอบของโซเดียมในปริมาณที่สูง ซึ่งเป็นที่ทราบกันดีว่าการรับประทานโซเดียมที่สูงเกินไปก่อให้เกิดโรคไม่ติดต่อเรื้อรังต่างๆ ตามมา

วัตถุประสงค์: เพื่อพัฒนาตำรับอาหารธาตุเจ้าเรือนทั้ง 3 ธาตุ (ปิตตะ วาตะ และเสมหะ) ตามทฤษฎีการแพทย์แผนไทยโดยปรับลดปริมาณของโซเดียมในอาหารลงทดสอบความพึงพอใจทางประสาทสัมผัสของอาสาสมัครในด้านต่างๆ ได้แก่ ด้านรสชาติ ด้านกลิ่น ด้านสี ด้านเนื้อสัมผัส และด้านความพึงพอใจโดยภาพรวม

วัสดุและวิธีการ: ตำรับอาหารที่มีส่วนประกอบและรสชาติสำหรับแต่ละธาตุเจ้าเรือนตามทฤษฎีการแพทย์แผนไทย

ได้รับการพัฒนาขึ้น ธาตุเจ้าเรือนละ 3 เมนู (รวมทั้งสิ้น 9 เมนู) แต่ละเมนูแบ่งออกเป็น 2 สูตร คือ สูตรต้นตำรับและสูตรลดโซเดียม ทำการทดสอบทางประสาทสัมผัสในอาสาสมัครทั้งสิ้น 90 คน (ธาตุเจ้าเรือนละ 30 คน) โดยให้อาสาสมัครตอบแบบสอบถามคัดกรองธาตุเจ้าเรือนของตนเองก่อน จากนั้นจึงทำการทดสอบทางประสาทสัมผัสในเมนูอาหารที่เป็นธาตุเจ้าเรือนของตนเอง

ผลการศึกษา: จากผลที่ได้พบว่า คะแนนเฉลี่ยความพึงพอใจทางประสาทสัมผัสในด้านต่างๆ ของอาหารแต่ละเมนูไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ยกเว้น เมนูอาหารในธาตุเจ้าเรือนเสมหะที่พบว่าคะแนนเฉลี่ยความพึงพอใจทางประสาทสัมผัสมีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติในด้านกลิ่นและด้านสี ($p < 0.05$) นอกจากนี้ ปริมาณโซเดียมเฉลี่ยของอาหารทั้ง 9 เมนูของสูตรลดโซเดียมมีปริมาณน้อยกว่าสูตรต้นตำรับอย่างมีนัยสำคัญทางสถิติ ($p < 0.05$) และคะแนนเฉลี่ยด้านความพึงพอใจโดยรวมของทุกเมนูบ่งชี้ว่าอยู่ในระดับที่อาสาสมัครให้การยอมรับ

สรุป: จากผลที่ได้สามารถสรุปได้ว่า อาหารธาตุเจ้าเรือนสูตรลดโซเดียมทั้ง 3 ธาตุได้รับการยอมรับจากอาสาสมัคร

คำสำคัญ: การแพทย์แผนไทย; อาหาร; โภชนาการ; โซเดียม; ความพึงพอใจทางประสาทสัมผัส

Original article

Development and Acceptance of the Low Sodium Food Recipes Based on the Thai Traditional Medicine Belief

Narisa Rueangsri, M.Sc. (Food and Nutrition for Development)*,

Uraiporn Booranasuksakul, M.Sc. (Food and Nutrition for Development)*,

Somjet Khongkhon, M.Sc. (Applied Thai Traditional Medicine)**,

Alongkote Singhato, M.Sc. (Food and Nutrition for Development)*

*Faculty of Allied Health Sciences, Burapha University

**Faculty of Thai Traditional and Alternative Medicine, Ubon Ratchathani Rajabhat University

Abstract

Background : Thai Traditional Medicine (TTM) theory states that humans were created by combination of various elements (Pitta-heat, Wata-motion, and Semha-fluidity) which form their physical and physiological beings. Based on TTM theorists' belief humans can also be defined by their main element called 'TathuJaoRuen' which is determined according to their personal characteristics. Previous studies found that regular consumption of food based on their main elements can lower risk of illness among people. Unfortunately, food available in Thai communities is commonly high in sodium which can lead to many chronic diseases in the later part of life span.

