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Line Spread Test Results for Commercially Available the White Rice Porridge

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Abstract- Lifelines are cut off during disasters. As a result, water, gas, and electricity cannot be used, making it impossible to prepare meals. If you always have ready-to-eat porridge, you do not need to cook it, and can eat it whenever you want. The porridge with a lot of water causes aspiration in older people. In welfare facilities and hospitals, a thickener is used to adjust the viscosity of porridge so that the elderly can safely swallow it. In this study, we measured the thickness of commercially available porridge using the line spread test (LST).

First, the viscosity of commercially available white rice porridge was assumed. Next, the white rice porridge was homogenized with a mixer, and the thickness was measured. Two g of each of the four commercially available thickeners was added to white rice porridge, homogenized with a mixer, and the viscosity was measured after stirring for five minutes. Viscosity measurements were taken 30 seconds, 5 minutes, 15 minutes, and 30 minutes after each porridge placed on the measuring plate. When the white rice porridge was homogenized using a mixer, the viscosity became thin, and there was the risk of aspiration.

Keywords: commercial product, white rice porridge, lin spread test (LST), thickener.

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Including the Effect of Four Types of Thickening Agents Added after Blending

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First, the viscosity of commercially available white rice porridge was assumed. Next, the white rice porridge was homogenized with a mixer, and the thickness was measured. Two g of each of the four commercially available thickeners was added to white rice porridge, homogenized with a mixer, and the viscosity was measured after stirring for five minutes. Viscosity measurements were taken 30 seconds, 5 minutes, 15 minutes, and 30 minutes after each porridge placed on the measuring plate. When the white rice porridge was homogenized using a mixer, the viscosity became thin, and there was the risk of aspiration. Thickness was measured after adding the four thickening agents to the blended white rice porridge, and all porridges with thickener had thick density. In the event of a disaster, it is necessary to keep white rice porridge on hand and prepare thickeners for baby food for infants and meals for the elderly.

Keywords: commercial product, white rice porridge, lin spread test (LST), thickener.

I. Introduction

Many disasters have occurred in recent years. The Japanese government calls on the general public to stockpile food for at least three days. In addition, in some areas, residents are asked to collect food for a week. In that case, baby food for infants, nursing care food for the elderly, allergy-friendly food, pathological food, and the like are problematic. If lifelines are cut off, and there is no water, gas, electricity, etc., it will be impossible to cook meals. That is where ready-made commercial products come in handy. In particular, white rice porridge, which is allergy-free and contains water, is one of the foods you should always be on hand. We can make baby food by making white rice porridge, a uniform liquid with a mixer. When white rice porridge is processed in a blender, it contains a lot of water, so the viscosity is thin, and there is a risk of aspiration by the elderly. Liquid white rice porridge needs t be thickened with a commercially available thickener so that people with impaired swallowing ability can eat it safely. In this study, we report the results of viscosity measurement by line spread test using commercially available white rice porridge and four types of thickeners.

II. Materials and Methods

The nutritional components of the white rice porridge used in this experiment are shown in the Table 1.The white rice porridge used had 33.2kcal and 7.86g of carbohydrates per 100g (displayed on the product packaging).

Table 1. Contents and nutritional value of commercial porridge

Contents		Nutrient contents (Per 100g)				
		Energy (kcal)	Protein (g)	Fat (g)	Carbohydrates (g)	Sodium (mg)
White rice porridge	Non-glutinous rice	33.2	0.60	0.00	7.68	0.00

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Table 2 shows the content and nutritional value of the four commercially available thickeners used in this experiment. The main component of all thickeners was dextrin (displayed on the product packaging).

