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Research on the Combination of Commercially Available Thickeners and Commercially Available Nursing Food -By using Universal Design Food: UDF (Do not have to Bite) –

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Abstract- Assuming home care for the elderly, we aimed to create a nursing food that can be created even at home, considering the combination of thickeners and foods, and creating useful data. Therefore, we used two types of thickeners that can purchase at pharmacies and three types of commercially available nursing food that can eat without chewing. Line Spread Test Start Kit (LST) manufactured by SARAYA used for viscosity measurement. The two types of thickeners used this time became more viscous when added to the food. And the viscosity of the food could be maintained over time (this time after 5minutes). However, in the case of foods rich in lipids, the thickener B was able to maintain the viscosity more than the thickener A. It is necessary to select a thickener that is compatible with the raw material ratio of the food.

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Research on the Combination of Commercially Available Thickeners and Commercially Available Nursing Food -By using Universal Design Food: UDF (Do not have to Bite) –

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I. Introduction

In recent years, the Japanese population has been declining, and the number of children is decreasing. On the other hand, the proportion of older adults has increased, and society has become super-aged. Nutritional problems in the elderly include sarcopenia and flail associated with muscle loss due to insufficient protein intake and lack of exercise. Muscle deterioration in the elderly, and the ability to swallow food declines. As a result, it is difficult to swallow and not dysphagia. It becomes easier to swallow when food makes a certain mass (food mass) in the mouth. To that end, the viscosity of food is important. Especially, smooth liquid foods are hard to swallow. Therefore, liquids with a thickness (viscosity) such as soup-like potage and ketchup can swallow more safely. In the past, Katayama et al. measured the viscosity after adding at thickener using a commercially available nutritional supplemental drink by the line spread test (LST) and reported the result[1)]. Therefore, in this study, the viscosity of nursing foods (Universal Design Food: UDF) that can be purchased at pharmacies and can eat without chewing was measured, and the viscosity with the addition of a thickener was measured using the line spread test.

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II. Material and Methods

a) Commercially Available Thickeners

We use two types of thickeners that have almost the same price and weight as those available at pharmacies. Thickener A and B were including 50 packs of 3grams. And thickener A was 1296 yen (12 USD), and thickener B was 1274 yen (11.54 USD). The raw materials, thickener A, was dextrin, water-soluble dietary fiber, and xanthan gum, and thickener B, was dextrin, thickening polysaccharides, potassium chloride, and sucralose. Each the nutritional content per 3 grams, thickener A, was 8.1kcal energy, 0g protein, 0g lipid, 2.04g sugar, 0.75g dietary fiber, and 18.6mg sodium, and thickener B, was 7.9kcal energy, 0g protein, 0g lipid, 1.9g sugar, 0.7g dietary fiber, and 16mg sodium.

b) Commercially Available Nursing food

Three types of products used from the Do Not Have to Bite category of the universal design food (UDF) on the market. These are Chicken and vegetables, Beef and vegetables, and Spinach. Chicken and vegetables, and Beef and vegetables are 100g retort pouches and sold for 180 yen (1.67 USD). Spinach is 100g retort pouches and sold for 150 yen (1.29 USD). The nutritional value of Chicken and vegetables was 49 kcal, 2.0g protein, 1.3g lipid, 8.8g carbohydrates, 3.2g dietary fiber, and 0.81g salt equivalent per 100 grams. The nutritional value of Beef and vegetables was 71 kcal, 1.7g protein, 4.3g lipid, 7.9g carbohydrates, 3.2g dietary fiber, and 0.79g salt equivalent per 100 grams. The nutritional value of Spinach was 81 kcal, 0.5g protein, 6.5g lipid, 6.5g carbohydrates, 1.9g dietary fiber, and 0.43g salt equivalent per 100 grams.

c) Sample (food with a thickener added) adjustment

Each of the three foods prepared as follows.

1) The viscosity of the food product itself measured without any modification.
2) The viscosity measured after adding 1g of thickener (A or B) to the food (100g) after stirring for 5 minutes.

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3) The viscosity measured after adding 2g of thickener (A or B) to the food (100g) after stirring for 5 minutes.
4) The viscosity measured after adding 3g of thickener (A or B) to the food (100g) after stirring for 5 minutes.

d) Viscosity measurement method

By using the Line Spread Test Start Kit (LST) manufactured by SARAYA, the viscosity of each food measured. The measurement procedure is as follows. The viscosity test performed at 24 degrees (room temperature) results obtained by performing the test, which repeated three times, averaged to obtain the LST value (viscosity). The measurement method was according to Line Spread Test Start Kit (LST) manufactured by SARAYA.

