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Effect of the Proportion of Rice Flour; Modified White Corn Flour (*Zea mays L*) and Addition of *Sodium Tripolyphosphate* (STPP) to Vermicelli Characteristics

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A B S T R A C T

Vermicelli, a form of food diversification from rice, was investigated in this study using modified rice flour and white corn flour (Zea mays L). The modification of white corn flour, employing the BIMO-CF starter containing various lactic acid bacteria, aimed to increase amylose levels. Sodium Tripolyphosphate (STPP) was added to improve the vermicelli's physical properties, including stickiness, color, hardness, and chewiness. A 2-factor Complete Randomized Design (CRD) with two replicates was utilized. Data were analyzed using ANOVA at a 5% significance level, followed by a DMRT 5% post-hoc test if significant effects were observed. Results demonstrated significant interactions between the proportions of rice flour, modified white corn flour, and STPP on vermicelli's water content, ash content, protein content, starch content, amylose content, elasticity, and rehydration power. The optimal treatment was a combination of rice flour and modified white corn flour in a 50:50 ratio with 0.3% STPP, resulting in vermicelli with 8.65% water content, 0.72% ash content, 5.60% protein content, 52.5% elasticity, 127.5% rehydration power, and average sensory scores of 4.04 for color, 4.20 for aroma, 3.88 for taste, and 4.16 for texture, indicating favorable consumer acceptance.

1. INTRODUCTION

1.1. Research Background

Vermicelli is known in various countries with terms such as bihon, bijon, bifun, mehon, and vermicelli. Vermicelli is one of the staple foods that is quite familiar in Indonesian society. The main raw material in the manufacture of vermicelli is rice flour. Vermicelli contains energy of 360 kilo calories with a content of 82.1 grams in 10 grams. Good vermicelli can be processed with a 25-30% amylose content.

Rice flour has amylose (20-30%) and amylopectin (70-80%). Amylose is a linear polysaccharide with related D-glucose units α-1,4, while amylopectin is a highly branched polysaccharide consisting of short chains of α-1,4 held together by α-1,6 [1]. Rice flour is one of the alternative basic ingredients of composite flour and consists of carbohydrates, fats, proteins, minerals and vitamins. Making rice flour takes 12 hours by soaking rice in clean water, drained, dried in the sun, mashed, and sifted using an 80 mesh sieve [2].

White corn (*Zea mays L*) has a high amylopectin content and low amylose. White corn (*Zea mays L*) has a physicochemical appearance and tastes more like rice. White corn *(Zea mays) is* a cereal commodity with components such as components in conventional rice, white corn is a food commodity producing high carbohydrates (83.64%) after rice. The reservoir contained white corn, almost similar to rice; white corn has potential as an alternative material for making vermicelli, so in research, white corn was used as raw material for making vermicelli.

BIMO-CF starter is a seed in the form of flour (*powder*) used for the fermentation of cassava in the form of chips or sawdust. BIMO-CF starter consists of carrier ingredients and lactic acid bacteria active ingredients that are safe for food, enriched with nutrients, and made with technology that produces high starter stability and effectiveness [3]. BIMO-CF starter is in the form of nutrient-enriched flour to produce flour with high stability and effectiveness. Modification of white corn flour (*Zea*

mays L) by fermentation using BIMO-CF starter has not been widely done. Modifying white corn flour (*Zea mays L*) by fermentation using a BIMO-CF starter is expected to increase amylose levels.

Good vermicelli criteria can be determined based on appearance and texture. Therefore, tapioca flour, which functions as a binder, will be added to make vermicelli. Tapioca flour is an adhesive that forms a good dough. Tapioca is used in making vermicelli as a gelatinization process to produce good vermicelli [4].

STPP (*Sodium Trypolyphosphate)* is an organic compound with the chemical formula $Na_5P_3O_{10}$. It is a white crystalline powder that is odorless, soluble in water and used as a water softener, food preservative, and texturizer. Adding STPP (*Sodium Trypholyphospahate)* aims to improve the quality of vermicelli, which has an elastic and chewy texture. Adding STPP (*Sodium Trypolyphosphate)* can produce vermicelli with good physical properties in terms of stickiness, color, hardness, and chewiness.

