



## Research on the Combination of Commercially Available Thickeners and Nutritional Supplemental Drink -Aiming At the Care Food That Can Be Done In the General Family-

Shoko Kondo<sup>1</sup>, Megumi Oohashi<sup>1</sup>, Naomi Katayama<sup>2,3\*</sup>

<sup>1</sup>Watanabe Hospital, Noma, Aichi, Japan

<sup>2</sup>Nagoya Women's University, Nagoya City, 4678610, Japan

<sup>3</sup>Graduate School of Nagoya Women's University, Nagoya City, Japan

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**\*Corresponding Author:** Naomi Katayama, Nagoya Women's University, Nagoya City, 4678610, Japan. And Graduate School of Nagoya Women's University, Nagoya City, Japan. E-mail: naomik@nagoya-wu.ac.jp

### Abstract

**Background:** Japan is currently a super-aged society with a percentage of people aged 65 and over exceeding 27.8%. According to the survey results of the Ministry of Health, Labor and Welfare, it was found that there were many elderly people who wanted to take care at home. It turned out that a total of 75.5% of the elderly wanted to receive family care or care services at home. Therefore, eating problems in home care are taken up a lot.

**Material and Methods:** Food viscosity was tested using the line spread test (LST). Since commercial products differ in each maker, in order to adjust viscosity, it is necessary to adjust according to each maker's instruction. A survey of viscosity control foods, thickeners and solidification supplements; nutraceuticals was conducted in the internet, pharmacy, and supermarkets. The available commercial food was actually purchased and the viscosity checked by LST.

**Results:** As a result, we found 23 companies and 90 types (53 types of viscosity control food and 37 types of solidification supplements). Among them, we selected three types of viscosity control foods. Moreover, as for the commercial food which adjusted viscosity, the jelly was the six products and 13 types of taste, and the beverage was the seven products and 25 types of taste. Among them, we selected jelly foods and dietary supplement beverage that are also available to the general household. Food viscosity was

tested using the line spread test (LST). It was found that when the food contains a large amount of protein and lipid, it is difficult to obtain viscosity depending on the compatibility with the thickener.

**Conclusion:** The compatibility between the viscosity control food and the solidifying food supplement sold by each manufacturer is good. When combining products from other companies, it is necessary to make adjustments and optimize in advance.

**Keywords:** Care food; Line spread test; Solidification supplement; Thickener; Viscosity adjustment food

### Introduction

Japan is super aged society. According to the announcement of the recent Japanese Government, the ratio in the population of the elderly person of Japan is higher than 27.3% (15 million people male, 19.59 million people is female: 2016). The following three points are the issues brought about by the aging society. The first is a decline in the working age population. The second is the increase in social security costs. The last is an increase in the care burden. According to the survey results of the Cabinet Office in Japan, the majority of elderly societies want to spend their old age with their families. Especially for elderly people over 70, 59.8% would like to live with or close to their family. Also, according to the

survey results of the Ministry of Health, Labor and Welfare, it was found that there were many elderly people who wanted to take care at home. It turned out that a total of 75.5% of the elderly wanted to receive family care or care services at home. Therefore, eating problems in home care are taken up a lot. It is necessary to provide reasonable care food by making good use of commercially available products. The Japanese Government performs a campaign to reduce a bedridden elderly person. Specifically, it is lifestyle improvement to postpone the healthy life expectancy of the elderly person. The Japanese Government wants to prevent Sarcopenia [1, 2] and Frailty [3-8] by the improvement of dietary habits and the exercise custom of the elderly person. We talk about the meal content to increase quantity of muscle of the elderly person. It is necessary to have the elderly person take in a meal with much protein<sup>9</sup>. However, the elderly person has the decline of the chewing function and the decline of the deglutition function. In addition, the elderly person has the person who cannot go for shopping far and wide every day. Therefore the protein which it is easy to eat which storable duration makes is necessary. The highly concentrated liquid food product is the food which it is easy to get and popular for a Japanese very much at drug stores. As for the highly concentrated liquid food product in particular, it is high protein, and it has many different kinds of flavours. In addition, various types of soft food have come to be sold in Japan. As for the soft food, there are various choices by a person eating from a little hard thing to a very soft thing. Therefore, the Japanese Society of Dysphagia Rehabilitation presented the swallowing adjustment food classification 2013 as a guideline for the hardness of food. Food Companies have also begun selling Universal Design Food (UDF: indication the hardness of the food) so that more consumers can choose the right food. Furthermore, the elderly person cannot often take in a meal of much quantity at a time. Therefore, the elderly person need to eat rich-nutrition food which quantity is not so much. In addition, because the physical condition of the elderly changes daily, it is necessary to make the hardness of the diet tailored to each person. Many elderly people have problems with swallowing function. Even in water, viscosity adjustment is often required. Therefore, in this study, the compatibility between commercially available viscosity control food, thickener and solidifying supplement and nutraceutical was investigated using the line spread test (LST).