Objectives: This study aimed to develop the low sodium food recipes based on the Thai people main elements and determine the satisfactions (taste, flavor, color, texture, and overall satisfaction) of the participants.

Materials and Methods: Nine menus for the 3 main

elements (3 menus for each element) were developed for conducting the sensory evaluation by 90 participants (30 for each element) who had been screened and identified for main elements towards the developed menus.

Results: Results revealed that almost of all aspects in each element, there were no difference on satisfaction scores, except for Semha that there were significant difference on flavor and color of food based on Semha element. In addition, the average amount of sodium in the low sodium recipe was significant lower than original recipe. Moreover, results indicated the overall satisfaction scores of all menus were classified as acceptable to participants

Conclusion: The developed low sodium food recipes according to the Thai Traditional Medicine belief were satisfactory and acceptable to participants based on their main elements.

Keywords: Thai traditional medicine; food; nutrition; sodium; sensory evaluation

Introduction

Non-communicable diseases (NCDs) are well known and important health problems worldwide that are caused by long-term inappropriate lifestyles including low physical activity and food habits.¹ Reports showed high prevalence of NCDs especially in both low and middle income countries which lead to increasing mortality and reduction of the quality of life.^{2,3} In Thailand, a study revealed that NCDs accounted for 65% of disability-adjusted life years lost in Thai people which resulted from socioeconomic, environmental and lifestyle changes associated with urbanization.⁴ In addition, Thailand was reported to have 60% of total deaths attributed to chronic non-communicable diseases which is higher than many countries in South-East Asian Region.⁵ High sodium consumption above reference level is one of major food-habit problem commonly found in many countries that can lead to NCDs development and increased the mortality among global population. The average amount of sodium consumption globally is 3,950 mg per person per day and this incurred an estimated annually 1.65 million death from cardiovascular diseases attributed from long-term high sodium intake.⁶ The suggested amount of sodium consumption is 2,300 mg per person per day.⁷ Unfortunately, over consumption of sodium via processed food and added salt for seasoning were commonly found that is related to the increasing of NCDs development.⁸⁻¹⁰ In Thailand, a report showed Thai people consumed more than 3,400 mg of sodium per person per day which is way above the suggested amount.¹¹ Reducing sodium intake has been reported to be effective in lowering risk of many chronic diseases such as hypertension and cardiovascular disease.¹² Therefore, encouraging people to consume low amount of sodium in food is recommended and should be promoted in order to lower the incidents of NCDs.

Thai Traditional Medicine (TTM) is influenced by Indian Ayurvedic medicine, and it is one of the most valuable legacies handed down from Thai ancestors which has been used for treatment and relief against diseases and illness based on local wisdom. The conceptual theory of TTM states that the human anatomical and physiological systems were formed by the combinations of various elements. Balancing of these elements system enable the external and internal organs to function normally; therefore, unstability or damaging of any element due to any reasons (aging, unhealthy food, etc.) will lead to illness and organ dysfunctions.¹³ Moreover, TTM theory believes that human have their main elements, in Thai called 'TathuJaoRuen', which is the chief of every element that form their anatomical and physiological beings. TathuJaoRuen (TJR) is based on elements of people's personal characteristics that can be summarized and defined into three categories: Pitta (heat), Wata (motion), and Semha (fluidity). Eating food according to TJR with variations in taste and flavor, has been passed down from generation to generation as described in ancient TTM texts that aim to guide people in consuming foods and ingredients that help promote and support their main elements to function properly and to be healthy. Additionally, the ingredients of each TJR food also include local fruits and vegetables that are easily found in Thai communities. For example, people who define their main element as Wata are suggested to consume spicy foods and foods rich in spicy flavor such as spicy soup, any food cooked with chili, etc. Example of vegetables categorized as Wata include ginger, basil, garlic, etc. People who define their main element as Semha are suggested to consume bitter- or sour-tasting food such as orange juice, lemon juice, and any Thai spicy acidic-tasting soup or salads (ie., Tom Yum Kung, Som Tum, etc.). Example of fruits and vegetables categorized as Semha included

oranges, neem, gourds (*Coccinia grandis* L.), cassia (*Senna siamea* L.), etc. People who define their main element on Pitta are suggested to consume bland or tasteless foods such as those lacking in spices (i.e., clear soup). Example of vegetables categorized as Pitta included zucchinis, cucumbers, etc.^{14,15} Previous study showed the benefits of regular consumption of food according to TRJ belief which can lower illnesses among Thai people as shown in several historical records.¹⁶ Unfortunately, high sodium consumption was reported in commercially available processed foods as well as in home-cooked foods.^{17,18} This study, therefore, aimed to develop the low sodium food recipes according to TJR belief for people to consume which hopefully will minimize the ill effects due to high sodium intake.

