

**Original****Effects of Thinly Sliced Meat on Time, Number of Chews, and Food Intake in Elderly People with Tooth Loss**

Hien Ngo Thi Thu<sup>1</sup>, Ngoc Ta Thi<sup>1</sup>, Yen Ma Ngoc<sup>2</sup>, Phuong Nguyen Mai<sup>1</sup>, Thao Tran Phuong<sup>1</sup>, Thu Truong Thi<sup>3</sup>, Hang Dinh Thi Dieu<sup>3</sup>, Linh Nguyen Thuy<sup>2</sup>, Khan Nguyen Cong<sup>3</sup> Yoshihiro Tanaka<sup>4</sup>, Shigeru Yamamoto<sup>1</sup>

<sup>1</sup>*International Nutrition, Graduate School of Human Life Science, Jumonji University, Saitama 352-8510, Japan,*

<sup>2</sup>*Hanoi Medical University Hospital, Hanoi, Vietnam*

<sup>3</sup>*Haiduong Medical Technical University, Haiduong, Vietnam*

<sup>4</sup>*Nantsune Co, Osaka, Japan*

**ABSTRACT** *Background:* The loss of teeth in elderly people reduces their chewing ability and leads to a decrease in food intake, including meat. In Vietnam, meat is a common source of protein; most people maintain the habit of buying meat in large pieces from traditional markets and then slicing it at home with a knife. However, the thickness of meat sliced by hand is usually 3-5mm; the slices are large and irregular so they are difficult for the elderly to chew. In Japan, which has the highest proportion of elderly and the longest healthy life expectancy in the world, people generally use pre-sliced meat instead of block meat. By using a meat slicer, we can get pieces of meat of the same size, with a thickness of only 1.5mm (depending on the adjustment to the slicer). *Purpose:* To examine the effect of using thinly sliced meat compared with meat sliced by hand on time of chewing and the number of chews and food intake in older adults who have lost teeth. *Methods:* We conducted an intervention study following a cross-over design on 38 elderly subjects. After evaluating sensory characteristics and recording the time and number of chews between 2 samples of meat (thinly sliced meat and hand-cut meat), they were randomly divided into groups A and B; each group had 19 subjects. We provided subjects all the foods that they ate with either diet, using thinly sliced meat or hand-cut meat (cooked in the same way and with the same quantity) for 1 week. After a week washout, the diet was reversed. The subjects did not eat anything apart from the diets that they were served. The diets were weighed before and after eating and then the amount of food consumed was calculated. *Results:* The thinly sliced meat took less over-all time for chewing and fewer chews than the hand-cut meat (same quantity). To chew 3g of thinly sliced meat, subjects took  $53 \pm 22$  times and  $47 \pm 23$  seconds while to chew the same quantity of hand-cut meat needed  $73 \pm 35$  times and  $65 \pm 33$  seconds, both ( $p < 0.05$ ). When subjects consumed the Thinly sliced meat diet, energy, protein, lipid intakes were higher than with the Hand-cut meat diet in both moderate dentition subjects (21-27 teeth) and poor dentition subjects (20 teeth or less), and the differences were statistically significant ( $p < 0.05$ ). The average scores of the sensory test for thinly sliced meat samples were higher than for sliced by hand samples in terms of taste, tenderness, and overall acceptability ( $p < 0.05$ ). *Conclusions:* Thinly sliced meat was easier to chew and favored over meat sliced by hand in the elderly who have lost teeth.

**Keywords:** food intake, elderly people, lost teeth, thinly sliced meat

**INTRODUCTION**

The Vietnamese aging population is increasing rapidly. According to the United Nations Population Fund and General Statistic Office, the proportion of

the population aged 65 and over will increase from 7.1% in 2014 to 18.1% in 2049(1). Elderly people have many health problems, among which tooth loss has become an issue of concern in the Vietnamese elderly. Although the prevalence of complete tooth loss has declined over the last decade, edentulism remains a

\*To whom correspondence should be addressed:  
hienmeo1110@gmail.com

major disease worldwide, especially among older adults (2). According to Nguyen Thuy Nga and Truong Manh Dung (2017), the overall rate of tooth loss in elderly people in Hanoi in 2017 was very high (80.7%)(3). Another study showed that 27.8% of 258 elderly people aged 65-74 years in Danang often had difficulty chewing foods (4).

