Global Journal of Medical Research: L
Nutrition & Food Science
Volume 22 Issue 3 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4618 & Print ISSN: 0975-5888

Line Spread Test Results for Commercially Available the White Rice Porridge with Salmon

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By making porridge into a uniform liquid porridge with a mixer, baby food and people with weak chewing ability can eat it. Uniform liquid porridge poses a risk of aspiration for people with impaired swallowing function. In this study, we report the result of making the white rice porridge with salmon into a uniform liquid porridge with a mixer and adding four different types of Thickener to increase the viscosity. By adding salmon as an ingredient, the amount of protein was higher than that of white rice porridge. By adding two types of Thickener containing dextrin and calcium lactate, the viscosity remained stable over time. The type of thickening agent that stabilizes the viscosity varies depending on the nutrients contained in the porridge, we would like to study more combinations of porridge and thickening agents in the future.

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GJMR-L Classification: NLMC Code: QU 145

Strictly as per the compliance and regulations of:

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

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By making porridge into a uniform liquid porridge with a mixer, baby food and people with weak chewing ability can eat it. Uniform liquid porridge poses a risk of aspiration for people with impaired swallowing function. In this study, we report the result of making the white rice porridge with salmon into a uniform liquid porridge with a mixer and adding four different types of Thickener to increase the viscosity. By adding salmon as an ingredient, the amount of protein was higher than that of white rice porridge. By adding two types of Thickener containing dextrin and calcium lactate, the viscosity remained stable over time. The type of thickening agent that stabilizes the viscosity varies depending on the nutrients contained in the porridge, we would like to study more combinations of porridge and thickening agents in the future.

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I. Introduction

Commercially available retort porridge is beneficial daily and in the event of a disaster. Porridge on the market already contains enough water, making it easy to eat. If the porridge contains ingredients (meat, fish, vegetables, etc.), the nutritional value will be higher. Daily, we can add side dishes to commercially available rice porridge for a meal, but in times of disaster, it may be challenging to make said plates because lifelines are cut off. At that time, if there is porridge containing ingredients (meat, fish, vegetables, etc.), it will be possible to supplement nutrients as a meal. In the case of porridge with ingredients, it may be necessary to use a mixer to make it into a uniform liquid porridge for baby food or people with impaired swallowing function. Liquid porridge is less viscous and more likely to be aspirated by people with poor swallowing ability. Therefore, it is necessary to add a thickener to the liquid porridge to increase its viscosity. In this study, we investigated the stability of white rice porridge with salmon, which has a higher protein content than white rice porridge after adding a thickener.

II. Materials and Methods

The nutritional components of the white rice porridge with salmon used in this experiment are shown in the Table 1. The white rice porridge with salmon used had 37.20 kcal, 1.20g of protein, 7.60g of carbohydrate, and 0.56g 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 salmon	Non-glutinous rice、Sockeye salmon flakes、Salt、Kombu stock、Yeast extract powder	37.20	1.20	0.00	7.60	0.56

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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 with salmon decreased from moderately thick to mildly thick with time. The white rice porridge with salmon was processed with a mixer to become a uniform liquid, the viscosity became mildly thick. However, when the Thickener B and D added to the liquid white rice porridge with salmon, the viscosity remained highly dense. When the thickener C added to the liquid white rice porridge with salmon, the viscosity decreased from highly dense to moderately dense with time. When the thickener A was added to the liquid white rice porridge with salmon, the viscosity decreased from moderately dense to mildly dense with time.

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

	After 30 seconds	After 5 minutes	After 15 minutes	After 30 minutes
No adjustment	31.9 ± 5.3	34.8 ± 3.7	35.5 ± 4.2	35.5 ± 4.2
Mixer processing (MP)	47.4 ± 3.6	53.1 ± 9.8	53.7 ± 9.6	53.7 ± 9.8
MP with Thickener A (Toromicria)	35.6 ± 1.9	39.2 ± 2.4	40.7 ± 2.6	41.0 ± 2.5
MP with Thickener B (Tururinko)	26.8 ± 3.5	28.6 ± 3.7	28.3 ± 7.2	30.1 ± 3.8
MP with Thickener C (Toromifaiver)	31.9 ± 2.3	35.2 ± 2.7	36.2 ± 4.0	36.4 ± 2.7
MP with Thickener D (Neohaitoromi-ru)	23.6 ± 3.1	24.7 ± 3.0	25.5 ± 3.1	25.6 ± 3.1