This study aimed to analyze the effect of the proportion of rice flour and modified white corn flour (Zea mays L) with the addition of STPP on vermicelli's physicochemical and organoleptic characteristics and determine the best treatment for the entire treatment.

1.2. Literature Review

Vermicelli is one of the staple foods that is quite familiar in Indonesian society. The main raw material in the manufacture of vermicelli is rice flour. Raw material rice flour, one of the largest sources of carbohydrates, vermicelli can be used as a source of calories/energy. Vermicelli contains energy of 360 kilo calories with a content of 82.1 grams in 10 grams. Good vermicelli criteria can be determined based on appearance and texture [4].

Sodium Trypolyphosphate (STPP) is a food additive that can be added to food in the permitted amount. *Sodium Trypolyphosphate* (STPP) functions as a chewer and can bind water. STPP can form rice noodles into chewy so that they are not easily broken and can absorb water to form hydrocolloids so that they can develop rice noodles and do not shrink easily during cooking. The phosphate group in *Sodium Tripolyphosphate* (STPP) can react with the -OH group in the amylose structure, and amylopectin can form crosslinks so that the integrity of starch granules is stronger [5]. The safe and allowable dose is 3 grams/kg of dough weight or 0.3%. Use exceeding the dose of 0.5% will degrade the appearance of the product, that is, it is too chewy, like rubber, and tastes bitter.

The characteristics of flour largely determine its use in food products about the quality of the product. Modified cornstarch has a different tendency from natural cornstarch. The function of the fermentation process in making corn flour is to change the physicochemical and functional properties. Fermentation causes changes in the nutritional content of corn, including carbohydrates, proteins, fats, dietary fiber, vitamins, and minerals [6].

Lactic acid bacteria are a group of bacteria that can convert carbohydrates (glucose) into lactic acid by fermenting carbohydrates. BAL that can utilize starch as a substrate is known as amylase-producing BAL. The enzyme α-amylase is an enzyme that hydrolyzes the α-1,4 glycosidic linear bonds at random amylose to produce a mixture of dextrin, maltose, and glucose. BIMO-CF starter is a seed for cassava fermentation in the biological MOCAF manufacturing process. BIMO-CF starter consists of carrier material and active ingredient Lactic Acid Bacteria. BIMO-CF starter is made from a carrier raw material in flour added with a certain concentration of nutritional additives to increase effectiveness and stability. BIMO-CF starter uses active ingredients of various lactic acid microbes that are safe for food, enriched with nutrients, and made with technology that produces high starter stability and effectiveness [3].

1.3. Research Objective

This study aims to analyze the effect of the proportion of rice flour, white corn flour, and the addition of STPP (0.1%, 0.2%, and 0.3%) on the physicochemical properties of vermicelli and determine the best formulation of all treatments.

2. MATERIALS AND METHODS

2.1. Material and Tools

The main ingredients used in making vermicelli are rice flour and white corn flour (*Zea mays L*) modified using BIMO-CF starter produced by the Center for Agricultural Post-Harvest Research and Development. While rice flour uses the Rose Brand brand. The additional ingredients used for making vermicelli in this study were water, Rose Brand tapioca flour and STPP (*Sodium Trypolyphosphate)* purchased in *e-commerce.*

The analysis materials used include HCL, H_2SO_4, NaOH, Alcohol, Iodine, Acetic Acid, Aquades, BCG-MR, and indicator. Tools used to make vermicelli include spoons, pans, lids, basins, stoves, digital scales, analytical scales, *multifunctional noodle machines*, *steam blanchers*, and *cabinet dryers*.

Equipment used in the test included moisture ovens, pipettes, test tubes, desiccators, ovens, water baths, measuring flasks, kilns, blenders, 80 mesh sieves, Erlenmeyer 250ml, 100ml measuring cups, and weighing bottles.

2.2. Research Design and Analysis

The research design used in this study was a Complete Randomized Design (RAL) with a 2-factor factorial pattern with two replications. The treatment used was the proportion of modified rice flour and corn ovaries (70:30, 60:40, and 50:50) and the addition of STPP (0.1%, 0.2%, and 0.3%). Observational variable data were statistically tested using variance analysis at α=5% using the DMRT follow-up test. The method used to determine the best treatment is the Garmo effectiveness test.