It is necessary to provide soft diets in hospitals and nursing homes, where the majority of elderly people have difficulty in chewing due to tooth loss. Most elderly patients commonly avoid hard foods and are provided soft and light meals like porridge, noodles, and soup, which are usually cooked with meat, particularly pork and beef. These types of meat are common sources of protein in Vietnam and are frequently present in daily meals.

However, meat sliced by hand is usually thick (3-5mm), large, and irregular in size, which causes the elderly to have some difficulties in chewing. Therefore, soft meals in Vietnam lack variety and are repetitive because of the use of finely chopped meat. This increases the feeling of anorexia. Consequently, this situation has a negative effect on nutritional status in such patients in the present and will have in the future.

In this regard, thinly sliced meat could be a feasible solution. It is a type of meat which is cut by machine, very thin (1.5mm), against the grain, so it is easy to chew and is especially suitable for the elderly with tooth loss. Sliced meat can be used daily, prepared in various ways and combined with a variety of foods, increasing the nutritional value of the dishes. Not only is this a solution for hospitals in the nutritional care of the elderly, but patients can also learn recipes using sliced meat so they can prepare their own meals at home. We expect that using sliced meat is more beneficial than the currently used hand-cut meat in helping elderly patients improve their daily meals, increase their food intake, and finally improve their quality of life through their diet.

Therefore, we decided to conduct a study “Using thinly sliced meat to improve the time, number of chews and food intake in elderly people with edentulism” with the purpose of determining whether sliced meat can improve taste and appetite for elderly people with tooth loss problems by increasing variety in their diet.

## METHOD

**Subjects:** Elderly patients ( $\geq 65$  years old) who were classified with moderate dentition (21-27 teeth) or poor dentition (20 teeth or less) by the number of remaining teeth (excluding the third molar) from the Geriatric Department, Internal Medicine Department, and Traditional Medicine Department at Dong Da General Hospital were screened. Patients with mental disorders, confusion and those with contraindications to oral nutrition or being fed by tube were not included in our study. We used the Water Swallow Test (WST) to exclude patients with

dysphagia. After screening, a total of 38 elderly patients who met the inclusive criteria were selected.

**Sensory evaluation:** To prepare for evaluation, the subjects were not hungry, had not consumed food or chewed gum within 1 hour, had not consumed liquids except water within  $\frac{1}{2}$  hour, were not wearing perfume, had not brushed their teeth within 1 hour, had not smoked within 1 hour, and were not wearing lipstick. The evaluation area was separate from the food preparation area, free of extraneous odors, with minimal noise level and no communication, visual or oral, between panelists during sensory evalution. The subjects received 2 meat samples for comparison; one was 50g boiled thinly sliced meat (thickness 1.5mm) and the other was 50g boiled hand-cut meat (thickness 3-5mm). The subjects observed, smelled, and tasted them, and then used a Hedonic 9-point scale to score the characteristics of the two samples on color, aroma, taste, softness and overall acceptability.

**Time and number of chews:** After the sensory test, the subjects ate the same quantity (3g) of each meat sample. This process was recorded by camera. Then researches watched that and counted the over-all time for chewing and number of chews before swallowing.

**Intervention study:** We conducted an intervention study following a cross-over design. After assessing the nutritional status of subjects by Mini Nutrional Assessment Tool (MNA), they were randomly divided into groups A and B; each group had 19 people. We provided subjects all the foods that they eat with either diet, one using thinly sliced meat and one using hand-cut meat (cooked in the same way and with the same quantity) for 1 week. After a week washout, the diet was reversed. The subjects did not eat anything apart from the diets that they were served. The diets were designed to meet the nutritional recommendations of the National Institute of Nutrition (NIN) for the elderly in Vietnam. We made the three-day cycle menus from Vietnamese traditional dishes which are commonly served at home meals. They combined a variety of locally available ingredients, also including protein-rich foods other than meat such as fish, shrimp and tofu; there was always at least one dish using meat. The two diets used the same ingredients and quantities, were cooked in the same way by the same chef, and were different only in the kind of meat they used. Despite being cut the same size, the thickness of the two types of meat was different, the Thinly sliced meat with a thickness of 1.5mm, the Hand-cut meat with a thickness 3-5mm. Snacks were provided in mid-morning and afternoon with lactose-free milk and fruits. The diets were weighed before and after eating and then the amount of food consumed was calculated. The ratio of raw and cooked food was converted according to the coefficient of NIN [5]. Energy and nutrient intakes were calculated based on the Vietnamese Food Composition Table 2016 [6].