Objective of the study

This study aimed to develop the low sodium food recipes according to TJR belief for people to consume which hopefully will minimize the ill effects due to high sodium intake.

Materials and Methods

1. Development of questionnaires

1.1 TJR screening questionnaires

These close-ended questionnaires were adapted from the Thai Traditional Medicine script and used in screening and identifying the main elements of participants.¹⁹ Participants were asked to answer 14 questions by choosing the choices that match with their personal and characteristics for each element. The most frequently selected main element was identified as participants' main element. An example of Pitta characteristics include "Your mouth is small and dry" and "You are speaking too fast and voluble" An example of Wata characteristics include "Your mouth size is proportionate and your lip appears

naturally red" and "You are laconic" An example of Semha characteristics include "Your mouth is rather big and looks healthy" and "You speak slowly."

1.2 Survey of the favorite TJR food menu questionnaires

The TJR food menus to be used as the test samples of sodium-modified recipes were selected by developing close-ended questionnaires that included the lists of TJR food menus commonly found in the communities and easily produced in household cookings. Three lists of TJR food menus for each main element (Pitta, Wata, and Semha) were developed to provide the 20 food menus in each list. Examples of menus for Pitta were such as vegetable gourd soup with minced pork, stir-fried zucchini with eggs, etc. Examples of menus for Wata were such as stir-fried basil with pork, stir-fried ginger with pork, etc. Examples of menus for Semha were such as mung bean noodle salad, stuffed bitter melon with seasoned minced pork soup, etc. The top 3 menus that were most frequently selected for each main element were chosen to be sample of sodium-modified recipes in the next phase.

1.3 Satisfaction questionnaires

This study used the 5-point hedonic scale to determine participants' satisfaction on the developed TJR food menus (Fig 1). Thirty participants from each of the three main elements were asked to complete answering the questions that elicit responses for their sensory evaluations of the six domains of each developed menu on appearance, taste, flavor, color, texture, and overall satisfaction.²⁰ The scoring method used in sensory evaluation were as followed; 5=like very much, 4=like, 3=somewhat like, 2=dislike, 1=dislike very much. The menus with the average overall satisfaction score above 3.5 (from the total score=5) was considered as satisfying and acceptable to participants.²¹

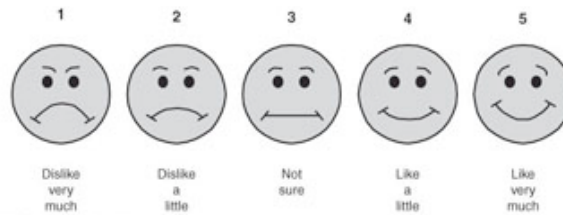


Figure 1. Five-point hedonic scale

All developed questionnaires were proof-read and revised by experts in nutritional science who were registered in Applied Thai Traditional Medicine at Burapha University. Once completed, all revised questionnaires and study protocols were submitted to the Faculty of Allied Health Sciences Burapha University Institutional Review Board for the ethical review and approval (approval code number 13/2559). After that, twelve participants having comparable demographic background with an intervention group were asked in the pre-test for approving the questionnaires for their reviews, comments, and understandings.

2. Study procedure

This study was conducted at the Tambon Saensook, Mueng Chonburi, Thailand. A total of 496 participants in each 3 main element (total=1,488) were screened and identified for their main elements, and then asked to complete the survey of their favorite TJR food menu questionnaires by choosing their most favored three menus from the list of questionnaires according to their main element.²² Once completed, the most frequently selected three menu of each 3 main element (total=9) were prepared and calculated for calories, nutrients, and sodium content modification using an analysis software package (INMUCAL-Nutrient V3-version 3.0) at the Clinical Nutrition Laboratory, Faculty of Allied Health Sciences, Burapha University, Saensook Campus. Commercialized reduced sodium-seasoning products (KCl substituted for NaCl) were used in cooking for low sodium recipes.