1. Place the sheet on a level surface. Place a ring with an inner diameter of 30mm in the center of the concentric circles.
2. Add the liquid to be measured to the full thickness of therig (20ml) and let stand for 30 seconds.
3. Lift the ring vertically, and after 30 seconds, measure the spread distance of the solution. Since there are a total of 6 points to measure, the average value of them is used as the LST value.
4. After still standing for 5 minutes, the spread of the samples is measured again at 6 points, and the average value recorded as the LST value.

e) Criteria for viscosity

There are three levels of classification by LST value[2]. The first stage is the mildly thick with a viscosity that falls within the range of 43mm to 36mm (50-150 mPa・s). As for the properties, when the spoon is tilted, it flows down quickly[2]. The second stage is moderately thick with a viscosity that falls within the range of 36mm to 32mm (150-300 mPa・s). As for the properties, when you tilt the spoon, it flows to the surface[2]. The third stage is extremely thick with a viscosity that falls within the range of 32mm to 30mm (300-500 mPa・s). Even if the spoon is tilted, the shape maintained to some extent, and it does not flow easily[2].

f) Statistical processing

This study was statistically processed using statistical processing software, Excel 2010 (SSRI Co., Ltd). The data to be compared were first tested for normal distribution by F-test. For comparisons between correlated data, the paired Student t-test used for normally distributed data. Wilcoxon test was used for non-normally distributed data. For comparisons between uncorrelated data, the unpaired Student t-test used for non-normally distributed data. Mann-Whitney test used for non-normally distributed data.

III. Result

a) Result of Chicken and vegetables LST test

Table 1 shows the results of viscosity measurement performed by adding the thickener A in Chicken and vegetables. As a result of measuring the viscosity of commercial care food without treatment, it found to be stage 3 (Extremely thick) after 30 seconds. However, it found to be stage 2 (moderately thick) after 5 minutes. It means the viscosity loosens and spreads after taking the time. When the thickener A added 1g, the LST value found to be stage 3 after 30seconds and stage 2 after 5 minutes. However, when the thickener A added 2g or 3g, the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 2 shows the results of viscosity measurement performed by adding the thickener Bin Chicken and vegetables. When the thickener B added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 1. Universal Design Food : UDF(Do not have to bite) Chicken and vegetables (Thickener A)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	30.8	34.3	28.6	32.2	26.6	28.9	23.6	26.1
SD	1.6	1.6	2.2	1.7	2.9	3.0	6.1	5.4
F test	P=0.450		P=0.154		P=0.414		P=0.286	
Paired Student-t	P=0.0001**		P=0/0001**		P=0.0001**		P=0.120	
Wilcoxon								

* P<0.05, ** P<0.01

Table 2. Universal Design Food : UDF(Do not have to bite) Chicken and vegetables (Thickener B)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	30.8	34.3	28.2	31.9	25.0	28.1	23.1	24.8
SD	1.6	1.6	1.5	2.1	4.3	3.3	3.9	3.8
F test	P=0.450		P=0.086		P=0.130		P=0.447	
Paired Student-t	P=0.0001**		P=0.0001**		P=0.003**		P=0.0001**	
Wilcoxon								

* P<0.05, ** P<0.01

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b) Result of Beef and vegetables LST test

Table 3 shows the results of viscosity measurement performed by adding the thickener A in Beef and vegetables. As a result of measuring the viscosity as it was on the market without treatment, it was Stage 3 after 30 seconds and Stage 2 after 5 minutes. When the thickener A added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 4 shows the results of viscosity measurement performed by adding the thickener Bin Beef and vegetables. When the thickener B added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 3. Universal Design Food : UDF(Do not have to bite) Beef and vegetables (Thickener A)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	28.5	32.4	26.4	27.9	23.3	24.1	21.8	22.3
SD	1.3	2.7	2.8	2.5	4.4	4.5	6.8	7.0
F test	P=0.003**		P=0.339		P=0.490		P=0.446	
Paired Student-t			P=0/0001**		P=0.166		P=0.820	
Wilcoxon	P=0.0001**							

* P<0.05, ** P<0.01

Table 4. Universal Design Food : UDF(Do not have to bite) Beef and vegetables (Thickener **B**)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	28.5	32.4	26.4	27.9	21.8	24.9	20.3	21.0
SD	1.3	2.7	4.8	4.7	5.3	5.8	5.4	7.0
F test	P=0.003**		P=0.465		P=0.355		P=0.127	
Paired Student-t			P=0.015*		P=0.00001**		P=0.748	
Wilcoxon	P=0.0001**							

* P<0.05, ** P<0.01

c) Result of Spinach LST test

Table 5 shows the results of the viscosity measurement performed by adding the thickener Ain Spinach. As a result of measuring the viscosity as it was on the market without treatment, it was Stage 3 after 30 seconds and Stage 2 after 5 minutes. When the thickener A added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 6 shows the results of the viscosity measurement performed by adding the thickener Bin Spinach. When the thickener B added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 5. Universal Design Food : UDF(Do not have to bite) Spinach (Thickener A)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	30.5	33.2	28.2	29.4	27.3	28.3	25.5	26.5
SD	1.7	1.2	0.9	0.9	2.4	1.5	1.6	1.7
F test	P=0.086		P=0.467		P=0.026*		P=0.451	
Paired Student-t	P=0.0001**		P=0.0001**				P=0.0001**	
Wilcoxon					P=0.003**			