**Meat for study:** The pork and beef used in this study were produced in Vietnam. After being frozen under the same conditions, half of the meat was sliced thinly by a meat cutter with a thickness of 1.5mm, the other half was sliced by hand after defrosting. Both kinds of meat were defrosted in a refrigerator at 5°C or lower before cooking.

**Ethics of human subject participation:** The study received permission from the ethical committee at Hanoi Medical University, Vietnam. All subjects were informed in detail about the purpose, the

advantages and disadvantages of this study, and their rights and obligations. Informed consent was obtained from all the participants.

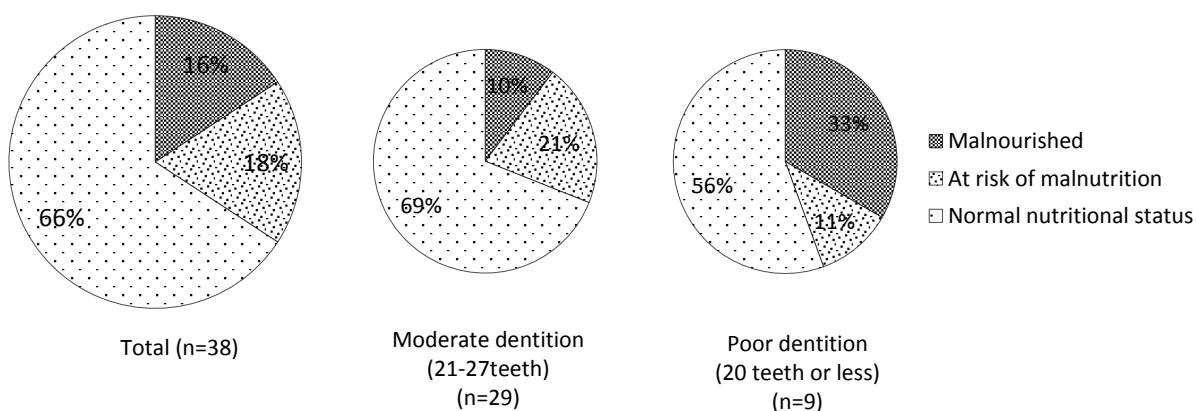
**Statistical methods:** Data were analyzed by using STATA version 14. Values are reported as means  $\pm$  standard deviations (SD). Quantitative variables (energy and nutrient intake between 2 diets) were checked for distribution and compared by the Wilcoxon signed-rank test, *p*-values of less than 0.05 were considered statistically significant.



**Photograph 1.** Slicer and thinly sliced meat (left) and hand cut meat (right)

**Table 1. General characteristics of subjects**

	Classification	Number (n=38)	Percent (%)
Gender	Male	12	31.6
	Female	26	68.4
Age	Mean age (Mean $\pm$ SD)	73.8 $\pm$ 6.7	
	65-79 years old	29	76.3
Dentition	$\geq$ 80 years old	9	23.7
	Moderate dentition (21-27 teeth)	29	76.3
	Poor dentition (20 teeth or less)	9	23.7