Next, other groups of 30 participants per each of the 3 main elements (total=90) were recruited to participate in this study by quota sampling with the following inclusion criteria: age between 18-60 years, able to read and write Thai, and are healthy.²³ Exclusion criteria included medical history of food allergy, color blindness, not completing questionnaires, mental disorder, prohibition of food ingredients due to their cultural or religion, sensory problems in taste and smell. Once all participants signed informed consents to participate in this study, they were invited to the clinical nutrition laboratory room to conduct the sensory evaluation for 3 TJR food menus to determine their satisfactions on appearance, taste, flavor, color, texture, and overall satisfaction according to their main element. The blinded samples of TJR food (both original recipe and low sodium recipe) were served to each participant. Samples were presented with water and paper ballots on a plastic tray. Participants were asked to intake the whole sample and then rinse their mouths with water between conducting the tasting to minimize any residual effect.

3. Statistical analysis

Mean (\pm SD) of calories, carbohydrate, protein, fat, sodium, potassium, and phosphorus were determined. Dependent paired t-test was used to compare the means of the data on calories, nutrients, and satisfaction scores between original recipes and low sodium recipes using the predictive analytics software statistics (PASW) version 21. (SPSS Inc., Chicago, IL, USA). Statistical significance was established at $p < 0.05$.

Results

1. Most selected TJR food menus

The top 3 selected TJR food menus of Pitta element were stir-fried morning glory (n selected=280), stir-fried Kai Lan and crispy pork (n selected=266), and vegetable gourd soup with minced pork (n selected=234). The top 3 selected TRJ food menus of Wata element were stir-fried chicken with ginger and mixed vegetables (n selected=276), stir-fried pork and basil (n selected=224), and stir-fried chicken and curry paste (n selected=219). The top 3 selected TJR food

menu of Semha element were sour soup with fish and mixed veggies (n selected=273), mung bean noodle salad (n selected=269), and Thai chicken soup with coconut milk (n selected=265).

2. Participants' satisfaction on the TJR food menus

Sensory evaluation was conducted to determine participants' satisfactions on the TJR food menus according to their main element. Table 1 presents the participants' characteristics for each main element that indicated most of them were female.

Table 1. Participants' baseline of each element on gender and mean age in years

| Main element | Pitta (N=30) | Wata (N=30) | Semha (N=30) |
|------------------------|-----------------------|-----------------------|-----------------------|
| Gender (Mean \pm SD) | | | |
| - Males | 10 (25.20 \pm 1.31) | 12 (26.16 \pm 1.58) | 10 (25.90 \pm 1.96) |
| - Females | 20 (24.80 \pm 1.57) | 18 (25.50 \pm 1.68) | 20 (25.72 \pm 2.13) |
| Mean age in year (SD) | | | |
| - Males | 25.20 (1.31) | 26.16 (1.58) | 25.90 (1.96) |
| - Females | 24.80 (1.57) | 25.50 (1.68) | 25.72 (2.13) |

Table 2 is the TJR food menus preferred Pitta element, which shows that there were no significant differences of satisfaction scores in all aspects on stir-fried morning glory (SMG), stir-fried

Kai Lan and crispy pork (SKP), and vegetable gourd soup with minced pork (VGP) between original recipe (ORG) and low sodium recipe (LS).

Table 2. Sensory evaluation scores expressed in mean \pm SD on the TJR food menus for Pitta element

| Aspects | SMG | | <i>p</i> | SKP | | <i>p</i> | VGP | | <i>p</i> |
|----------------------|----------------|----------------|----------|----------------|----------------|----------|----------------|----------------|----------|
| | ORG | LS | | ORG | LS | | ORG | LS | |
| Appearance | 3.76 (0.89) | 3.80 (0.88) | 0.88 | 3.53 (0.86) | 3.60 (0.89) | 0.76 | 3.43 (0.93) | 3.53 (0.97) | 0.65 |
| Taste | 4.13 (0.93) | 4.16 (0.87) | 0.87 | 3.83 (1.17) | 3.63 (1.09) | 0.37 | 3.63 (1.12) | 3.53 (1.00) | 0.69 |
| Flavor | 3.80 (0.99) | 3.73 (0.90) | 0.78 | 4.00 (1.08) | 4.06 (0.82) | 0.78 | 3.73 (1.31) | 3.56 (1.27) | 0.64 |
| Color | 3.96 (1.27) | 3.90 (1.15) | 0.82 | 3.66 (1.26) | 3.73 (1.14) | 0.82 | 4.26 (0.98) | 4.13 (0.68) | 0.54 |
| Texture | 3.66 (0.99) | 3.70 (0.95) | 0.86 | 3.60 (0.96) | 3.56 (1.00) | 0.87 | 3.86 (1.00) | 3.60 (0.89) | 0.23 |
| Overall satisfaction | 3.83 (0.94) | 3.80 (0.92) | 0.87 | 3.83 (1.01) | 3.93 (1.04) | 0.71 | 3.66 (0.99) | 3.53 (1.16) | 0.62 |