* P<0.05, ** P<0.01

Table 6. Universal Design Food : UDF(Do not have to bite) Spinach (Thickener B)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	30.5	33.2	24.7	25.6	22.5	23.7	21.4	22.3
SD	1.7	1.2	3.4	2.8	2.3	2.1	3.4	3.5
F test	P=0.0186		P=0.223		P=0.333		P=0.456	
Paired Student-t	P=0.0001**		P=0.132		P=0.00001**		P=0.0001**	
Wilcoxon								

* P<0.05, ** P<0.01

d) Results of comparison of two thickeners

Comparing the stability of the two types of thickeners are shown in Table 7, 8, and 9. In chicken and vegetables and beef and vegetables, the viscosities of the two thickeners were almost the same. There was no statistically significant difference. However, in spinach, thickener B was statistically significantly more viscous thickener than thickener A all conditions.

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Table 7. Comparison of viscosities with two thickeners (A and B) in Chicken and vegetables

	Add 1g thickener, After 30 sec		Add 1g thickener, After 5 min.		Add 2g thickener, After 30 sec.		Add 2g thickener, After 5 min.		Add 3g thickener, After 30 sec.		Add 3g thickener, After 5 min.	
	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B
Average value	28.6	28.2	32.2	31.9	26.6	25.0	28.9	28.1	23.6	23.1	26.1	24.8
SD	2.2	1.5	1.7	2.1	2.9	4.3	3.0	3.3	6.1	3.9	5.4	3.8
F test	P=0.050*		P=0.232		P=0.048*		P=0.370		P=0.031*		P=0.073	
Unparied Student-t			P=0.663				P=0.436				P=-0.413	
Wilcoxon	P=0.318				P=0.143				P=0.889			

* P<0.05, ** P<0.01

Table 8. Comparison of viscosities with two thickeners (A and B) in Beef and vegetables

	Add 1g thickener, After 30 sec		Add 1g thickener, After 5 min.		Add 2g thickener, After 30 sec.		Add 2g thickener, After 5 min.		Add 3g thickener, After 30 sec.		Add 3g thickener, After 5 min.	
	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B
Average value	26.4	26.4	27.9	27.9	23.3	21.8	24.1	24.9	21.8	20.3	22.3	21.0
SD	2.8	4.8	2.5	4.7	4.4	5.3	4.5	5.8	6.8	5.4	7.0	7.0
F test	P=0.016*		P=0.007**		P=0.234		P=0.143		P=0.160		P=0.496	
Unparied Student-t					P=0.388		P=0.619		P=0.484		P=0.589	
Wilcoxon	P=0.849		P=0.861									

* P<0.05, ** P<0.01

Table 9. Comparison of viscosities with two thickeners (A and B) in Spinach

	Add 1g thickener, After 30 sec		Add 1g thickener, After 5 min.		Add 2g thickener, After 30 sec.		Add 2g thickener, After 5 min.		Add 3g thickener, After 30 sec.		Add 3g thickener, After 5 min.	
	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B
Average value	28.2	24.7	29.4	25.6	27.3	22.5	28.3	23.7	25.5	21.4	26.5	22.3
SD	0.9	3.4	0.9	2.8	2.4	2.3	1.5	2.1	1.6	3.4	1.7	3.5
F test	P=0.0001**		P=0.0001**		P=0.436		P=0.089		P=0.001**		P=0.001**	
Unparied Student-t					P=0.0001**		P=0.0001**					
Wilcoxon	P=0.0001**		P=0.0001**						P=0.0001**		P=0.001**	

* P<0.05, ** P<0.01

IV. Discussion

There is a need to prevent sarcopenia[3,4] and flails[5-11] associated with malnutrition and lack of exercise in the elderly. Older adults also have poor swallowing, so it is necessary to adjust the viscosity in the diet[12]. In this study, the measurement of viscosity after adding a thickener to a commercially available nursing food (UDF: do not need to bite) is an area for further research in the future. The two types of thickeners used this time became more viscous when added to the food. And the viscosity of the food could be maintained over time (this time after 5minutes). However, in the case of foods rich in lipids, the thickener B was able to maintain the viscosity more than the thickener A. It is necessary to select a thickener that is compatible with the raw material ratio of the food. In the future, we would like to create useful data for creating safe nursing care foods that can create at home by checking the viscosity of more types of thickeners and combination s of many types of foods.

V. Conclusions

Viscosity measured in different combinations of two commercially available thickeners and three commercially available nursing foods results. When the amount of thickener added to food, the viscosity stabilized by adding a thickener (1g, 2g, or 3g per 100g this time). In the case of foods high in fat (Spinach), the viscosity of thickener B was more stable than that of thickener A. In the future; it will be necessary to increase the number of samples and clarify the differences due to the combinations.

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