**Figure 1. Nutritional status assessment based on MNA tool**

## RESULTS

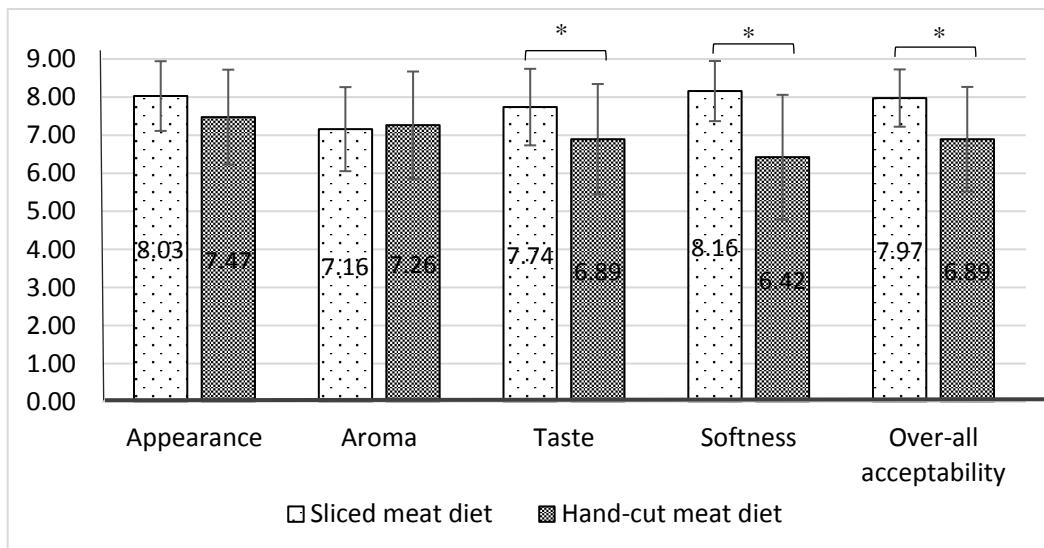
Table 1 shows the general information on study subjects (including gender, age and dentition). Data consisted of 38 subjects; 12 subjects (31.6%) were male while 26 subjects (68.4%) were female. The average age was  $73.8 \pm 6.7$  years old. There were 76.3% (*n*=29) patients aged 65 – 79 years old and 23.7% (*n*=9) aged 80 and over. There were 76.3% of

total patients who were classified with moderate dentition (the number of remaining teeth was 21-27 teeth), equivalent to 29 patients; 8 patients were in the poor dentition group (20 teeth or less), accounting for 23.7% of the total. Of the total of 38, subjects with normal nutritional status were highest, at about 66%; the percentage of patients with at risk

malnutrition was 18% while the figure for malnourished was lowest, at 16% (Fig. 1). The proportion of patients with normal nutritional status in the Moderate dentition group was higher than in the poor dentition group, 69% compared with 56%. There were 10% malnourished patients in the moderate dentition group while 1/3 patients in the poor dentition group were malnourished.

**Sensory evaluation:** Fig. 2 shows average points for characteristics of sensory evaluation. The mean

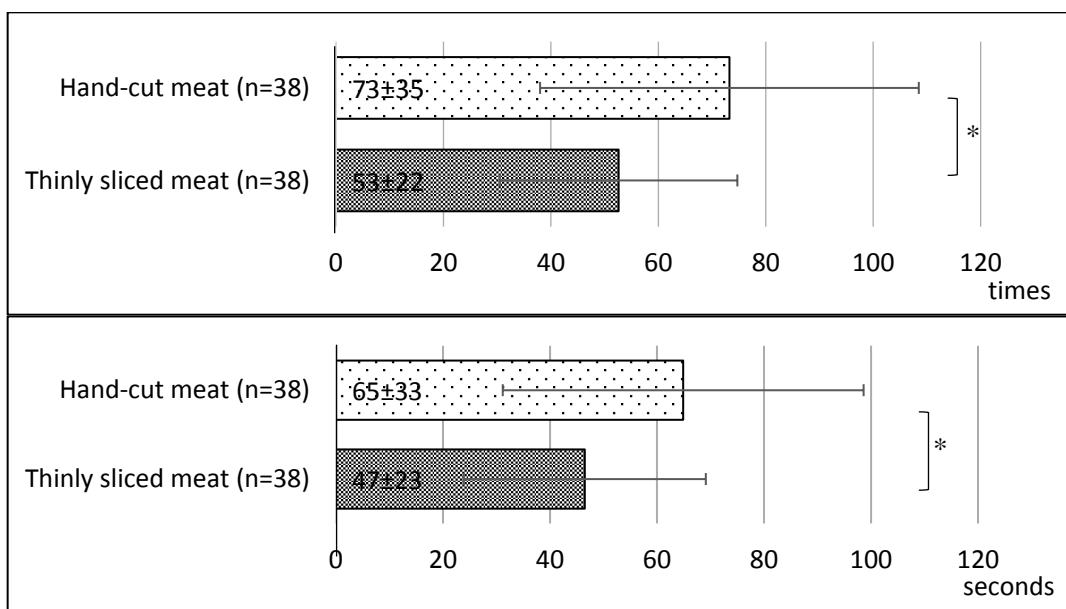
scores for the thinly sliced meat sample were higher than for the hand-cut meat sample in appearance, taste, softness and over-all acceptability in which taste, softness and over-all acceptability are statistically significant ( $p<0.05$ ). The mean scores for the Hand-cut meat samples were higher than the mean points for the Thinly sliced meat samples only for aroma; however the differences are not statistically significant ( $p>0.05$ ).