2.3. Research Implementation

2.3.1. Making of Modified White Corn Flour

1 kg of corn flour is added 1 liter of equates and 1gr of BIMO-CF starter; the ingredients are then mixed into a fermentation container. The material is fermented in a sealed container for 24 hours. The material is drained to reduce moisture content, then dried in the *cabinet dryer* at 60°C for 6 hours. The material is reduced in size with a blender and continued sieving with a size of 80 mesh.

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2.3.2. Making Vermicelli

Tapioca, as much as 40% (w/w) of the mixture of rice flour and white corn flour, is added to boiling water as much as 60% (w/w) of the rice flour mixture and modified white corn flour for gelatinization. The gelatinized starch is mixed with rice flour and white corn flour with a 70:30 formulation, 60:40; 50:50%, and added STPP as much as 0.1%,0.2%, and 0.3% (w/w) from a mixture of rice flour and modified white corn flour. Making dough is done by kneading until the dough is well mixed and steamed at a temperature of ±100°C for 1 hour. The dough is then printed with a hole diameter of 1.5 mm shaped like yarn and dried using an oven at 65 ° C for ± 2 hours so that vermicelli is obtained.

2.4. Analytical methods

2.4.1. Raw Material Analysis

Analysis parameters include moisture content, ash content, protein content, starch content, and amylose content.

2.4.2. Chemical Analysis

Analysis parameters include moisture content, ash content, protein content, starch content, and amylose content.

2.4.3. Physical Analysis

Analysis parameters include elasticity and rehydration power.

3. RESULTS AND DISCUSSION

3.1. Raw Material Analysis

Analysis of raw materials in the form of rice flour, modified corn flour and tapioca flour consists of water, ash, protein, starch, and amylose. The results of raw material analysis can be seen in Table 1 and Table 2.

Table 1. Analysis Results of White Corn Flour and White Corn Flour Modified

Parameters	White Corn Starch	White Corn Starch Modified
Water Content (%)	10.79 ± 0.24	6.72 ± 0.01
Ash Content (%)	0.56 ± 0.02	0.71 ± 0.12
Protein Content (%)	7.65 ± 0.00	8.44 ± 0.00
Amylose Content (%)	23.87 ± 0.07	28.43 ± 0.03
Starch Content (%)	65.56 ± 0.09	71.11 ± 0.09

Table 1 shows white corn flour has a moisture content of 10.79%, ash content of 0.56%, protein content of 7.65%, starch content of 65.56% and amylose content of 23.87% Themodified white corn flour using BAL in the BIMO-CF Starter has a moisture content of 6.72%, ash content of 0.71%, the protein content of 8.44%, the starch content of 71.11%, and amylose content of 28.43% Based on the results of the study, it is known that the results of modifying white corn flour using BIMO-CF Starter increased amylose levels and protein levels. This is because during corn flour fermentation for 24 hours using a BIMO-CF starter, which contains lactic acid, bacteria-producing proteinase enzymes will convert protein into amino acids, which then become lactic acid so that there is a decrease in protein at 14 hours of fermentation time. The longer the fermentation time, the microbes increase, so that dissolved protein levels after a 24-hour fermentation process increase [7].

Amylose levels in modified white corn flour using BAL in BIMO-CF Starter increased from 23.87% to 28.43%. The BIMO-CF starter has lactic acid bacteria that can degrade the branch chain in amylopectin to produce amylose in fermented corn flour. The smaller the size and the longer the fermentation, the faster the bond-breaking process will occur. During fermentation, microbes break the glycosidic α-1,6 bonds in the amylopectin branch chain into amylose straight chains, increasing amylose levels [8].

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Table 2. Analysis Results of Rice Flour and Tapioca Flour.

Parameters	Rice Flour	Tapioca Flour
Water Content (%)	11.09 ± 0.72	12.25 ± 0.86
Ash Content (%)	0.64 ± 0.12	0.32 ± 0.26
Protein Content (%)	5.6 ± 0.00	2±0.00
Amylose Content (%)	20.45± 0.03	16.96± 0.07
Starch Content (%)	70.11 ± 0.09	89.86 ± 0.18

Table 2 shows that rice flour has a moisture content of 11.09%, ash content of 0.64%, starch content of 70.11%, and amylose content of 20.45%. Tapioca flour has a moisture content of 12.25%, ash content of 0.32%, starch content of 89.86%, and amylose content of 16.96%.

