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Development of Innovative Seven-Colored Jellies to Promote Nutrition among the Elderly with Diabetes and Hypertension

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Abstract

This research and development aimed 1) To develop the "Seven-Colored Jellies", an innovative solution designed to enhance nutrition for elderly individuals with diabetes and hypertension. 2) To evaluate satisfaction with the innovation of "Seven-Colored Jellies" in order to promote nutrition among the elderly with the diabetes and hypertension. A quota sampling method was utilized to select the sample group for this study. The sample comprised 30 elderly individuals aged 60 years and older, classified as the Dark Green group according to the "PBRI Seven Colors Traffic Pingpong Model" developed by the Suratthani Municipal Public Health Service Center (Suan Luang Rama IX). This classification was used to ensure that participants were representative of the target population segment for the study. The research instruments were the innovation of "Seven-Colored Jellies" and the satisfactory assessment form for the innovation of "Seven-Colored Jellies". The data were analyzed using descriptive statistics to calculate the mean and standard deviation. The results of the research show that 1) The "Seven-Colored Jellies" were successfully developed as a nutritionally enhanced product specifically tailored for elderly individuals with diabetes and hypertension. The product was evaluated by specialists, who determined its suitability to be at a very high level. (Mean=4.79, S.D.=0.66) 2) The satisfactory level is high, towards the innovation of "Seven-Colored Jellies" to promote nutrition among the elderly with the diabetes and hypertension (Mean=4.24, S.D.=0.89)

Keywords: Innovation, Seven-Colored Jellies, Nutritional level, Diabetes, Hypertension

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Introduction

Individuals aged 60 years and older are categorized as elderly, representing a vital and respected demographic within society. They contribute significantly through their knowledge, expertise, and roles in preserving tradition and culture, as well as maintaining familial bonds. Thailand has been classified as an aging society since 2005, when the proportion of the population aged 60 years and above exceeded 10%. Currently, Thailand's elderly population is rapidly increasing, with projections indicating a complete transition to an aging society when this demographic reaches 20% of the total population. In 2022, a study revealed that the elderly population constituted 18.31% of the total population, amounting to 12,116,199 individuals. Of these, 5,339,610 were male (8.07%), and 6,776,589 were female (10.24%). Chronic non-communicable diseases, such as diabetes and hypertension, are prevalent among the elderly. These conditions are often attributed to dietary behaviors, insufficient physical activity, and age-related physiological changes that contribute to the decline of various biological systems.

The situation relating to diabetes in Thailand shows that the trend continues to rise. The estimated number is at 300,000 new cases per year with the number of diabetic patients in the registry of the Ministry of Public Health at 3.2 million. This problem causes significant loss in the health care budgetary, which averaged up to 47,596 million Baht per year (Chomchoei1C., Yeemard F., Tamornpark R., Apidechkul T. & Upala P., 2021) This disease is one of the chronic diseases that the elderly patients need to be nurtured to maintain their quality of life. The information from Policy and Strategy Division, Ministry of Public Health, it is found that the same result resonates with the hypertension situation in Thailand, as the morbidity rate of hypertension per population of 100,000 during the past 5 years (2013-2017) increased from 12,342.14 (3,936,171 people) to 14,926.47 (5,597,671 people). The data from Information Technology and Communication Division, Ministry of Public Health also shows that the morbidity rate of Hypertension per population of 100,000 people during the past 3 years (2015-2017) increased from 916.89 (540,013 people) to 1,353.01 (813,485 people) Health System Development, Office of Non-communicable Disease The situation of chronic non-communicable diseases among the elderly shows that 31.7% of the elderly have hypertension, 13.3% with diabetes, 7% with heart disease, 2.5 % with paralysis/paresis, 1.6% with cerebrovascular disease, and 0.5% with cancer. They need to be under long-term care in order to reduce complications from chronic non-communicable diseases, as well as promoting better health among the elderly and increasing their quality of life. (Prasomsuk S., Nilnate N., Chairum N. and Chammana M., 2020).