**Figure 2. Average of points for characteristics of sensory evaluation (n=38)**  
(\*:  $p<0.05$ , by Wilcoxon signed – rank test)

To chew 3g of thinly sliced meat, subjects needed  $53 \pm 22$  times and  $47 \pm 23$  seconds while to chew hand-cut meat of the same weight took  $73 \pm 35$  times

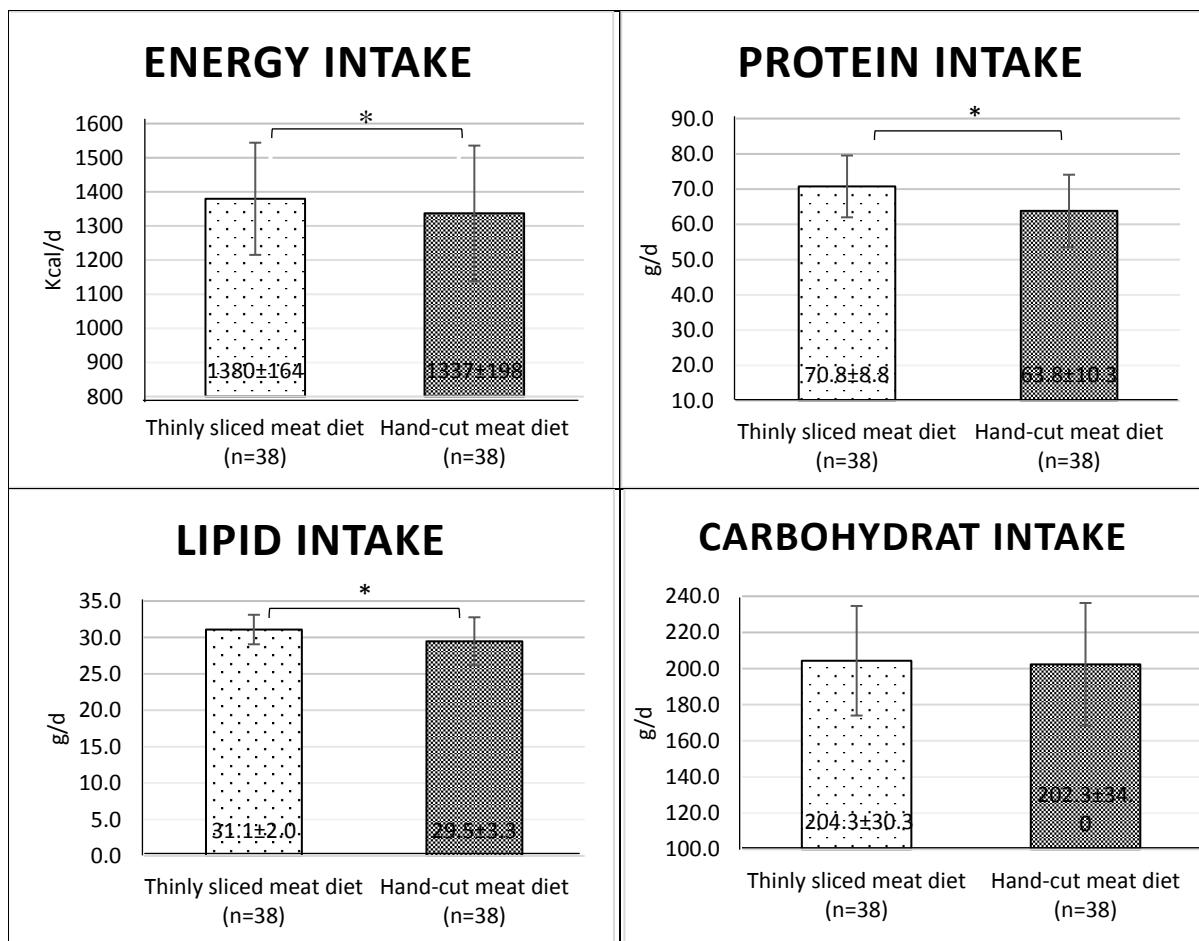
and  $65 \pm 33$  seconds (Fig.3). Both indicators were statistically significantly different ( $p<0.05$ ).