3.2. Chemical Analysis

The chemical analysis of vermicelli includes water, ash, protein, starch, and amylose.

3.2.1. Water Content

Based on the results of variance analysis, there was a real interaction ($p \leq 0,05$) between the treatment of the proportion of rice flour, modified corn flour, and the addition of STPP to a moisture content of vermicelli. The average value of water content of vermicelli can be seen in Table 3.

Table 3. *Average Value of Water Content in Vermicelli*

Treatment		Water Content (%)	DMRT (5%)
Flour Proportions	Addition of STPP		
70:30	0.1%	4.51±0.71a	1.567
	0.2%	5.50±0.78a	1.635
	0.3%	7.93±0.01b	1.675
60:40	0.1%	8.05±0.82b	1.7
	0.2%	8.18±0.06b	1.715
	0.3%	8.28±0.09b	1.726
50:50	0.1%	8.30±1.32b	1.732
	0.2%	8.54±0.50b	1.735
	0.3%	8.65±0.54b	-

Note: The average value accompanied by different letters shows a noticeable difference at $p \leq 0.05$

Table 2 shows the average moisture content of vermicelli ranges from 4.51% - 8.65%. The highest water content of 8,65% was found in the treatment with the proportion of rice flour and the modified white corn flour (50:50) with the addition of 0,3% STOO. In comparison, the treatment with the proportion of rice flour and modified white corn flour (70:30) with the addition of 0,1% STPP produced the lowest water content of 4,51%. Amylopectin plays a role in water absorption; amylopectin has

smaller pores than amylose. As a result, it isn't easy to release water, which causes higher water content available Nisah (2017). The higher the addition of STPP, the higher the moisture content value will be, but statistically, it is not significantly different. This is thought to be due to the addition of STPP relatively little 0.1%-0.3%. In addition, STPP 0.3% produces the highest moisture content. STPP can increase water content because STPP is a hydrophilic phosphate group. The phosphate fraction can bind water, which causes the water-binding capacity by starch to be higher [9]; [10].

3.2.2. Ash Content

Based on the variance results, there was a real interaction ($p \leq 0.05$) between the treatment of the proportion of rice flour, modified white corn flour, and the addition of STPP to vermicelli ash content. The average value of water content of vermicelli can be seen in Table 4.

Table 4. Average value of ash content in vermicelli

Treatment		Ash Content (%)	DMRT (5%)
Flour Propotions	**Addition of STPP**		
70:30	0.1%	0.43 ± 0.01c	0.085
	0.2%	0.48 ± 0.01bc	0.092
	0.3%	0.52 ± 0.02bc	0.093
60:40	0.1%	0.45 ± 0.03bc	0.091
	0.2%	0.54 ± 0.06b	0.094
	0.3%	0.66 ±a 0.08a	0.093
50:50	0.1%	0.43± 0.04c	0.089
	0.2%	0.53 ± 0.02b	0.093
	0.3%	0.72 ± 0.01a	-

Note: The average value accompanied by different letters shows a noticeable difference at $p \leq 0.05$

Table 4 shows the average ash content of vermicelli ranges from 0.43%-0.72%. The higher the proportion of modified white corn flour and the higher the addition of STPP, the ash content obtained increases. This is because the ash content of modified white corn (0.71%) is higher than rice flour (0.64%), so the higher the use of white corn flour, the ash content of vermicelli increases. The high and low ash content is influenced by differences in mineral content contained in raw materials [11]. Similarly, the addition of STPP which is getting higher, produces increasing vermicelli ash content. STPP is an inorganic salt constituent component of minerals; the more phosphate groups are bound, the more ash content suggests that phosphate groups are constituent components of ash [12].

3.2.3. Protein Content

Based on the results of variance analysis, there was a real interaction ($p \leq 0.05$) between the treatment of the proportion of rice flour, modified white corn flour, and the addition of STPP to vermicelli protein levels. Based on the results of variance analysis, there was a real interaction ($p \leq 0.05$) between the treatment of the proportion of rice flour, modified white corn flour, and the addition of STPP to vermicelli protein levels. The average value of vermicelli protein content can be seen in Table 5.