Elderly people suffering from chronic non-communicable diseases need a long time to care. They cannot be cured. It can also cause complications from other existing chronic diseases such as cardiovascular. Besides, they are major causes of other complications such as eye, kidney and nervous system, which may result in disability or even death. The patient's inability to adapt properly to the disease can also cause discouragement, despair and stress affecting their lives, and in turn lead to lower quality of life (Kaewyoo R., Phatchararin Niamkerd and Supranee Promsukhan, 2020). With these problems, the Ministry of Public Health has then adopted the policy of using the 7-Colored Life Traffic Ping Pong ball to monitor, prevent and control Diabetes and Hypertension with the clear policy and goals. This can be done by involving and raising individual awareness to turn this into a way of life, with the focus on screening, monitoring. The target group was divided into 4 groups, with Normal being in white color, Risky being light green, Sick being in dark green, yellow, orange and red) and group with complications being in black. The level of severity are also divided by the 7-Colored Life Traffic Ping Pong ball, which is used as a tool to determine principles and measures to operate and promote better health with 3 principles to promote (Food, Exercise, Emotion), and 3 principles to reduce

(Alcohol, Cigarettes, Beer belly) to reduce the risk of getting the disease and other health related problem. The information would be provided on selfcare for Normal, Risky and Sick groups, to reduce the risk of contracting the diseases at different stage. (Jamjumroon P. and Phatisena T., 2017)

As people become older, they face physical changes which is more deteriorating than having better health. Particularly, the change that affect nutrition change among the elderly such as the decrease in sense of taste and smell causing the elderly to consume more flavorful food. This would then result in chronic non-communicable diseases such as diabetes and hypertension. In addition, other symptoms such as slower function of salivary gland resulting in lack of saliva and unhealthy teeth. The decrease in the ability to chew and swallow food, the function of the digestive system. The symptoms will easily lead to deficiency of Iron and Vitamin B12 easily, the slower performance of glucose metabolism causes sugar level in the blood to rise. Elderly people are then more prone to have diabetes, as well as psychological related problems. The latter problem causes the elderly people to lack mental stability, loneliness, tiresome, feel the discouragement in their lives and eventually leads to the loss of appetite. Such changes cause the elderly to consume less food which might cause malnutrition or even severe in some cases, and also the decreasing level of immunity system. This can make it difficult to treat chronic diseases and may require long period of time to heal. (Yuenyongputtakal W., Wicheanchot S. & Sukutta U., 2020)

It is necessary to care for the elderly persons and ensure that they receive required nutrition that aligns with the nutritional plan. It is absolutely necessary for the elderly to consume food with sufficient energy sources such as proteins, vitamins and essential minerals to the level that meets the daily needs, especially protein level in 1 day. Elderly people need about 1 gram of protein / body weight. (kg/day)

Elderly people who receive adequate protein nutrients would help building muscle strength, strengthening the bones, increasing the level of immune system and other mechanisms, as various enzymes in the body are consisted of proteins. If the elderly people receive insufficient amount of protein, then they tend to become more obese than those who receive sufficient amount. This is apparent among the elderly with diabetes and hypertension, as protein may help stabilizing sugar level in their blood, which in turn will make them feel less appetite. It would control their consumption behavior and their weight. High-protein diets can lower blood sugar level in patients with type 2 diabetes with the right proportion of protein. If the patients with diabetes consume more food with protein, then it would heighten the response to insulin, but will not increase sugar level in their blood. (Tongta S., 2020). Besides ensuring that the elderly people will receive proper protein nutrients, other factors such as malnutrition or malnutrition must also be taken into account. This also include the gastrointestinal system and congenital diseases (Kaewanun C., 2018). It is therefore important to promote nutrition as it will enable the elderly in categorized 4 groups with Normal being in white color, Risky being light green, Sick being in dark green, yellow, orange and red) and group with complications being in black to receive proper nutrition promotion, so their illnesses will not become more serious. Also their category will not change from dark green group to the more severe group.

