

The study on development of easily chewable and swallowable foods for elderly

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BACKGROUND/OBJECTS: When the functions involved in the ingestion of food occurs failure, not only loss of enjoyment of eating, it will be faced with protein-energy malnutrition. Dysmasesis and difficulty of swallowing occurs in various diseases, but it may be a major cause of aging, and elderly people with authoring and dysmasesis and difficulty of swallowing in the aging society is expected to increase rapidly.

SUBJECTS/METHODS: In this study, we carried out a survey targeting nutritionists who work in elderly care facilities, and examined characteristics of offering of foods for elderly and the degree of demand of development of easily chewable and swallowable foods for the elderly who can crush foods and take that by their own tongues, and sometimes have difficulty in drinking water and tea.

RESULTS: In elderly care facilities, it was found to provide a finely chopped food or ground food that was ground with water in a blender for elderly with dysmasesis. Elderly satisfaction of provided foods is appeared overall low. Results of investigating the applicability of foods for elderly and the reflection will of menus, were showed the highest response rate in a gelification method in molecular gastronomic science technics, and results of investigating the frequent food of the elderly; representative menu of beef, pork, white fish, anchovies and spinach, were showed Korean barbecue beef, hot pepper paste stir fried pork, pan fried white fish, stir fried anchovy, seasoned spinach were the highest offer frequency.

CONCLUSIONS: This study will provide the fundamentals of the development of easily chewable and swallowable foods, gelification, for the elderly. The study will also illustrate that, in the elderly, food undergone gelification will reduce the risk of swallowing down to the wrong pipe and improve overall food preference.

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INTRODUCTION

Social and economic development has led to several qualitative change in the diet of the elderly, more than half of the elderly are exposed to the nutritional risk of malnutrition and risk group [1]. Nutritional status of the elderly is closely related to health, but there is a limitation of food selection and intake because of reduced physical function [2]. Reduction of masticatory function, which affects the chewing of food, can result in malnutrition and unbalanced diet [3,4]. Reduction of swallowing function, such as oral, pharynx and esophagus increase the risk of swallowing down the wrong pipe [5]. The fear of swallowing down the wrong pipe can cause reduced food and water intake, and thus may lead to malnutrition and water shortage [6]. As the elderly's physical function deteriorates, compared to the average population, the risk of malnutrition increases [7,8]. It is important to support the development and commercialization of a variety of products that complement the intake function for the elderly. However, that is lack of interest in food manufacturers for the aged in South Korea [9]. There

is an urgency to develop and supply of easily chewable and swallowable elderly foods products to maintain health and promote the nutrition of the elderly. The most ideal items are easily chewable and swallowable nutritious foods for elderly that reflect the physiological and preferential changes. However, in the forms of the food which can be consumed by the aged are limited. That is finely chopped food by a blender or ground food. It is make no fun meals by dropping the appetite [10]. In addition, finely chopped or ground goods by a blender, does not consider swallowing function of the elderly with dysmasesis. As such they increase the risk of swallowing down the wrong pipe [11]. Some people with dysmasesis reduce the intake of water and tea because they tend to swallow down the wrong pipe [12], therefore, it is important to carry out moisture control to treat not only the energy but also various nutrients, and to give a viscosity suitable to prevent dehydration. Today's molecular gastronomy science has attracted an interest of the gourmet, not only in Europe, one of the trend setters of the world's food service industry, but also around the world [13]. That was reported that, in the last five years, molecular

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gastronomy science has rapidly been gaining much recognition by the public in Ireland [14]. It was also reported that application of molecular gastronomic science in restaurants, enable the implementation of new ideas and recipes and indirectly raises the awareness of the role that food and nutrition play for better quality of life [15]. This study focused on possible applications of technics of molecular gastronomy in the development of easily chewable and swallowable foods for the elderly that are both flavorsome and nutritious. Therefore, in this study, we carried out a survey targeting nutritionists who work in elderly care facilities, and examined characteristics of offering of foods for elderly and the degree of demand of development of easily chewable and swallowable foods for the elderly who can crush foods and take that by their own tongues, and sometimes have difficulty in drinking water and tea.