## Material and Methods

### Commercial Product Survey

A survey of viscosity control foods, thickeners and solidification supplements, nutraceuticals was conducted in the internet, pharmacy, and supermarkets.

### Viscosity Adjustment

The viscosity was adjusted to be used as a solidification supplement, nutraceutical, nutraceutical beverage, etc. using the selected viscosity-adjusting food and thickener. The adjustment method was performed based on each manufacturer's instruction.

### Line Spread Test (LST)

The line spread test was performed using a simple viscosity test kit manufactured by Saraya. The inspection procedure is as follows.

- Examine and adjust the food.
- Put the viscosity adjustment plate on a flat place.
- Place a ring of containing the food to be tested in the designated area of the viscosity test board (centre of the test board).
- Put the food to be tested in the ring. Make sure that the entire amounts do not go out of the ring.
- Let stand for 30 seconds.
- Ring only, quietly pull up vertically. By this thing, the food spreads on the viscosity test board.
- After 30 seconds, the spread of the food on the viscosity test board is recorded by reading the scale indicated on the test board. There are six scales to read.
- The average of the six scales is recorded as the viscosity of the food to be measured.

### Viscosity Evaluation

The viscosity of each obtained food was classified according to the swallowing adjustment food classification 2013 proposed by the Japan Society of Dysphagia Rehabilitation. The classification is as follows.

- **Stage 1:** Thin viscosity; 43-36 mm
- **Stage 2:** Intermediate viscosity; 36-32 mm
- **Stage 3:** Thick viscosity; 32-30 mm

When the above three classifications do not apply, 43 mm or more was made very thin viscosity, and 30 mm or less was made very thick viscosity.

## Results

### Commercial Product Survey

A survey of viscosity control foods, thickeners and solidification supplements, nutraceuticals was conducted in the internet, pharmacy, and supermarkets. As a result, we found 23 companies and 90 types (53 types of viscosity control food and 37 types of solidification supplements). Among them, we selected three types of viscosity control

foods that are also available to the general household. (Table 1) shows the contents, prices and nutritional components of N company product and Ms Company product were dextrin, polysaccharide thickeners and pH adjusters. The raw

these three types of viscosity-adjusted food. The raw materials of Ma company product were dextrin, xanthan gum, calcium lactate, tri-sodium citrate.

Product Name	Taste	Contents	Price	Nutritional Ingredients (per 100kg)				
				Energy (kcal)	Protein (g)	Fat (g)	Carbohydrates (g)	Salt Equivalent (g)
H Company	Strawberry	63g	118 JY (1 USD)	88	5	2	12.5	0.1
A Company	Apple	130g	137 JY (1.3 USD)	19	0	0	5.2	0.3
Ac Company	Apple	10g	210 JY (1.9 USD)	30	3	0	9.7	0.2
Ka Company	Peach	80g	103 JY (0.92 USD)	50	0	0	15.1	0~0.3
	Grape	80g	103 JY (0.92 USD)	52	0	0	15.5	0.2
	Apple	80g	103 JY (0.92 USD)	51	0	0	15.2	0~0.3
Me Company	Pine Apple Yogurt	150ml	224 JY (2 USD)	150	6	4.2	-	-
	Peach Yogurt	150ml	224 JY (2 USD)	150	6	4.2	-	-

Table 1: About selected viscosity adjustment food (thicker).