Talbe 2 Content and nutritional value of four types of thickeners

	Contents	Nutrient contents (Per 2g)					
		Energy (kcal)	Protein (g)	Fat (g)	Carbohydrates (g)		Sodium (mg)
					Sugar (g)	Dietary fiber (g)	
A	Dextrin、Polysaccharide thickener、potassium chloride、sweetener (Sucralose)	5.27	0.00	0.00	0.87	0.47	10.67
B	Dextrin、Xanthan gum、Trisodium chloride、Calcium lactate	4.00	0.00	0.00	1.00	0.70	3.00
C	Dextrin、Water-soluble dietary fiber、Thickener (Xanthan gum)	5.40	0.00	0.00	1.36	0.50	12.33
D	Dextrin、Polysaccharide thickener、Calcium lactate	0.53	0.03	0.00	0.91	0.83	24.00

a) Sample (food with Thickener added) adjustment

Samples were adjusted according to previous reports[1,2,3,4]. Each of the three foods was prepared as follows.

1. The viscosity of the food product was measured without any modification (homogenize with a mixer) after 30seconds, 5minnutes, 15minnutes, and 30minutes.
2. The viscosity of the food product was measured with modification (homogenize with a mixer) after 30seconds, 5minnutes, 15minnutes, and 30minutes.
3. The viscosity was measured on the food product with modification (homogenize with a mixer) after adding 2grams of thickener (A, B, C, and D) to the food (100g) after 30seconds, 5minnutes, 15minnutes, and 30minutes.

b) Viscosity measurement method

Using Line Spread Test Start Kit (LST) manufactured by SARAYA, the viscosity of each food was measured. The measurement procedure is as follows. The line spread test (LST) was performed in a room with room temperature of 24 degrees. Viscosity measurements by line spread test (LST) were performed three times using the same sample. Data was obtained by averaging the viscosity results of three repeated measurements. 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 total 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. Six points on the outermost circumference of the sample spread concentrically were measured, and the average value was calculated as the result of LST values.
4. After still standing for 5 minutes, the spread of the samples is measured again at 6 points, and the average value is recorded as the LST value.

c) Criteria for viscosity

There are three levels of classification by LST value[5]. The first stage is 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 highly 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 is maintained to some extent, and does not flow easily[5].

d) 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 was used for normally distributed data. Wilcoxon test was used for non-normally distributed data.

III. Results

Table 3 shows the line spread test results. The viscosity of white rice porridge decreased from extremely thick to moderately thick with time. When the white rice porridge was processed with a mixer to become a uniform liquid, the viscosity became mildly thick. And then, the thickener was added to the liquid white rice porridge, the thickness of liquid white rice porridge remained highly dense.

Table 3. Viscosity measurement results of four types of thickeners for white rice porrigde using the line spread test

	After 30 seconds	After 5 minutes	After 15 minutes	After 30 minutes
None mixer processing (NMP)	28.7 ± 2.9	33.7 ± 4.8	33.6 ± 2.7	33.4 ± 3.0
Mixer processing (MP)	44.8 ± 3.8	50.9 ± 8.7	50.2 ± 10.0	50.2 ± 10.1
MP with Thickener A (Toromicria)	25.8 ± 3.8	27.4 ± 3.9	27.8 ± 4.3	28.0 ± 4.5
MP with Thickener B (Tururinko)	24.4 ± 5.0	28.6 ± 11.1	26.4 ± 5.3	26.9 ± 5.7
MP with Thickener C (Toromifaiver)	25.5 ± 3.3	27.6 ± 3.7	28.3 ± 4.1	29.7 ± 4.1
MP with Thickener D (Neohaitoromi-ru)	22.7 ± 5.3	22.8 ± 5.1	23.9 ± 5.5	23.6 ± 5.4

a) Statistical processing results

The line spread test results and statistical processing results are shown in Table 4-9. Except for the white rice porridge with Thickener D, the viscosity was statistically significantly weakened from 30 seconds to 5 minutes. The white rice porridge with Thickener D, the viscosity was statistically significantly weakened from 5 minutes to 15 minutes. However, all the viscosities of the white rice porridge with Thickener fell into the highly thick.