Table 5. Average value of protein content in vermicelli

Treatment		Protein	DMRT
Flour Propotions	**Addition of STPP**	**Content (%)**	**(5%)**
70:30	0.1%	5.35 ± 0.01e	0.059
	0.2%	5.30 ± 0.03ef	0.058
	0.3%	5.29 ± 0.03f	0.055
60:40	0.1%	5.52 ± 0.03c	0.061
	0.2%	5.49 ± 0.03c	0.061
	0.3%	5.43 ± 0.01d	0.06
50:50	0.1%	5.77 ± 0.03a	-
	0.2%	5.64 ± 0.01b	0.061
	0.3%	5.60 ± 0.03b	0.061

Note: The average value accompanied by different letters shows a noticeable difference at $p \leq 0.05$

Table 5 shows that the average value of protein content in vermicelli products ranges from 5.29-5.77-%. The treatment of adding the proportion of rice flour and modified white corn flour (50:50) with the addition of STPP (0.1%) resulted in the highest protein content value of 5.77%. In comparison, in the treatment, the proportion of rice flour and modified white corn flour (70:30) with the addition of STPP (0.3%) resulted in the lowest moisture content value of 5.29%. The higher the addition of STPP, the higher the protein content of vermicelli will decrease. STPP can add flavor, improve texture, prevent rancidity, and improve the quality of the final product by binding nutrients dissolved in salt solutions, such as proteins, vitamins, and minerals [13].

3.2.4. Starch Content

Based on the results of variance analysis, there was a real interaction ($p \leq 0.05$) between the treatment of the proportion of rice flour, modified white corn flour, and the addition of STPP to the moisture content of vermicelli. The average value of vermicelli starch content can be seen in Table 6

Table 6. Average value of starch content in vermicelli

Treatment		Starch Content (%)	DMRT (5%)
Flour Propotions	**Addition of STPP**		
70:30	0.1%	67.82 ± 0.09f	0.212
	0.2%	66.76 ± 0.09g	0.207
	0.3%	59.93 ± 0.09h	0.198
60:40	0.1%	71.25 ± 0.09c	0.218
	0.2%	70.64 ± 0.09d	0.217
	0.3%	69.92 ± 0.17e	0.215
50:50	0.1%	77.16 ± 0.09a	-
	0.2%	72.39 ± 0.00b	0.219
	0.3%	72.27 ± 0.09b	0.219

Note: The average value accompanied by different letters shows a noticeable difference at $p \leq 0.05$

Table 6. Shows that the average value of starch content in vermicelli products ranges from 59.93-77.16%. The treatment of adding the proportion of modified rice flour and white corn flour (50:50) with the addition of STPP (0.1%) resulted in the highest starch content value of 77.16%. In comparison, the treatment of the proportion of modified rice flour and white corn flour (70:30) with the addition of STPP (0.3%) resulted in the lowest starch content value of 59.93%.

The lower proportion of rice flour and the higher the proportion of modified white corn flour causes the starch

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content of vermicelli to increase. However, the higher the addition of STPP, the starch content of vermicelli decreases. This is because the starch content in modified white corn (71.11%) is higher than in rice flour (70.11%), so the higher the use of modified white corn flour, the starch content of vermicelli increases. Meanwhile, the decrease in starch content with the addition of higher STPP is caused by STPP binding water and increases water content so that vermicelli starch levels decrease. The addition of more STPP to starch results in lower starch levels. Vermicelli starch levels decrease with the increasing addition of STPP; this is due to hydrogen bridges in starch molecules being substituted by phosphate compounds so that phosphate bridges are formed on starch molecules, and these bridges, when analyzed are not detected as starch compounds, causing starch levels to decrease with the increasing number of phosphate bridges formed.

3.2.5. Amylose Content

Based on the results of variance analysis, there was a real interaction ($p \leq 0.05$) between the treatment of the proportion of rice flour and modified corn flour with the addition of STPP to vermicelli amylose levels. The average value of vermicelli amylose content with the proportion treatment of rice flour and modified corn flour with the addition of STPP can be seen in Table 7.