### Viscosity Adjustment

Moreover, as for the commercial food which adjusted viscosity, the jelly was the six products and 13 types of taste, and the beverage was the seven products and 25 types of taste. Among them, we selected jelly foods that are also available to the general household. (Table 2) shows the contents, prices and nutritional components of these three types of jelly food. And we selected dietary supplement beverage that are also available to the general household. (Table 3) shows the contents, prices and nutritional components of these three types of dietary supplement beverage.

Product Name	Taste	Contents	Price	Nutritional Ingredients (per 100kg)				
				Energy (kcal)	Protein (g)	Fat (g)	Carbohydrates (g)	Salt Equivalent (g)
H Company	Strawberry	63 g	118 JY (1 USD)	88	5	2	12.5	0.1
A Company	Apple	130 g	137 JY (1.3 USD)	19	0	0	5.2	0.3
Ac Company	Apple	10 g	210 JY (1.9 USD)	30	3	0	9.7	0.2
Ka Company	Peach	80 g	103 JY (0.92 USD)	50	0	0	15.1	0~0.3
	Grape	80 g	103 JY (0.92 USD)	52	0	0	15.5	0.2
	Apple	80 g	103 JY (0.92)	51	0	0	15.2	0~0.3

			USD)					
Me Company	Pine Apple Yogurt	150 ml	224 JY (2 USD)	150	6	4.2	-	-
	Peach Yogurt	150 ml	224 JY (2 USD)	150	6	4.2	-	-

**Table 2:** Selected jelly food (Commercial item used for line spread test (LST)).

Product Name	Taste	Contents	Price	Energy (Kcal)	Nutritional Ingredients(per 100g)			
					Proteins (g)	Fat (g)	Carbohydrates (g)	Salt Equivalent (g)
Mo Company	Strawberry	125ml	177 JY (1.6 USD)	200	7.5	6.7	29.3	0.28
	Milk Tea	125ml	177 JY (1.6 USD)	200	7.5	6.7	29.3	0.28
Ke Company	Strawberry	125ml	160 JY (1.4 USD)	200	7.5	7.5	25.6	-
	Coffee	125ml	160 JY (1.4 USD)	200	7.5	7.5	25.6	-
Ke Company	Fruit Mix	125ml	160 JY (1.4 USD)	200	7.5	7.5	25.6	-
Me Company	Blueberries	125ml	167 JY (1.5 USD)	200	7.5	5.6	31.7	0.28
	White Peaches	125ml	167 JY (1.5 USD)	200	7.5	5.6	31.7	0.28
	Strawberry	125ml	167 JY (1.5 USD)	200	7.5	5.6	31.8	0.28
	Banana	125ml	167 JY (1.5 USD)	200	7.5	5.6	31.8	0.28
	Yogurt	125ml	167 JY (1.5 USD)	200	7.5	5.6	31.8	0.28
Me Company	Banana	125ml	240 JY (2.2 USD)	200	7.5	5.6	31.8	0.28
Me Company	Fruit Mix	125ml	212JY (1.9 USD)	200	10	5.6	29.2	0.36
G Company	Oranges	100ml	128 JY (1.2 USD)	44	0	0	12	0.01
	Carrot & Apples	100ml	128 JY (1.2 USD)	45	0	0	12	0.03
	Fruit Mix	100ml	128 JY (1.2 USD)	37	0	0	10	0.01

**Table 3:** Selected dietary supplement beverage (Commercial item used for line spread test (LST)).

#### Line Spread Test (LST)

In order to know the characteristics of each thickener, LST was first performed using water. The results are shown in (Table 4).The thickeners of each company showed almost the same viscosity. The viscosity was about Stage 2: Intermediate viscosity; 36-32 mm.