SUBJECTS AND METHODS

Subjects

The elderly medical facilities of admission capacity 80 or more of nursing care facilities 150 locations of 760 sites that have been displayed on the current state of the Ministry of Health and Welfare's facility in 2012 for the purpose of this study was extracted by region (Seoul, Gyeonggi-do, Chungcheong-do, Jeollado, Gyeongsang-do and Gangwon-do). Survey has conducted through pre-phone and official documents for nutritionists who work in elderly care facilities, and we describes the purpose of the study, and requested the cooperation. Then ship the questionnaire by mail, and asked write down it themselves and return it. November 2012 to February 2013 to be distributed to a total of 150 institutions, was collected 102 questionnaires and used for statistical analysis and (return rate 68%).

Questionnaire configuration

Search for current situation of foods provide for elderly was constructed as follows: whether or not to apply the recognition of chewing and swallowing steps, taste of the strength of foods for elderly which was compared with general foods, elderly satisfaction of foods for elderly, improvements of foods for elderly provided. Research for the development of easily chewable and swallowable foods was constructed as follows: representative recipes of frequent food of the elderly, expected effects and applicabilities when applying molecular gastronomic science technics including gelification method in foods for elderly, and necessary items for applying molecular gastronomic science technics to foods for elderly.

The cooking process can be scientifically analyzed the material, the technic of molecular gastronomy science to create new flavor, there are following technics; gelification, densification, spherification, carbonating, foam abstract presentation, sous vide cooking and emulsification.

Statistical analysis

By using SPSS13.0 (Statistical Package for Social Science, SPSS Inc., Chicago, USA), collected data were performed statistical analysis, and were performed descriptive statistical analysis in order to investigate the current level of provision of foods for

elderly and development possibility and needs of new easily chewable and swallowable foods for elderly.

RESULTS

Perception and applicability of chewing and swallowing function

There is a recognition of chewing and swallowing steps and applicability of nutritionists as shown in the Table 1. Chewing and swallowing step of foods for elderly: Eating hard and large pieces of food is a little difficult, and is possible to relatively easily chewed, and may drinking normally (chewing and swallowing first step). Eating hard and greater pieces of food is possible to ingest by gums, sometimes there is a difficult to drink (chewing and swallowing second step). Not be able to ingest the food, if food size is not small and not smooth, but able to ingest and crush foods by tongue, sometimes there is a difficult to drink water and tea (chewing and swallowing third step). Not be able to ingest the food even if food size is small, there is a possible to ingest food without chewing and drinking water or tea is difficult (chewing and swallowing forth step). The result was investigated as follows respectively: know about first step 56.9%, know about second step 84.3%, know about third step 55.9%, know about forth step 73.5%. 55.9% of subjects who are aware about first step, 73.5% of subjects who are aware about second step, 55.9% of subjects who are aware about third step, 82.4% of subjects who are aware about forth step, replied that it has to offer the food of each stage. In elderly care facilities, it was found to provide mainly a finely chopped food or ground food that was ground with water in a blender for elderly with dysmasesis. The reason for providing a high frequency of second step is more likely to provide a softer cooked food and finely chopped food is determined. The reason for providing a high frequency of forth step is considered mainly provide a liquid food that went to the blender. However, food went to shredded food and finely chopped without the shape can become a factor that appetizing function for the elderly is insufficient to reduce the intake of food. The elderly prefer food that is shaped similar to the daily food, even if their abilities of chewing and swallowing functions lower, therefore, it must be always taken into account the fact that the appearance of food can be improved to preferences when develop new foods for elderly.