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 after putting the white rice porridge with salmon on the viscometer plate under other conditions. The white rice porridge with salmon with thickeners A, B, C, and D, the viscosity was statistically significantly weakened from 5 minutes to 15 minutes after putting the white rice porridge with salmon on the viscometer plate. The viscosities of the white rice porridge with salmon with thickener B and D were highly dense.

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

	After 30 seconds	After 5 minutes	After 5 minutes	After 15 minutes	After 15 minutes	After 30 minutes
Average value ±Standard deviation	31.9±5.3	34.8±3.7	34.8±3.7	35.5±4.2	35.5±4.2	35.5±4.2
F test	P=0.076		P=0.309		P=0.483	
Paired Student t-test	p=0.002**		p=0.264		p=1.000	
Wilcoxon test						

Table 5. Line spread test (LST) measurement results of salmon 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	47.4±3.6	53.1±9.8	53.1±9.8	53.7±9.6	53.7±9.6	53.7±9.8
F test	P=0.0001**		P=0.472		P=0.475	
Paired Student t-test			p=0.116		p=0.579	
Wilcoxon test	p=0.004**					

Table 6. Line spread test (LST) measurement results of salmon 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	35.6±1.9	39.2±2.4	39.2±2.4	40.7±2.6	40.7±2.6	41.0±2.5
F test	P=0.188		P=0.397		P=0.441	
Paired Student t-test	p=0.0001**		p=0.0001**		p=0.0001**	
Wilcoxon test						

Table 7. Line spread test (LST) measurement results of salmon 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	26.8±3.5	28.6±3.7	28.6±3.7	28.3±7.2	28.3±7.2	30.1±3.8
F test	P=0.399		P=0.003		P=0.005**	
Paired Student t-test	p=0.0001**		p=0.023*			
Wilcoxon test					p=0.114	

Table 8. Line spread test (LST) measurement results of salmon 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	31.9±2.3	35.2±2.7	35.2±2.7	36.6±4.0	36.6±4.0	36.4±2.7
F test	P=0.300[		0p=0.470*		P=0.054	
Paired Student t-test	p=0.0001**				p=0.738	
Wilcoxon test			p=0.004**			

Table 9. Line spread test (LST) measurement results of salmon 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	23.6±3.1	24.7±3.0	24.7±3.0	25.5±3.1	25.5±3.1	25.6±3.1
F test	P=0.433		P=0.413		P=0.499	
Paired Student t-test	p=0.007**		p=0.001**		p=0.163	
Wilcoxon test						

IV. Discussions

The liquid rice porridge of white rice porridge with salmon, which has a higher protein content than white rice porridge, became thicker with the four different thickeners used in this study. Thickeners containing dextrin, polysaccharide thickener, and lactate were the most dense, followed by Thickeners included dextrin, xanthan gum, trisodium chloride, and calcium lactate. The other two thickeners made the porridge more viscous than the liquid porridge alone, but did not produce a thick consistency. Thickeners containing dextrin and calcium lactate are likely to increase the viscosity of liquid porridge with high protein content. The viscosity of the liquid porridge is thin and thick, making it a good meal for people with weakened masticatory function. Since the viscosity of the liquid porridge is low, there is a risk of aspiration for people with impaired swallowing function[6,7]. In the future, it is necessary to research the combination of the nutritional value of commercially available porridge and a suitable thickening agent that stabilizes the viscosity when it is made into a liquid porridge.

V. Conclusion

White rice porridge with salmon, which has a higher protein content than white rice porridge, was made into a uniform liquid porridge using a mixer, and Thickener added to examine the stability of viscosity. The results showed that thickening agents containing dextrin and calcium lactate increased the viscosity of the liquid porridge. It may be necessary to investigate in more detail the combination of porridge and thickener that have different nutritional values.

Acknowledgments

We would like to thank Ms. Sahoko Ito for her cooperation in the LST experiment.

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