The development of innovation of Seven-colored jelly are good for the elderly and to promote nutrition among the elderly with diabetes and hypertension would consequently be in line with the increasing demand for energy from food source that is suitable with the elderly with diabetes and hypertension. This innovative development was designed from evolving the medical food with the raw materials that can be easily found at home and with good nutrition. They are then adapted to suit the level of the patients' diabetic and hypertension limitations. The use of "Lor Hang Guo" sugar as part of ingredients for the jelly is to use as substitute for sugar. It does not turn bitter after consuming large amount and does not affect the increase of sugar level in the blood

and the level of insulin in the body. It contains no calorie and is suitable for elderly people with diabetes and hypertension, whom need to control or limit their sugar intake, to prevent the more serious illnesses (Sookaim N. and Tubbiyam P., 2013). The development of suitable texture of jelly to suit the elderly to promote chewing and swallowing would prevent the complications that may rise from food aspiration in the elderly. The product was developed into a gel type of food, in the form of a jelly to reduce the case of food aspiration in this age group, as well as to provide the elderly with adequate nutrition that suit their needs to promote nutrition, which would benefit their health.

Research Methodology

This research and development aimed to develop the innovation on "Seven-Colored Jellies" to promote nutrition among the elderly with diabetes and hypertension with the following 3 steps as follows:

Step 1 The Study of the problem, documents and related research (Analysis Research)

The researcher studied the problem, documents and other research on the jelly, and the promotion of proper nutrition in the elderly with diabetes and hypertension. The information is gathered from the participants with the following 1) 2 nurse professors with the experience teaching subjects on the elderly people. 2) 2 nurse professors with experience teaching chronic non-communicable diseases and 3) 3 nutritionists from the hospital. The total number of participants was 7.

The instrument used was an assessment form consisting of questions regarding the texture of the jelly, the packaging, the smell, the taste, the color, the ease of consumption, the storage, etc.

Quality inspection of research instruments by bringing the innovation of seven colored jelly and the assessment form to the three experts. There were adjustments as per their recommendations. Then, a trial was performed (Try Out) with 10 elderly persons who have diabetes and hypertension, in order to check for clarity and understanding of the assessment form.

Content Analysis was conducted and the guideline of content analysis by Crabtree & Miller was used (Crabtree & Miller, 1992)

Step 2 Design and development

2.1 The researcher used the findings from Step 1 to develop a conceptual framework for the "Seven-Colored Jellies" innovation.

2.2 This innovation was designed to improve nutrition among elderly individuals with diabetes and hypertension, ensuring it could be consumed without worsening their conditions. The researchers considered both nutritional value and caloric intake, consulting with three nutritionists from Suratthani Hospital for guidance on the preparation process and selection of ingredients. The ingredients and equipment used are as follows:

Table 1: Displaying the items and quantity of raw materials per one formula.

material	amount	instructions
1. Pandan juice 100 g		Step 1: Ingredient Preparation The innovation of 'Seven-Colored Jellies for the Elderly' begins with the preparation of key ingredients: 100 g of pandan juice, Luo Han Guo sugar, special medical food for diabetes (Glucerna SR), gelatin, carrageenan, and maltodextrin. Step 2: Heating and Packaging All the prepared ingredients—pandan juice, Luo Han Guo sugar, Glucerna SR, gelatin, carrageenan, and maltodextrin—are combined and heated at 80±3 °C for 5 minutes. The mixture is then carefully transferred into pre-prepared, tightly sealed packages. Step 3: Cooling and Storage The sealed packages are allowed to cool at room temperature for 5 minutes, followed by refrigeration at 4±2 °C for 3 hours. Each package contains 1.56 g of protein, 1.27 g of fat, and 4.292 g of carbohydrates, with a total energy content of 34.86 Kcal."
2. Luo Hang Guo Sugar	10 g	
3. Special medical food for diabetes Glucerna SR	40 g	
4. Gelatin	1 g	
5. Cagenan	1 g	
6.Maltodextrin	5 g	
Total	160 g	

Table 2: Displays the nutrition facts per 1 formula.