The biggest problem of food went shredded food and food finely chopped within a blender is consider only a reduced chewing function but physical properties that are not considered, therefore, for people with dysmasesis to increase the risk of swallowing down the wrong pipe [10]. Therefore, it is necessary to resolve preferences and safety quickly of food went shredded food and food finely chopped within a blender

Table 1. Perception and applicability of chewing and swallowing function (N = 102)

Variables	Perception N (%)	Applicability N (%)
Chewing and swallowing first step	58 (56.9)	57 (55.9)
Chewing and swallowing second step	86 (84.3)	75 (73.5)
Chewing and swallowing third step	57 (55.9)	57 (55.9)
Chewing and swallowing forth step	75 (73.5)	84 (82.4)

mainly provided in elderly care facilities. Research and development of easily chewable and swallowable foods for the elderly need to be able to substitute for this, is urgently needed.

Taste intensity of elderly meals compared to general meals

Strength of the taste of foods for elderly that are provided in the elderly care facility is as shown in the Table 2. As the aged enjoy plain taste, plainness was contained in questionnaire in order to develop flavorsome food manufactures for the aged. Set the degree of each intensity of sweetness, saltiness, spiciness, sourness, lightness of general diet for adults into 3, in comparison, study shows that the strength of the taste of foods for elderly as follows, sweetness 2.36, saltiness 1.97, spiciness 1.59, sourness 1.79 and plainness(not rich) 2.75. Salty, spicy, sour and sweet are generally provided weaker than general foods, light taste was found to have been provided as well as general foods. The result of the study, the function of taste and smell were conducted to examine the changes in taste functions of elderly depending on the aging [16-22], threshold of sweet and salty of the elderly was higher than young adults, threshold of sour compared to young adults was lower. Result of this study, sweet and salty than general foods were low, so this did not reflect the threshold level and preferences of the elderly, besides, it reduces the desire of the intake of food, and determined to be one of the factors to increase the rate of food from market and leftovers. Therefore, developing easily chewable and swallowable foods for elderly may increase the dietary intake that reflecting not only nutrition of the elderly and the taste.

Satisfaction and improvements needed for the elderly meals

We were asked to respond to the elderly of satisfaction of foods that are provided in the elderly care facility to target the nutritionist in response to the leftovers rate. For each items were to be evaluated by five point scale: very satisfied, satisfied, unsure, dissatisfied, very dissatisfied (1 point for very dissatisfied and 5 points for very satisfied).

The results of the survey, 2.37 points are very satisfied, 3.45 points are satisfied, 4.21 points are usual, 1.35 points are dissatisfied, the satisfaction level of foods for the elderly being provided was generally lower. Satisfaction of foods of the elderly affects dietary intake, and the health of the elderly is affected most by nutrition state. Therefore, it is considered to be necessary to develop easily chewable and swallowable foods for the elderly, which can accelerate preferences of the elderly.

The results of the survey of points to be improved for foods

Table 2. Improvements needed for elderly meals

Variables	Mean ± SD
Cooking convenience	4.74 ± 2.06 ¹⁾
Consumption convenience	4.27 ± 1.89
Texture improvement	4.13 ± 1.90
Taste improvement	4.09 ± 1.92
Presentation improvement	3.93 ± 2.22
Safety improvement	3.44 ± 2.01
Nutrition improvement	3.44 ± 1.81

¹⁾ 1(not necessary)-5(very necessary)

for the elderly that are provided in the elderly care facilities are as shown in Table 2. Improving convenience of cooking, improving consumption convenience, improving texture, improving taste, improving presentation, improving safety, improving nutrition in order of mention, demanding for improving convenience of cooking and texture were found to be highest.

Types of dishes made with ingredients consumed in high frequency by elderly

Protein, dietary fiber and calcium is a scarce nutrients in the elderly [23,24], consequently, ingredients which can provide calcium, protein and dietary food were chosen to produce easily chewable and swallowable foods for elderly. By reference to year 2010 of the National Health Statistics for 65-year-old or more of the food intake frequency questionnaire [25], we selected beef, pork and white fish in category of meat and beef of the sources of food protein supply food. And we selected halibut in category of white fish that is often used to meals, and the sources of calcium food, anchovy is selected that intake frequency is high, and the expression fiber sources food, spinach has been selected that has high intake frequency as the material of easily chewing and swallowing food for the elderly. Survey results about beef, pork, white fish and anchovy are multi-frequency foods for the elderly on representative menu of anchovy as shown on Table 3. Beef was investigated the provision of Korean barbecue beef (61.8%) and beef boiled in soy sauce (50%) often. As shown, we have found that often provided of hot pepper paste stir-fried pork and pork stew, and preference for foods with a wet recipe was high such as food boiled down in soy sauce, boiled dish and poaching. Fatty food acts as a major cause of eating habits that cause chronic disease in the elderly, we can be considered to have a high preference of wet recipes to cook meat. White fish showed similar results

