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Line Spread Test Results for Commercially Available the White Rice Porridge with Egg - Including the Effect of Four Types of Thickening Agents Added After Blending -

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Abstract- Viscosity was evaluated using a line spread test (LST) using white rice porridge with egg, which has more lipids and proteins than white rice porridge and has a wide range of versatility. Liquid porridge is used for older people with weak chewing, and babies as baby food have low viscosity, and are highly likely to be aspirated by people with weakened swallowing function. Therefore, a uniform liquid porridge was prepared using a mixer, and the viscosity was measured. As a result, it was shown that liquid porridge is thin and has a high risk of aspiration in people with weakened swallowing function. In order to increase the viscosity of the liquefied white rice porridge with egg, commercially available thickeners (four different types) were added. The viscosity of white rice porridge with egg with added thickener was evaluated using the line spread test (LST).

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Abstract- Viscosity was evaluated using a line spread test (LST) using white rice porridge with egg, which has more lipids and proteins than white rice porridge and has a wide range of versatility. Liquid porridge is used for older people with weak chewing, and babies as baby food have low viscosity, and are highly likely to be aspirated by people with weakened swallowing function. Therefore, a uniform liquid porridge was prepared using a mixer, and the viscosity was measured. As a result, it was shown that liquid porridge is thin and has a high risk of aspiration in people with weakened swallowing function. In order to increase the viscosity of the liquefied white rice porridge with egg, commercially available thickeners (four different types) were added. The viscosity of white rice porridge with egg with added thickener was evaluated using the line spread test (LST). As a result, the viscosity of the white rice porridge with egg to which the thickener containing dextrin, calcium lactate and thickening polysaccharide was added was stable. We need to investigate more combinations of porridges and thickeners that exhibit high density.

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

I. Introduction

There are many types of porridge on the market, some of which are highly nutritious. Among them, white rice porridge with egg containing a lot of protein and Fat is more versatile than white rice porridge. It can be used as liquid porridge for baby food, older people with weak mastication, and sick patients. However, liquid porridge is highly likely to be aspirated by people with impaired swallowing function. Therefore, liquid porridges often require the addition of thickeners. Combining porridges of varying nutritional value and thickeners may not provide sufficient viscosity. In this study, we used a commercially available white rice porridge with egg, and four different Thickeners in chooses from many different kind of Thickeners. We evaluated the viscosity of the rice porridge after adding four types of thickeners using a line spread test (LST).

II. Materials and Methods

The nutritional components of the white rice porridge with egg used in this experiment are shown in Table 1. The white rice porridge with egg used had 36.00 kcal, 1.32g of protein, 0.92g of Fat, 5.72g of carbohydrate, and 0.52g of sodium 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 with egg	Egg、Non-glutinous rice、Bonito flakes extract、Salr、soy sauce、Yeast extract powder、Thickener（modified starch）、acidulant	36.00	1.32	0.92	5.72	0.52

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Table 2 shows the content and nutritional value of the four commercially available Thickeners. 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 2 grams of thickener (A, B, C, and D) to the food (100g) after 30seconds, 5minnutes, 15minnutes, and 30minutes.

b) Viscosity measurement method

Using the 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 a room temperature of 24 degrees. Viscosity measurements by line spread test (LST) were performed three repetitions 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 in thering (capacity is 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 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 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 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 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 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 with egg decreased from moderately thick to mildly thick with time. The white rice porridge with egg was processed with a mixer to become a uniform viscosity became mildly dense. The thickener B, C, and D were added to the liquid white rice porridge with egg, and the viscosity remained highly viscous. But, with the thickener A added to the liquid white rice porridge with egg, the viscosity decreased from highly dense to moderately dense with time.

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

	After 30 seconds	After 5 minutes	After 15 minutes	After 30 minutes
No adjustment	37.0 ± 3.1	39.5 ± 2.1	40.3 ± 2.4	40.3 ± 2.1
Mixer processing (MP)	48.9 ± 5.6	54.8 ± 11.5	55.5 ± 12.7	54.5 ± 11.6
MP with Thickener A (Toromicria)	30.5 ± 2.8	32.4 ± 4.0	34.0 ± 3.0	34.3 ± 3.1
MP with Thickener B (Tururinko)	26.9 ± 2.3	28.4 ± 2.6	29.3 ± 2.8	29.7 ± 3.2
MP with Thickener C (Toromifaiver)	27.6 ± 3.6	29.1 ± 4.0	29.7 ± 3.9	29.9 ± 4.1
MP with Thickener D (Neohaitoromi-ru)	23.5 ± 5.3	24.5 ± 6.0	26.2 ± 5.7	24.6 ± 5.5

a) Statistical processing results

The line spread test results and statistical processing results are shown in Table 4-9. For all the samples, the viscosity was statistically significantly weakened from 30 seconds to 5 minutes, and from 5 minutes to 15 minutes after putting the white rice porridge with egg on the viscometer plate under other conditions. The viscosities of the white rice porridge with egg with thickeners B, C, and D were highly dense.