Product Name	Line Spread Test(mm)						LST Value (Average)
	1	2	3	4	5	6	
Water	28	34	34	42	71	49	54.3
N Company+Water	35	36	35	34	34	35	35.4
Ma Company+Water	38	38	36	34	32	34	37.3
Mo Company+Water	30	31	32	32	31	31	31.7

**Table 4:** Result of line spread test (LST) thicker adjusted with water.

Thirteen samples classified as jelly in the commercially available solidified supplements were tested without the addition of thickener. The results are shown in (Table 5). Similarly, 15 commercially available nutraceuticals, were also tested without the addition of thickener. The results are shown in (Table 6). Because the jelly-like food is solid or gel-like, the viscosity is thick at stage 2 or stage 3 or higher. However, the company A (apple taste), the company Ac (apple taste), the company Ka (Peach, grape, apple taste), was soft and thin viscous.

Dietary supplement beverages were all liquid and had thin viscosity below stage 1or stage 1. These thin viscous products have been found to require the addition of thickeners tailored to the state of swallowing function.

Product Name	Product Taste	Line Spread Test (mm)						LST value (Average)
		1	2	3	4	5	6	
H Company	Strawberry	17	17	18	20	17	16	18.5
	yogurt	15	17	15	17	15	15	16.6
A Company	Apple	42	42	40	41	37	41	41.8
Ac Company	Apple	42	43	41	37	40	40	42
Ka Company	Peach	40	41	35	34	36	35	39.3
	Grape	42	40	37	41	39	39	41
	Apple	40	41	40	36	33	38	40.3
Me Company	Pine apple yogurt	29	28	31	30	31	31	31
	Peach yogurt	31	30	27	30	32	31	31.3
	Yogurt	32	32	31	33	34	33	33.3
Mo Company	Honey yogurt	32	32	32	33	32	33	32.8
	Banana yogurt	18	22	27	29	24	19	26.7
	Grape yogurt	27	25	24	25	25	26	26.1

**Table 5:** Result of line spread test (LST) with selected jelly food.

Product Name	Product Taste	Line Spread Test(mm)						LST Value (Average)
		1	2	3	4	5	6	
Mo Company	Strawberry	53	58	52	53	54	54	55.3
	Milk Tea	67	64	59	50	47	47	60
Ke Company	Strawberry	60	63	54	50	52	55	59.6
	Coffee	60	74	56	46	41	45	63.3
Ke Company	Fruit Mix	61	62	57	52	53	58	60.3
	Blueberries	47	48	51	51	48	46	50.2

<b>Me Company</b>	White Peaches	47	46	48	48	52	50	50.2
	Strawberry	50	50	46	53	58	60	58
	Banana	47	45	46	54	66	59	59.7
	Yogurt	54	56	47	52	58	55	56.4
<b>Me Company</b>	Banana	69	67	51	50	58	64	66.7
<b>Me Company</b>	Fruit Mix	58	55	56	60	56	58	58.7
<b>G Company</b>	Oranges	48	50	49	53	54	45	52.3
	Carrot & Apples	52	52	58	59	53	56	57.7
	Fruit Mix	56	50	40	35	43	57	54.3

**Table 6:** Result of line spread test (LST) with selected dietary supplement beverage.

Thickener N was added according to the instruction of use to a commercial product determined to require a thickener. The results are shown (Table 7 and Table 8). Dietary supplements are high in protein. It was hard to get sticky overall. The tackiness may also be related to the lipid content.

Product Name	Product Taste	Line Spread Test (mm)						LST Value (Average)
		1	2	3	4	5	6	
<b>A Company</b>	Apple	18	18	27	33	27	20	29
<b>Ac Company</b>	Apple	19	21	26	33	28	21	29
<b>Ka Company</b>	Peach	21	28	32	36	30	29	32.7
	Grape	29	30	31	34	30	25	31.7
	Apple	33	27	24	27	32	35	33.3