Table 4. Line spread test (LST) measurement results of white rice porridge

	After 30 seconds	After 5 minutes	After 5 minutes	After 15 minutes	After 15 minutes	After 30 minutes
Average value ±Standard deviation	28.7±2.9	33.7±4.8	33.7±4.8	33.6±2.7	33.6±2.7	33.4±3.0
F test	P=0.020*		P=0.010**		P=0.334	
Paired Student t-test					P=0.781	
Wilcoxon test	P=0.042*		P-0.327			

Table 5. Line spread test (LST) measurement results of white rice porridge after Mixer processing (MP)

	After 30 seconds	After 5 minutes	After 5 minutes	After 15 minutes	After 15 minutes	After 30 minutes
Average value ±Standard deviation	44.8±3.8	50.9±8.7	50.9±8.7	50.2±10.0	50.2±10.0	50.2±10.1
F test	P=0.0001**		P=0.200		P=0.475	
Paired Student t-test			P=0.409		P-0.579	
Wilcoxon test	P=0.001**					

Table 6. Line spread test (LST) measurement results of white rice porridge after Mixer processing (MP) with Thickener A

	After 30 seconds	After 5 minutes	After 5 minutes	After 15 minutes	After 15 minutes	After 30 minutes
Average value ±Standard deviation	25.8±3.8	27.4±3.5	27.4±3.5	27.8±4.3	27.8±4.3	28.0±4.5
F test	P=0.430		P=0.356		P=0.430	
Paired Student t-test	P=0.030*		P=0.444		P=0.547	
Wilcoxon test						

Table 7. Line spread test (LST) measurement results of white rice porridge after Mixer processing (MP) with Thickene B

	After 30 seconds	After 5 minutes	After 5 minutes	After 15 minutes	After 15 minutes	After 30 minutes
Average value ±Standard devi	24.4±5.0	28.6±11.1	28.6±11.1	26.5±5.3	26.5±5.3	26.9±5.7
F test	P=0.001**		P=0.002**		P=0.408	
Paired Student t-test					P=0.001**	
Wilcoxon test	P=0.0001**		P=0.059			

Table 8. Line spread test (LST) measurement results of white rice porridge after Mixer processing (MP) with Thickene C

	After 30 seconds	After 5 minutes	After 5 minutes	After 15 minutes	After 15 minutes	After 30 minutes
Average value ±Standard devi	25.5±3.3	27.6±3.7	27.6±3.7	28.3±4.3	28.3±4.3	29.7±4.1
F test	P=0.316		P=0.350		P=0.488	
Paired Student t-test	P=0.0001**		P=0.059		P=0.034*	
Wilcoxon test						

Table 9. Line spread test (LST) measurement results of white rice porridge after Mixer processing (MP) with Thickene D

	After 30 seconds	After 5 minutes	After 5 minutes	After 15 minutes	After 15 minutes	After 30 minutes
Average value ±Standard devi	22.7±5.3	22.8±5.1	22.8±5.1	23.9±5.5	23.9±5.5	23.6±5.4
F test	P=0.443		P=0.373		P=0.476	
Paired Student t-test	P=0.507		P=0.007**		P=528	
Wilcoxon test						

IV. Discussions

People with impaired swallowing function are at risk of aspiration form ingesting food mixed with small solids. In the case of white rice porridge, there is a possibility of aspiration depending on the physical condition of the person who eats it because there are rice grains left. If the porridge is made into a uniform liquid using a mixer, the porridge has high water content. It thus becomes less dense, further increasing the possibility of aspiration by the person[6,7]. The safe consumption of liquid porridge requires the addition of thickeners. All four types of thickeners used this time were able to increase the thickness of the porridge that was made into a uniform liquid using a mixer, making into highly thick. The use of thickeners is effective for providing safe meals. To respond to disasters, we think it is realistic to stockpile porridge and Thickener together.

In the future, we would like to conduct similar tests on various types of rice porridge on the market, accumulate the results, and report them.

V. Conclusion

An attempt was made to adjust the viscosity for people with impaired swallowing function by using commercially available retort porridge and a commercially available thickening agent, which are also helpful in times of disaster. As a result, when commercially available retort white rice porridge becomes a uniform liquid using a mixer, its viscosity decreases, making it a dangerous ingredient for people with weakened swallowing functions. Therefore, a commercially available thickener was used to adjust the thickness of the liquid porridge. As a result, the liquid porridge became highly dense and stable. We think it is necessary to stockpile thickeners along with rice porridge so that many people can eat it safely even in the event of a disaster.

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