Material nutritional value	Protein	fat	carbohydrates
1. Pandan juice	-	-	-
2. Luo Hang Guo Sugar	-	-	-
3. Special medical food for diabetes Glucerna SR	7.8 g	6.36 g	16.46 g
4. Gelatin & Cagenan	-	-	-
5. Maltodextrin	-	-	5 g
Nutritional value	7.8 g	6.36 g	21.46 g
Energy (Kcal)	31.2	57.24	85.84
Total (Kcal)		174.28	

***Remark - Energy (Kcal) per gram: Protein 4, Fat 9, Carbohydrate 4 1 formula can create 5 packs

3. Process of making jelly.
4. The researchers created a package that was easy to swallow and useful for the elderly.
5. Eating: 1-5 sachets/day when needed for energy or when feeling hungry, eat as a snack.
6.Take a sample of jelly. Quality inspection by 7 experts and improvements according to recommendations. until the expert see that innovation "Seven color jelly good for the elderly" as mentioned above.

Step 3 Trial and Evaluation of the jelly's effectiveness (Implementation and Evaluation)

The sample group for this research comprised elderly individuals residing within the jurisdiction of Suan Luang Rama IX Public Health Service Center in Bang Kung Subdistrict, Mueang District, Surat Thani Province. A quota sampling method was employed, wherein specific subgroups and participant numbers were predetermined to meet the study's requirements. The final sample included 30 elderly participants (aged 60 years and over) who were classified within the 'Sick' group (dark green category) and had no prior history of stroke. These participants were selected based on their alignment with the inclusion criteria, which required them to be within the specified age range and health classification, and to be capable of participating in the study without the risk of complications. Exclusion criteria included any history of stroke or other conditions that could interfere with the study's procedures. All participants were assessed using the PMR Siriraj swallowing screening method to ensure their eligibility for the study.

Data Collection

With this research, the researcher collected the data after the project was approved by Human Ethics Section at Boromarajonnani College of Nursing in Surat Thani with the following action:

The researcher then collected thedata at the Suan Luang Rama IX Public Health Service Center. Select a sample group according to the specified properties is a group of 30 elderly people. The sample group tested the innovation and assessed their satisfaction.

Data Analysis

1. Analysis on personal data such as gender, age, education level by using descriptive statistics to calculate the Mean and the Standard Deviation.

2. Satisfaction analysis of using "Seven-Colored Jellies" using descriptive statistics to calculate the mean and standard deviation.

Ethical Approval

The protocol of this study was reviewed and approved by the Boromarajonani College of Nursing Surat Thani Ethical Review Board on 7 August 2022. The ethical approval number is 2022/17.

Results

1. The development of innovation of "Seven-Colored Jellies to Promote Nutrition among the Elderly" to promote good nutrition among those with diabetes and hypertension. The production process is as follows:

1.1 The ingredients were weighed with the production of 160 grams and divided into 5 sachets, by dissolving Glucerna SR, maltodextrin with pandan leaf juice and Lau Hung Gua sugar. The ingredients were then mixed.

1.2 Dissolve gelatin and carrageenan with warm water at 80±3 °C. The result will be clear solution.

1.3 Mix above ingredients together in a stainless steel bowl and heat it up for 5 minutes.

1.4 Pack the ingredients into the prepared sachets, then seal the envelope tightly. Leave to cool at room temperature for 5 minutes and then refrigerate at 4±2°C for 3 hours to allow the jelly to set.

The result of the assessment on this innovation, by 7experts found that the overall quality of the innovation was at the highest level (Mean = 4.79, S.D. = 0.66). Details as shown in table 3 below.

Table 3: Mean and Standard Deviation of the result of Quality Assessment on this innovation by the experts (N=7).

Assessment item	Mean	S.D.	Level of suitability
1. Suitability for the elderly with diabetes	5	0	Very High
2. Suitable for the elderly with hypertension	5	0	Very High
3. Adaptable for people in the community	5	0	Very High
4. Ability to prevent more serious illnesses according to the 7-colored life traffic Ping pong concept.	4.57	1.13	Very High
5. Ease of consumption	4.71	0.49	Very High
6. Appropriate amount per 1 serving.	5	0	Very High
7. Well nutrition, reduce appetite.	5	0	Very High
8. Soft and smooth texture, easy to swallow, encourage chewing and swallowing for the elderly.	4.57	1.13	Very High
9. Taste, scent, color. appealing.	4.43	1.13	High
10. Packaging and consumption style enable easy swallowing	4.57	0.53	Very High
Total	**4.79**	**0.66**	**Very High**