Table 3. Types of dishes made with ingredients consumed in high frequency by elderly (N = 102)

Main ingredient	Menu	N (%) ¹⁾
Beef	Korean barbecue beef	63 (61.8)
	Beef soup	54 (52.9)
	Beef boiled in soy sauce	51 (50.0)
	Beef steak	20 (19.6)
	Skewered beef	19 (10.8)
Pork	Hot pepper paste stir-fried pork	72 (70.6)
	Pork stew	52 (51.0)
	Pan-fried pork	45 (44.1)
	Boiled pork	31 (30.1)
	Sweet and sour pork	19 (18.6)
White flesh fish	Pan-fried white flesh fish	87 (85.3)
	White flesh fish boiled with seasonings	50 (49.0)
	White flesh fish stew	26 (25.5)
	Pan-fried white flesh fish	17 (16.7)
Anchovy	Deep fried white flesh fish	17 (16.7)
	Stir-fried anchovy	68 (66.7)
Spinach	Anchovy added to soup	39 (38.2)
	Seasoned spinach	94 (92.2)
	Spinach soup	35 (56.6)

¹⁾ Multiple responses: N = 102

Table 4. Expected effects of molecular gastronomy in elderly meals

Variables	Mean \pm SD
Provision of convenient foods consumption	4.82 \pm 0.70 ¹⁾
Provision of enjoyment in presentation of foods	4.57 \pm 0.80
Easy mixture of ingredients	4.43 \pm 0.93
Provision of foods with new texture	4.22 \pm 1.09

¹⁾ 1(not necessary)-5(very necessary)

as the preceding research found pan-fried white flesh fish and White flesh fish boiled with seasonings provides often [2]. Anchovies showed facilities provide stir fried anchovies most often. Chewing and swallowing function of the elderly are lowered in the case of anchovy is not easy to eat, for that reason anchovies are not provided as a side dish in some elderly care facilities. In view of the chewing and swallowing function in the elderly, it was possible to know that it is necessary to develop anchovy food that is easy to ingest for the elderly. Spinach has been investigated that the highest offer of Seasoned spinach it showed similar result as menu preferences survey of the elderly [26].

Expected effects of molecular gastronomy in elderly meals

Survey of promising effect when applying technics of molecular gastronomy science including gelification for foods for the elderly, those results are shown in Table 4. Items that showed the highest response in the effect to be expected when applying technics of molecular gastronomy science including gelification, is Provision of convenient foods consumption. In intake We were found to be highly convenient for demanding. The results of the study, all of the items, and therefore showed an overall high score, it was found that the expected effect of technics of molecular gastronomic science applications for foods for the elderly is high.

Applicability of foods for the elderly by each molecular gastronomy science

Molecular gastronomy science technic including gelification is whether applicable to foods for the elderly survey results are as shown. After describe carbonating, foam abstract presentation, spherification, gelification and densification to the nutritionist for dense method densification, we was researched whether can be expected to improve the preference when each technic has been applied to foods for the elderly. They answered in the order of gelification (95.1%), spherificacion (74.5%), densification (72.5%), carbonating (33.3%) and foam abstract presentation (31.4%). It was the highest degree to expect improvement of preference when you apply gelification to foods for the elderly. Survey results for the menu of applying the molecular gastronomy science technic including reflecting gelification to foods for the elderly are as shown. In the order of gelificacion (89.2%), densification (73.5%), spherification (63.7%), foam abstract presentation (30.4%) and carbonation (24.5%) had the highest degree of reflection of the menu to which is applied gelification. As a result of investigating reflect the will of the menu to which molecular gastronomy science technic including applicability of foods for the elderly of molecular gastronomic science technic including gelification