**Figure 3. The time and number of times to chew the same weight (3g)**  
(\*:  $p<0.05$ , by Wilcoxon signed – rank test)

Fig. 4 shows energy and nutrient intakes for diets using thinly sliced meat and diet using hand-cut meat. The results from the 38 subjects indicate that the mean energy, protein, lipid intakes for the sliced meat diet were higher than for the hand-cut meat diet. Values from the Sliced meat diet were  $1380 \pm 164$  kcal/day,  $70.8 \pm 8.8$ g protein per day,  $31.1 \pm 2.0$ g lipid per day, compared with  $1337 \pm 198$  kcal/day,  $63.8 \pm 10.3$ g protein per day,  $29.5 \pm 3.3$ g lipid per day. And the differences are statistically significant for mean

energy, protein, and lipid between the 2 diets ( $p<0.05$ ). The mean carbohydrate is the same for both diets with no statistical significance ( $p>0.05$ )  $204.3 \pm 30.3$  g in the Thinly sliced meat diet and  $202.3 \pm 34.0$ g in the Hand-cut meat diet. For all energy, protein, lipid and carbohydrate intakes, the distribution of data from the Hand-cut meat diet is scattered, from low to high values. While in for data in the thinly sliced meat diet, the distribution of data is concentrated at high values.



**Figure 4.** The energy and nutrient intakes for diets using thinly sliced meat and diet using hand-cut meat (\*:  $p<0.05$ , by Wilcoxon signed – rank test)

**Table 2.** The energy, nutrient and amount of meat intake by dentition

	Moderate dentition (21-27 teeth) n=29		Poor dentition (20 teeth or less) n=9	
	Sliced meat diet	Hand-cut meat diet	Sliced meat diet	Hand-cut meat diet
Energy (kcal/d)	$1400 \pm 154$	$1368 \pm 185$	$1352 \pm 185$	$1218 \pm 219$
Protein (g/d)	$72.7 \pm 7.5$	$66.0 \pm 9.1^*$	$66.6 \pm 10.2$	$55.7 \pm 11.0^*$
Protein from meat (g/d)	$29.4 \pm 4.0$	$26.5 \pm 5.9^*$	$26.2 \pm 3.7$	$20.4 \pm 7.2^*$
Protein/ kg BW (g/kg/d)	$1.36 \pm 0.26$	$1.24 \pm 0.28^*$	$1.26 \pm 0.28$	$1.13 \pm 0.36$
Lipid (g/d)	$31.5 \pm 1.9$	$30.0 \pm 2.0^*$	$29.8 \pm 2.0$	$27.6 \pm 3.8^*$
Carbohydrate (g/d)	$207.2 \pm 29.3$	$206.3 \pm 31.9$	$194.9 \pm 33.3$	$189.5 \pm 39.1$
Fiber (g/d)	$9.5 \pm 1.1$	$9.0 \pm 1.6$	$7.8 \pm 1.5$	$8.1 \pm 1.9$
Meat intake (g/d)	$149.3 \pm 20.1$	$133.7 \pm 30.0^*$	$132.8 \pm 18.1$	$103.5 \pm 36.5^*$