Total score=5

Table 3 is the TJR food menus preferred by Wata element, which shows that there were no significant differences of satisfaction scores in all aspects of stir-fried chicken with ginger and mixed vegetables (SCG), stir-fried pork and basil (SPB), and stir-fried chicken with curry paste (SCC) between ORG and LS.

Table 3. Sensory evaluation scores expressed as mean \pm SD on the TJR food menus for Wata element

| Aspects | SCG | | <i>p</i> | SPB | | <i>p</i> | SCC | | <i>p</i> |
|----------------------|----------------|----------------|----------|----------------|----------------|----------|----------------|----------------|----------|
| | ORG | LS | | ORG | LS | | ORG | LS | |
| Appearance | 3.86 (1.00) | 3.66 (1.06) | 0.47 | 4.20 (0.80) | 4.26 (0.90) | 0.78 | 3.60 (1.03) | 3.83 (1.17) | 0.37 |
| Taste | 3.60 (0.89) | 3.73 (1.04) | 0.57 | 4.10 (1.02) | 4.16 (0.91) | 0.76 | 3.93 (0.94) | 3.73 (0.90) | 0.26 |
| Flavor | 3.53 (1.04) | 3.50 (1.07) | 0.86 | 3.96 (0.96) | 4.10 (0.88) | 0.45 | 3.86 (0.89) | 3.63 (0.99) | 0.21 |
| Color | 3.73 (0.90) | 3.53 (1.10) | 0.41 | 4.20 (0.88) | 3.76 (0.97) | 0.06 | 4.23 (0.77) | 3.96 (0.99) | 0.24 |
| Texture | 3.83 (0.91) | 3.86 (1.10) | 0.85 | 4.33 (0.84) | 4.26 (0.82) | 0.71 | 4.06 (0.82) | 4.10 (0.75) | 0.84 |
| Overall satisfaction | 3.96 (0.96) | 3.56 (1.04) | 0.07 | 4.10 (0.92) | 3.66 (1.15) | 0.06 | 3.90 (0.80) | 3.66 (0.92) | 0.26 |

Total score=5

Table 4 is the TJR food menu preferred by Semha element, which shows that the mean scores on flavor and color of the ORG were significantly higher than LS in sour soup with fish and mixed veggies (SFV), mung bean noodle salad (MNS), and Thai chicken soup with coconut milk (TCC).

Table 4. Sensory evaluation scores expressed as mean \pm SD on the TJR food menu for Semha element

| Aspects | SFV | | <i>p</i> | MNS | | <i>P</i> | TCC | | <i>p</i> |
|----------------------|----------------|----------------|----------|----------------|----------------|----------|----------------|----------------|----------|
| | ORG | LS | | ORG | LS | | ORG | LS | |
| Appearance | 4.20 (0.84) | 4.03 (0.88) | 0.43 | 4.33 (0.84) | 4.16 (0.91) | 0.39 | 4.30 (0.74) | 4.13 (0.77) | 0.36 |
| Taste | 4.13 (0.68) | 3.90 (0.71) | 0.12 | 3.63 (1.06) | 3.66 (0.92) | 0.78 | 3.96 (0.80) | 4.06 (0.90) | 0.65 |
| Flavor | 4.33 (0.71) | 3.96 (0.85) | 0.03 | 4.16 (0.74) | 3.70 (0.98) | 0.02 | 4.16 (0.98) | 3.53 (1.07) | 0.01 |
| Color | 4.30 (0.83) | 3.80 (1.06) | 0.04 | 4.43 (0.89) | 3.86 (1.19) | 0.01 | 4.23 (1.04) | 3.73 (1.43) | 0.04 |
| Texture | 4.20 (0.96) | 3.90 (1.15) | 0.22 | 4.00 (1.14) | 3.83 (1.11) | 0.52 | 4.23 (1.04) | 3.66 (1.32) | 0.08 |
| Overall satisfaction | 4.13 (1.00) | 3.90 (1.06) | 0.34 | 3.70 (1.05) | 3.53 (1.13) | 0.55 | 4.26 (0.82) | 3.96 (1.12) | 0.19 |