From Table 3, it was found that the innovation of "Seven-Colored Jellies" had the overall suitability at the highest level (Mean = 4.79, S.D. = 0.66). The item with the highest score is "Suitability for the elderly with diabetes", "Suitability for elderly people with hypertension and "Adaptable for the people in the community" with the Mean = 5 S.D. equals to 0 for all 3 items, and the item with the lowest average score was "Taste, scent, color and appealing". which had the Mean = 4.43, S.D. = 1.13.

Following the production process, a sensory evaluation was conducted to assess the acceptability and quality of the "Seven-Colored Jellies." Seven experts in nutrition and food science participated in the evaluation. The jellies were assessed based on criteria such as texture, flavor, appearance, and overall acceptability.

Each expert rated the jellies on a scale, where the overall quality was found to be at the highest level. These results indicate a strong consensus among the experts regarding the innovation's effectiveness in promoting nutrition among the target elderly population.

2. The assessment on satisfaction with this innovation

2.1 General information of the elderly people with diabetes and hypertension in the area under the responsibility of Suan Luang Rama IX Public Health Service Center, Bang Kung Subdistrict, Mueang District, Surat Thani Province found 30 people, of whom 16 were males, representing 53.33%, 14 were females, representing 46.67%. The majority had secondary education as their highest education background representing 63.33%, 33.37% had hypertension as their chronic disease. At second spot come diabetes with 46.67% and 19.96% with both diabetes and hypertension.

2.2 The results of satisfaction assessment on this innovation based on the sample of 30 people found that the overall satisfaction level was at a high level (Mean = 4.04, S.D. = 0.99). Details as shown in Table 4.

Table 4: Mean and Standard Deviation of the Satisfaction on the Innovation, "Seven-Colored Jellies"by the sample group (N=30).

Assessment item	Mean	S.D.	Level of suitability
Product Aspect (Jelly)			
1. Nice scent. Appealing to consume	4	0.83	High
2. Soft and smooth texture	3.97	1.03	High
3. Delicious taste	3.70	1.02	High
4. Easily chewed and swallowed.	4.13	0.86	High
5. Colorful, appetizing	3.80	1.13	High
6. Appropriate amount per 1 serving.	4.13	0.90	High
Packaging Aspect			
1. Can be easily opened to consume.	3.87	1.22	High
2. Easy to keep	4.20	0.85	High
3. Durable and uneasy to tear apart.	4.23	0.97	High
4. Prevent contact with liquid, dampness or oxygen.	4.33	0.92	High
Total	**4.04**	**0.99**	**High**

From Table 4, the satisfaction of the innovation based on 30 elderly people can be found that their overall satisfaction was at a high level (Mean = 4.04, S.D. = 0.99). They were satisfied with the item under "Prevent contact with liquid, dampness or oxygen", which had the high level of satisfaction (Mean = 4.33, S.D. = 0.92) It is followed by "Durable and uneasy to tear apart" (Mean = 4.23, S.D. = 0.97). The aspect with the least satisfaction was "Delicious taste" which had a high level of satisfaction (Mean = 3.70, S.D. = 1.02).

Conclusion

1. The experts' assessment on the development of this innovation concluded that the suitability was at a very good level (Mean=4.79, S.D.=0.66). The researcher agreed that the innovation consisted of various nutrients such as protein, carbohydrates and fats. Protein in particular is considered significant food for the elderly. When they receive sufficient amount of protein, it would help them build muscle strength, strengthen the bones, improved immune system and mechanisms of their bodies, as enzymes consisted of protein.

If the elderly people do not receive sufficient level of protein to meet the needs of the body, then they will be more prone to become obese, especially the elderly people with diabetes and hypertension. Consistent with Sunandha Thongtha, (2020) whom stated that high-protein diets can reduce blood sugar level in patients with type 2 diabetes. Food with appropriate ratio of protein per carbohydrates and fats can reduce and control sugar level in the blood of people with type 2 diabetes.