\*:  $p<0.05$ , by Wilcoxon signed – rank test

Table 2 shows energy, nutrient and amount of meat intakes by dentition. The mean energy, protein, lipid intakes in the Thinly sliced meat diet were higher than in the Hand-cut meat diet in both the moderate dentition group and the poor dentition group. The results indicate that the mean amount of meat intake for the thinly sliced meat diet was higher than from for the hand-cut meat diet both in the Moderate dentition group and in the Poor dentition group. Subjects in the Moderate dentition group consumed  $72.7 \pm 7.5$ g protein per day and  $1.36 \pm 0.26$  g protein /kg per day in the Sliced meat diet while the Hand-cut meat was lower  $66.0 \pm 9.1$ g protein per day and  $1.24 \pm 0.28$  g protein/kg per day.

Subjects in the Poor dentition group had a protein intake per kg lower  $66.6 \pm 10.2$ g protein per day and  $1.26 \pm 0.28$  protein/kg per day with the sliced meat diet compared with  $55.7 \pm 11.0$ g protein per day and  $1.13 \pm 0.36$ g protein/kg per day in the Hand-cut meat diet. Protein/kg BW, protein from meat and amount of meat intakes are statistically significant between the 2 diets ( $p<0.05$ ).

## DISCUSSION

We found in this study that thinly sliced meat is easier to chew and is favored over meat sliced by hand in the elderly who have lost teeth. These findings suggest positive effects of thinly sliced meat on the time, number of chews and food intake in older adults who have difficulty in chewing from having lost teeth.

It was surprising that from the sensory test the subjects liked the sliced meat better than hand-cut meat with the overall taste score for the sliced meat 7.97 and that for hand-cut meat 6.89 ( $p<0.05$ ). The better acceptability was mainly not only because of softness but also better taste (score of sliced meat 8.16 and 7.74, that of hand cut meat 6.42 and 6.89 ( $p<0.05$ ). The results from this sensory evaluation showed that thinly sliced meat samples were rated higher than hand-cut meat samples in color, taste, softness, and over-all acceptability in the elderly people who have lost teeth. Sliced meat is thin, the uniform size and shape make them more eye-catching. When cooking, the meat pieces are evenly cooked so they are better. The use of manual slicing knives does not guarantee the uniformity of the pieces resulting in a dish that is less eye-catching and unevenly cooked. Easier chewing has affected to the elderly subjects who have difficulty in chewing due to tooth loss; this can improve their taste and appetite.

By using a meat slicer we can obtain pieces of meat with a thickness only 1.5mm so it is easy to chew and they are especially suitable for the elderly with lost teeth. This is shown by the time and number of chews. To eat one piece of thinly sliced meat (3g), subjects took less time and fewer chews than the hand-cut meat piece of the same weight ( $53 \pm 22$  times and  $47 \pm 23$  seconds compare with  $73 \pm 35$  times and  $65 \pm 33$  seconds). Both the chewing time and number of

chews were statistically significant for the two samples ( $p<0.05$ ).