Total score=5

3. Amount of calories and nutrients compared between original recipe and low sodium recipe

Table 5 shows the average amounts of calories, carbohydrate, protein, fat, sodium, potassium, and phosphorus of 9 TJR food menus for Pitta, Wata, and Semha, comparing between original

recipe and low sodium recipe. The average amount of sodium in the low sodium recipe was significant lower than the original recipe. Moreover, the average amount of potassium in the low sodium recipe was significant higher than the original recipe.

Table 5. The average amounts of calories and nutrients compared between original recipe and low sodium recipe

| Calories and nutrients | Original Mean (SD) | Low sodium Mean (SD) | p-value |
|------------------------|-----------------------|-------------------------|---------|
| Calories (kcal) | 203.55 (16.48) | 200.44 (14.58) | 0.06 |
| Carbohydrate (g) | 15.11 (1.90) | 14.22 (3.19) | 0.22 |
| Protein (g) | 19.66 (3.60) | 18.77 (4.60) | 0.16 |
| Fat (g) | 7.22 (1.20) | 6.55 (1.33) | 0.24 |
| Sodium (mg) | 907.88 (23.60) | 424.88 (20.81) | <0.001 |
| Potassium (mg) | 288.77 (28.20) | 793.11 (38.08) | <0.001 |
| Phosphorus (mg) | 128.66 (16.01) | 128.88 (15.17) | 0.92 |

Discussion

Nowadays, many studies revealed the effectiveness of using complementary and alternative medicine in food therapy, for examples, the use of earthworm (*Pheretima*) to improve immune system,²⁴ the use of Traditional Persian Medicine diet therapy for kidney damage,²⁵ and the use herbal products as dietary supplement.²⁶ For NCDs prevention especially high blood pressure, previous study showed the effectiveness of Traditional Chinese Medicine by using the diet therapy with the intake of powdered asparagus (*Asparagus officinalis* L.) roots and stems, and *Cladophylls*.²⁷ In this study we aimed to use the TTM which is traditional knowledge and belief on TJR foods as the diet therapy for the prevention of NCDs with the reduction of sodium in the foods as previous studies revealed the benefits of reducing sodium consumption in lowering the incidents of chronic diseases. The average amount of sodium being reduced was 50% which is the effective amount of sodium reduction that could lower the cardiovascular disease development.²⁸

In addition, previous study had shown that reduction of sodium is strongly recommended to lower blood pressure.^{29,30} On the other hand, the average amount of potassium of the low sodium TJR food recipe was significant higher than the original recipe due to using of KCl seasoning in replacement of NaCl seasoning. Therefore, these TRJ food menus are appropriate for healthy people but should be avoided by chronic kidney disease (CKD) patients in stage 3-5 who face potassium restriction due to their declining glomerular filtration rate (eGFR) in the late stages of CKD with defective in potassium excretion.^{31,32}

The findings of this study revealed that almost all TJR food menus showed no significant difference on satisfaction scores between original recipe and low sodium recipe in all aspects, except in color and flavor of Semha element with low sodium recipe had lower satisfaction scores than original recipe. TJR food menus of Semha element are suggested to have sour taste, therefore, reducing of sodium in food which ingredients rich in sour taste (lemon and vinegar) affected food pH and sense of smell due to

volatile aromas.^{33,34} Moreover, similar with previous study that amount of sodium in food also affected color development, therefore, reducing sodium such as salt, fish-sauce and soya bean sauce can affected coloring in some foods.³⁵ The average overall satisfaction scores were not significant difference between original recipes and low sodium recipe. In addition, all low sodium TJR food recipes had overall satisfaction scores at acceptable level. This findings were similar to previous studies which showed that low sodium food products were received with satisfaction by the participants, such as the low sodium salami³⁶ and the reduction of sodium content in spicy soups using monosodium glutamate.³⁷ In conclusion, the developed low sodium TJR food menus were satisfying and acceptable to participants based on their element.

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