**Table 7:** Result of line spread test (LST) with selected jelly food with N Company thickener.

Product Name	Product Taste	Line Spread Test (mm)(Table 8)						LST Value (Average)
		1	2	3	4	5	6	
<b>Mo Company</b>	Strawberry	60	63	51	45	57	51	58.6
	Milk Tea	63	53	45	44	47	54	56.7
<b>Ke Company</b>	Strawberry	59	66	56	50	46	48	60.3
	Coffee	65	64	51	45	51	56	61.7
<b>Ke Company</b>	Fruit Mix	55	50	49	49	59	64	59.3
<b>Me Company</b>	Blueberries	43	42	43	42	41	42	42.7
	White Peaches	41	39	38	39	40	42	41
	Strawberry	46	44	50	54	59	54	55.7
	Banana	50	47	51	58	57	55	56.7
	Yogurt	55	54	50	48	45	51	53.3
<b>e Company</b>	Banana	63	68	55	46	47	50	62
<b>Me Company</b>	Fruit Mix	46	46	45	43	43	43	45.7
<b>G Company</b>	Oranges	45	45	44	42	43	46	45.3
	Carrot & Apples	48	49	47	46	46	48	48.3
	Fruit Mix	45	43	43	44	49	49	47.8

**Table 8:** Result of line spread test (LST) with selected dietary supplement beverages with N Company thickener.



Thickener Ma was added according to the instruction of use to a commercial product determined to require a thickener. The results are shown (Table 9 and Table 10). Dietary supplements are high in protein. It was hard to get sticky overall as same as thickener N. The tackiness may also be related to the lipid content.

Product Name	Product Taste	Line Spread Test (mm)						LST Value (Average)
		1	2	3	4	5	6	
A Company	Apple	19	25	25	26	23	20	25.3
Ac Company	Apple	24	28	35	20	18	17	25.7
Ka Company	Peach	27	30	28	27	29	28	29.1
	Grape	32	27	28	27	29	31	30.7
	Apple	34	30	26	23	25	31	31.7

**Table 9:** Result of line spread test (LST) with selected jelly food with Ma Company thickener.

Product Name	Product Taste	Line Spread Test (mm)						LST Value (Averag)
		1	2	3	4	5	6	
Mo Company	Strawberry	55	54	50	48	49	52	3.7
	Milk Tea	60	55	51	48	49	54	56.3
Ke Company	Strawberry	59	59	53	47	49	53	57.1
	Coffee	58	61	54	47	48	50	57.7
Ke Company	Fruit Mix	52	46	45	49	56	60	56
Me Company	Blueberries	24	24	27	30	30	31	30.3
	White Peaches	31	29	21	19	20	28	29.3
	Strawberry	48	47	47	52	54	52	52.7
	Banana	47	48	52	53	54	50	53
	Yogurt	47	50	50	46	46	47	49.2
Me Company	Banana	54	54	53	49	50	52	53.7
Me Company	Fruit Mix	37	38	40	40	39	37	39.7
G Company	Oranges	41	41	40	39	39	40	40.7
	Carrot & Apples	36	37	36	34	34	35	36.3
	Fruit Mix	36	39	40	38	36	35	39

**Table 10:** Result of line spread test (LST) with selected dietary supplement beverage with Ma Company thickener.

Thickener Mo was added according to the instruction of use to a commercial product determined to require a thickener. The results are shown (Table 11 and Table 12). Dietary supplements are high in protein. It was hard to get sticky overall. The tackiness may also be related to the lipid content.

Product Name	Product Taste	Line Spread Test (mm)						LST Value (Average)
		1	2	3	4	5	6	
A company	Apple	22	24	28	26	20	20	26
Ac Company	Apple	19	18	20	24	27	24	25
Ka Company	Peach	29	30	30	28	27	27	29.7
	Grape	25	21	24	28	35	31	31.3
	Apple	33	30	24	22	24	30	31