The use of thinner meat (although the same size) makes it easier for older people to chew and eat better; the subjects can eat more meat without too much difficulty, thereby significantly improving energy, protein, and lipids intake. According to the recommendation from NIN (7) protein needs for healthy elderly people are 60-70 g/d. However this was the recommendation for normal elderly who are living in their community. For the elderly research subjects who were being treated in hospitals, we used ESPEN guidelines on clinical nutrition and hydration in geriatrics (8) as a standard of control. According to ESPEN, protein intake in older persons should be at least 1 g protein per kg body weight per day. Daily amounts of 1.2-1.5 g/kg have been suggested for older persons with acute or chronic illness and up to 2.0 g/kg body weight per day in case of severe illness, injury or malnutrition (9). In our study, whether eating a Thinly sliced meat diet or a Hand-cut meat diet, subjects with moderate dentition achieved the recommended protein level. However, for those who with poor dentition, when eating the Hand-cut meat diet, it was not possible to reach this level of recommendation (they only consumed  $55.7 \pm 11.0$ g/d equivalent to  $1.13 \pm 0.36$ g/kg/d). These results were consistent with the National Health and Nutrition Examination Survey during 2005–2008, which were conducted on 9140 American adults and showed that participants in the poor dentition group had significantly lower energy intake than those with moderate dentition ( $P < 0.05$ )(10). In both groups, when eating thinly sliced meat, protein intake was higher than with the hand-cut meat diet (the difference was statistically significant). This is an outstanding benefit when using thinly sliced meat (thickness 1.5mm) instead of hand-cut meat (thickness 3-5mm) in the diet for elderly subjects with lost teeth. Based on Figure 4, we can see not only the average but also the data distribution of the energy, protein, lipid and carbohydrate intakes when subjects ate Thinly sliced meat diet and the Hand-cut meat diet. While for the diet using sliced meat, the distribution data was concentrated in the higher part of the graph, in the diet using Hand-cut meat, the data were scattered, and there were even many values at the very low end of the figure.

The mean carbohydrate was the same for both diets and was not statistically significant ( $p>0.05$ ). This can be explained by the traditional diet of Vietnamese people. The main source of carbohydrates comes from rice, which is often cooked separately, seldom in combination with other ingredients when cooking. So, consumption of rice or carbohydrates is almost constant at every meal. Some of the subjects in our study had a history of diabetes for many years (they had received instruction on nutrition for diabetics before), so they controlled their own diet (limiting their foods rich in carbohydrate intake) by themselves. Therefore, the amount of energy intake

from carbohydrates in the subjects in our study accounts for only about 50% of the total energy intake.

In this study, the meals were prepared and weighed before being given to the subjects. After they had eaten, we weighted the food remaining and calculated the amount of food intake. During the study, subjects were not allowed to eat anything apart from diets that were prepared. This helps us to accurately control the amount of food and nutrients intake by the subject and reduce recall errors or errors from images.

There are studies that have provided evidence of an association between poor nutritional status and prolonged hospital stay, decreased quality of life, and increased morbidity and mortality (11). Better chewing ability of the elderly leads to better nutritional status and quality of life, as has been demonstrated through previous studies (12, 13). Chewing ability is closely correlated with the number of natural teeth present: there is a threshold of 20–21 teeth, below which chewing ability declines (14, 15). Our results were consistent with this view. There were only 10% malnourished patients in the moderate dentition group while 1/3 of subjects in the poor dentition group were malnourished. From results of this study, using thinly sliced meat improved the energy and nutrients intake and it also was expected to improve the nutritional status in the elderly. Our study was conducted with only 38 subjects and has not yet assessed the long-term effects of sliced meat on improving the nutritional status of subjects. However, while there are these limitations, still results of the present study are an important first step for further studies with longer duration and on a larger number of subjects, not only the elderly in a hospital but also the elderly living in the community.

In conclusion, thinly sliced meat is easier to chew and preferred to meat sliced by hand for the elderly who have lost teeth. Using thinly sliced meat improved the energy and nutrients intake in older adult who have difficulty in chewing (the difference is statistically significant). From these findings, besides minced meat, thinly sliced meat can become an optimal choice for elderly people who have lost teeth and are having difficulty chewing thick pieces of meat to diversify their meals. We expect the diets for elderly people who have lost teeth in Vietnam could have more variety and improve their daily meals, thus increasing their food intake and finally improving their quality of life through their diet.

### CONFLICT OF INTERESTS

The authors declare no conflict of interests regarding the publication of this article.

### ACKNOWLEDGMENTS

The authors are grateful to all participants and the staff members of the Dongda General Hospital, Hanoi,

and Nutritional senior students at Hanoi Medical University for collaborating in the study. This study was supported by Jumonji University. We would like to thank Andrew R. Durkin, Professor Emeritus of Indiana University, Bloomington, IN, USA, for his careful editing of the English of this article.

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