Table 5. Improvements needed for introduction of molecular gastronomy in elderly meals

Variables	Mean \pm SD
Education for dietitian and chef	4.73 \pm 1.37 ¹⁾
Distribution of standardized recipe	4.32 \pm 1.21
Convenience of ingredient purchase	3.91 \pm 1.31
Procuring cooking equipment	3.80 \pm 1.36

¹⁾ 1(not necessary)-5(very necessary)

approach, among all the gelification, it showed the highest response rate. Gelification is easy to mix the various materials, and physical properties of gelification is determined to be suitable, because foods for the elderly experiencing difficulties in chewing and swallowing.

Improvements needed for introduction of molecular gastronomy in elderly meals

The research results are required for introducing molecular gastronomy science technic including gelification to foods for the elderly are as shown in Table 5. And in order of education for dietitian and chef on molecular gastronomy science technic (4.73), the Distribution of standardized recipe (4.32), convenience of the ingredient purchasing (3.91) and procuring cooking equipments (3.80) are investigated, therefore, developing new foods for the elderly, also education for nutritionist and chef and standardized recipes of molecular gastronomy science is determined to be necessary. Because it is the state that menus and standardized recipes for the current for the elderly is insufficient, developing new easily chewing and swallowing foods for the elderly, education for nutritionists and cooks and education and spreading standard recipes, those are what we considered must precede.

DISCUSSION

In this study, we conducted a survey of nutritionists who work in elderly care facilities trying to develop easily chewing and swallowing foods for the elderly are not crushed. Also, we were trying to find possibilities of developing easily chewing and swallowing foods for the elderly who can crush foods by tongue and ingest foods, but sometimes they feel difficult to drink water and tea. Foods for the elderly that is provided in the facility; such as food in the form of liquid food that was ground with some water in a blender or minced form [27].

Degree of salty, spicy, sour, sweet of foods for the elderly had been provided weaker than general food, and the elderly satisfaction of foods for the elderly to subject nutritionists were surveyed that was overall lower.

Effects that can be expected, by applying molecular gastronomy science technic including gelification: in the order of providing a convenient food to be ingested, providing a visual enjoyment, mixing easy material and providing a food bit different texture. The result of investigating the will to reflect applicability of foods for the elderly and menus, showed the highest response rate among all gelification. Results on representative menu of beef, pork, white fish, anchovy and spinach that can provides scarce protein, calcium and dietary fiber in

the elderly, the frequency of providing Bulgogi (sliced and seasoned barbecued beef), Gochujang Jeyuk Bokkeum (stir-fried spicy pork), Gui (roasted food), Jorim (boiled down in soy sauce) and Namul (seasoned vegetables) were found to be the highest respectively.

For responding to demand an increase in foods for the elderly due to the arrival of the aging society, in the food industry, actively must be efforts to supply of developing a variety of products easily chewing and swallowing foods for the elderly, and it is necessary to provide a certain quality of food to satisfy the three conditions of nutrition, safety and preference [28]. Food industry keep always in mind not only nutrition and safety but also food appearance are important components, and must continue the research on the development of materials suitable for easily chewing and swallowing foods for the elderly.

However, it is the actual situation of the necessary support of the government for the construction of the system established for this, because the food physical properties criteria, display method and standards may change due to the manufacturer's conditions, In order to establish the food properties and preference suitable for easily chewing and swallowing foods for the elderly, by carrying a functional test of the elderly subject, it is necessary to extend the study on the relationship between the physical state and properties. It is necessary to provide the appropriate properties indices depending on the status of the physical properties measured by the device as a functional test and physical properties by the accumulated experience in the medical field.

In response to demand of easily chewing and swallowing foods for the elderly, it has to be delicious, safe and fun meals, reflecting the physiological changes and preference in the elderly and development of easily chewing and swallowing foods for the elderly considering physical properties, be in the super-aged society in the future, is a problem which must always be accompanied.

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