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

	After 30 seconds	After 5 minutes	After 5 minutes	After 15 minutes	After 15 minutes	After 30 minutes
Average value ±Standard deviation	37.0±3.1	39.5±2.1	39.5±2.1	40.3±2.4	40.3±2.4	40.3±2.1
F test	P=0.058		P=0.309		P=0.305	
Paired Student t-test	p-0.0001**		p-0.0001**		p=0.668	
Wilcoxon test						

Table 5. Line spread test (LST) measurement results of egg 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	48.9±5.6	54.8±11.5	54.8±11.5	55.5±12.7	55.5±12.7	54.5±11.6
F test	P=0.002**		P=0.349		P=0.454	
Paired Student t-test			p=0.579		p=0.306	
Wilcoxon test	p-0.002**					

Table 6. Line spread test (LST) measurement results of egg 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	30.5±2.8	32.4±4.0	32.4±4.0	34.0±3.0	34.0±3.0	34.3±3.1
F test	P=0.070		P=0.120		P=0.458	
Paired Student t-test	p=0.004**		p=0.010**		p=0.780	
Wilcoxon test						

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

	After 30 seconds	After 5 minutes	After 5 minutes	After 15 minutes	After 15 minutes	After 30 minutes
Average value ±Standard deviation	26.9±2.3	28.4±2.6	28.4±2.6	29.3±2.8	29.3±2.8	29.7±3.2
F test	P=0.665		P=0.423		P=0.246	
Paired Student t-test	p=0.0001**		p=0.0001**		p=0.250	
Wilcoxon test						

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

	After 30 seconds	After 5 minutes	After 5 minutes	After 15 minutes	After 15 minutes	After 30 minutes
Average value ±Standard deviation	27.6±3.6	29.1±4.0	29.1±4.0	29.7±3.9	29.7±3.9	29.9±4.3
F test	P=0.315		P=0.474		P=0.432	
Paired Student t-test	p=0.0001**		p=0.0001**		p=0.381	
Wilcoxon test						

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

	After 30 seconds	After 5 minutes	After 5 minutes	After 15 minutes	After 15 minutes	After 30 minutes
Average value ±Standard deviation	23.5±5.3	24.5±6.0	24.5±6.0	26.2±5.7	26.2±5.7	24.5±5.5
F test	P=0.306		P=0.412		P=0.440	
Paired Student t-test	p=0.0001**		p=0.034*		p=0.095	
Wilcoxon test						

IV. Discussions

Using commercially available retort porridge, which is helpful in times of disaster, we tried to make a thick porridge that can avoid the risk of aspiration by people with dysphagia. In a paper published by the authors in the past, adding Thickener D (including dextrin, calcium lactate, and polysaccharide) to white rice porridge made it more viscous and stable[6]. In the white rice porridge with sticky barley (rich in fat), adding Thickener B (including dextrin, calcium lactate, xanthan gum, and tri-sodium chloride) and Thickener D made it more viscous and stable[7]. In white rice porridge with salmon (rich in protein), adding Thickener B (including dextrin, calcium lactate, xanthan gum, and tri-sodium chloride) and Thickener D made it more viscous and stable[8]. In the case of the white rice porridge with egg (rich in fat and protein), adding Thickener D (including dextrin, calcium lactate, and polysaccharide) made it more viscous and stable. As previously reported on the relationship between ease of swallowing and food viscosity[9,10], low viscosity also increases the likelihood of aspiration. Depending on the difference in the nutrients in the target food, it is considered that there is compatibility with other ingredients of the thickener containing dextrin. In order to think of a better combination, it is necessary to measure the viscosity of more combinations of thickeners and porridges.

V. Conclusion

A commercially available retort porridge, which is useful even in the event of a disaster, was used. A thickener added to avoid the risk of aspiration by people with impaired swallowing function. The viscosity of white rice porridge with eggs, which contains more protein and fat than white rice porridge, stabilized when Thickener D (including dextrin, calcium lactate, and polysaccharide) was added. The viscosity is also stabilized when Thickener B (including dextrin, calcium lactate, xanthan gum, and tri-sodium chloride) is added to the white rice porridge with eggs. When the thickener D was added to the white rice porridge with egg, the viscosity of the porridge stabilized more than when the thickener B was added. This difference in viscosity may be due to differences in the polysaccharide content of the thickening agent.

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