In addition, food with high can help reduce insulin resistance and may prevent or delay early symptom of heart disease and metabolic syndrome in type 2 diabetic patients with obesity. Rudchanok Klinkat, Sumalee Rachaniyom, Tassamon Namwong, Nongnaphat Rungnoei, Nittaya Thongma, (2018) also stated that patients with diabetes consume food that has appropriate ratio of protein, the body would be more responsive towards insulin, however it will not increase the concentration of sugar in their blood.

Besides protein, another nutrient source is Maltodextrin, which provides a type of carbohydrate nutrient called Polysaccharide. It provides energy, but has no taste, color, odor and is suitable for the elderly who need to receive carbohydrates for energy. This is consistent with Chawisa Kaewanun, (2018) whom stated that the amount of carbohydrates intake by the elderly people should be at 55% of the total energy. It should also be Polysaccharide which come brown rice, coarse rice, whole grains, whole wheat bread etc., rather than simple sugar. The comment corresponds to Nisarat Sook-Aim & Prassanee Tubbiyam, (2013) whom stated that Lau Hun guo contains Mogrosides, a nutrient in the Triterpene Glycosides group. It is a substance that can provide 300 times more sweetness than actual sugar, but it gives no energy with no affect towards insulin level in the blood. It can also help people with diabetes and prevent heart disease. Mogroside can prevent heart disease among patients with diabetes, by preventing oxidation reaction which is a reaction to burn

fat in the body. without affecting insulin level.

2. The satisfaction assessment towards this innovation found that the overall satisfaction level was at a high level. It can be explained as follows.

2.1 Product aspect – generally, the sample group found the product to be at highest level of satisfaction under the category of "Easily chewed and swallowed" and "Appropriate amount per one meal" followed by "Nice scent, appealing to consume", while the lowest is "Delicious taste".

2.2 Packaging aspect - Overall, the sample group gave highest level of satisfaction for "Prevent contact with liquid, dampness or oxygen", followed by "Durable and uneasy to tear apart". The lowest level is "Can be easily opened to consume".

The results from can be concluded that generally, the sample group was satisfied with this innovative product, with the focus on the ability to chew and swallow, at the highest level of satisfaction and the least attention towards product with delicious taste. palatability. The result is in line with Eungprasert, P., Sirisupalak, P. & Sanglestsawai, S. (2018) whom studied food attributes for elderly people in Bangkok area. It was found that the elderly gave priority to food attributes in terms of taste. The second priority is the difficulty of digestion. Softness of food and nutritional value. However, the satisfaction towards nutritious food which consist of necessary nutrients and does not affect the severity of the existing disease, it was found that the innovation has unfamiliar taste due to it being medical food, in which regular people may not consume regularly. causing unfamiliarity with the taste.

The successful development and high evaluation scores of the "Seven-Colored Jellies" underscore their potential as a nutritional intervention for elderly individuals with diabetes and hypertension. The innovation is both practical and effective, as supported by expert assessments.

Suggestions for the further study

1. Below are suggestions for the development of this innovation.

1.1 The selected packaging should open and be consumed easily.

1.2 Develop the products to have a variety of colors, scents and flavors.

1.3 Develop the Products that are suitable for people with different diseases.

2. Suggestions for future research

2.1 Assessment of Glycemic Control: Conduct studies to evaluate the impact of the jellies on blood glucose levels. Measure Capillary Fasting Blood Glucose before and after consumption to determine the effect on glycemic control and overall diabetes management.

2.2 Evaluation of Swallowing Difficulties: Focus future research on individuals with dysphagia or other swallowing difficulties. Assess the product's effectiveness in improving ease of swallowing and overall acceptance in this population.

2.3 Long-Term Health Outcomes: Investigate the long-term health effects of regular consumption of the jellies, including potential impacts on nutritional status, disease management, and overall quality of life.

2.4 Ingredient Optimization: Analyze the effectiveness of the current ingredients and explore alternative components if certain ingredients are found to be less effective. Optimize the formulation to enhance both nutritional benefits and sensory attributes.

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