**Table 11:** Result of line spread test (LST) with selected jelly food with Mo Company thickener.

Product Name	Product Taste	Line Spread Test (mm)						LST value (Average)
		1	2	3	4	5	6	
Mo Company	Strawberry	58	59	50	47	52	54	57
	Milk Tea	58	56	54	52	51	52	56
Ke Company	strawberry	53	54	53	51	53	54	53.7
	Coffee	54	54	52	49	50	49	53.3
Ke Company	Fruit Mix	54	44	53s	48	59	63	58.7
	Blueberries	37	37	38	38	37	36	37.7
Me Company	White Peaches	40	40	39	37	35	37	39.7
	strawberry	43	44	51	53	60	50	54.7
	banana	48	48	50	53	55	52	53.3
	yogurt	49	49	47	48	49	47	49
Me Company	banana	57	55	52	49	52	54	55.3
Me Company	Fruit Mix	37	38	37	34	33	34	37.3
G Company	Oranges	36	39	40	39	37	36	39.3
	Carrot & Apples	41	44	43	40	38	39	42.7
	Fruit Mix	36	39	40	39	37	36	39.3

Table 12: Result of line spread test (LST) with selected dietary supplement beverage with Mo Company thickener.

### Viscosity Evaluation

Determination of viscosity was made according to the swallowing adjustment food classification 2013 of the Japanese Society of Dysphagia Rehabilitation. All of the waters to which the three thickeners were added were in the classification of the society. The eight out of thirteen, jelly products were mostly in the academic category without the addition of thickeners. But five, jelly products need to add some thickeners within the classification of the society. In the case of a nutritional supplement beverage, even if it added a thickener, it was often thinner than the society classification. Products containing a large amount of protein and lipid are thickeners and do not stick easily. However, depending on the combination of the thickener and the product, it may be said that it is compatible because of its viscosity. This is because a product which had a viscosity thinner than that of the Society classification for Thickener N was recorded as a viscosity of Stage 1 of the Society classification for Thickeners Ma and Mo.

### Discussion

In this study, compared to water, beverages containing protein, lipids and sour fruit juice tend to be less sticky. When the viscosity is low, it is necessary to increase the amount of thickener, take time until the physical properties become stable after adding the thickener, and select and select the thickener suitable for the material. In addition, it was

compatible with products sold by the same manufacturer and was easy to get sticky. It may take tens of seconds before the viscosity is obtained, so it is not necessary to check the viscosity while mixing, but a predetermined addition amount may be sufficiently mixed and evaluated in the optimized time, is necessary. Since the viscosity changes depending on the content of the food, it is necessary to confirm the viscosity in advance in the case of food and thickener used for the first time, if the concentration is low or high, it is a very dangerous food for people who are losing their swallowing function. As a result of performing the line spread test (LST) of the marketed product actually, there was a food which did not conform to the swallowing adjustment food classification of the Japan Dysphagia Rehabilitation Society. It is without saying that although LST alone ca not make a sufficient judgment, we will consider it a city that can be used as means to avoid danger. The viscosity needs to be tailored to the individual who consumes the food [10]. However, on the other hand, it has been reported that intake of viscous food induces abdominal bloating and may reduce the total intake of food [11]. In the present study, we adjusted the consistency at room temperature. Since the viscosity changes with temperature, it is necessary to consider the difference with temperature from now on. It is a future subject.



## Conclusions

In this research, we investigated the viscosity-adjusted food and the solidified supplement food that are marketed. Food viscosity was tested using the line spread test (LST). As for the commercial food which adjusted viscosity, the jelly was the six products and 13 types of taste, and the beverage was the seven products and 25 types of taste. Among them, we selected jelly foods that are also available to the general household. Since commercial products differ in each maker, in order to adjust viscosity, it is necessary to adjust according to each maker's instruction. The compatibility between the viscosity control food and the solidifying food supplement sold by each manufactures is good. When combining products from other companies, it is necessary to make adjustments and optimize in advance. In this study, compared to water, beverages containing protein, lipids and sour fruit juice tend to be less sticky. When the viscosity is low, it is necessary to increase the amount of thickener, take time until the physical properties become stable after adding the thickener, and select and select the thickener suitable for the material. In addition, it was compatible with products sold by the same manufacturer and was easy to get sticky.

In the present study, we adjusted the consistency at room temperature. Since the viscosity changes with temperature, it is necessary to consider the difference with temperature from now on. It is a future subject.

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