Table 7. Average Value of Amylose Content for Vermicelli

Treatment		Amylose Content (%)	DMRT (5%)
Flour Proportions	**Addition of STPP**		
70:30	0.1%	22.56 ± 0.02f	0.091
	0.2%	22.22 ± 0.02g	0.089
	0.3%	21.55 ± 0.04h	0.085
60:40	0.1%	22.89 ± 0.02d	0.094
	0.2%	22.84 ± 0.02d	0.093
	0.3%	22.65 ± 0.07e	0.092
50:50	0.1%	23.61 ± 0.05a	-
	0.2%	23.50 ± 0.02b	0.094
	0.3%	23.27 ± 0.04c	0.094

Note: The average value accompanied by different letters shows a noticeable difference at $p \leq 0.05$

Table 7 shows that the average value of amylose content in vermicelli products ranges from 21.55-23.61%. The treatment with the addition of the proportion of rice flour and modified white corn flour (50:50) with the addition of STPP (0.1%) produced the highest amylose content value, namely 23.61%, whereas in the treatment with the proportion of rice flour and modified white corn flour (70:30) with the addition of STPP (0.3%) produced the lowest starch content value, namely 21.55%.

The lower the proportion of rice flour and the higher the proportion of modified white corn flour the amylose content of vermicelli to increase. However, the higher the addition of STPP, the amylose content of the vermicelli decreased. This is because the amylose content in modified white corn (28.43%) is higher than in rice flour (20.45%), so the higher the use of modified white corn flour, the higher the amylose content of vermicelli. Meanwhile, the decrease in amylose content with the addition of higher STPP is because STPP binds water and increases the water content so that the starch content of vermicelli decreases, followed by a decrease in amylose content.

3.3. *Physical Analysis*

Physical analysis of vermicelli includes elasticity and rehydration capacity.

3.3.1. Elasticity

Based on the results of variance analysis, there was a significant interaction ($p \leq 0.05$) between the treatment of the proportion of rice flour and modified corn flour with the addition of STPP on the elasticity of vermicelli. The average value of elasticity of rice noodles treated with the proportion of rice flour and corn flour modified with the addition of STPP can be seen in Table 8.

Table 8. Average Value of Elasticity for Vermicelli

Treatment		Elasticity (%)	DMRT (5%)
Flour Proportions	**Addition of STPP**		
70:30	0.1%	12.50 ±3.54	7.998
	0.2%	22.50 ±3.54	8.348
	0.3%	35.00 ±7.07	8.55
60:40	0.1%	40.00 ±0.00	8.675
	0.2%	45.00 ±0.00	8.755
	0.3%	45.00 ±0.00	8.808
50:50	0.1%	47.50 ±3.54	8.84
	0.2%	47.50 ±3.54	8.86
	0.3%	52.50 ±3.54	-

Note: The average value accompanied by different letters shows a noticeable difference at $p \leq 0.05$

Table 8 shows that the average elasticity value for vermicelli products ranges from 12.50%-52.50%. The treatment of adding the proportion of rice flour and modified white corn flour (50:50) with the addition of STPP (0.3%) produced the highest elasticity value, namely 52.50%. In comparison, the treatment of adding the proportion of rice flour and modified white corn flour (70:30) with the addition of STPP (0.1%) produces the lowest elasticity value, namely 12.50%. The more STPP added, the greater the vermicelli's elasticity level.

The less rice flour you use and the more modified white corn flour you use, the more elasticity you get. This is because the amylose and amylopectin levels of vermicelli can also influence the elasticity of vermicelli. The amylose content of modified white corn flour is (28.43%) while the amylose content of rice flour is (20.45%). So the higher the use of modified white corn flour, the more elasticity of the vermicelli produced will increase. This is due to the gel-forming ability of starch through the gelatinization process and the strong sticky power formed from the high levels of amylopectin. Amylose can affect elasticity when high levels of dissolved amylose are accompanied by a high ability to expand granules, the elasticity of noodles will increase [14]. Starch with a high amylose content has greater hydrogen bond strength because of the large number of straight chains in the granules, so it requires greater energy for gelatinization so that the resulting product is chewier [15].

3.3.2. Rehydration Power

Based on the results of variance analysis, there was a significant interaction ($p \leq 0.05$) between the treatment of the proportion of

rice flour and modified corn flour with STPP on vermicelli. The average value of the rehydration power of vermicelli treated with the proportion of rice flour and corn flour modified with the addition of STPP is seen in Table 9.

Table 9. Average Value of Vermicelli Rehydration Power

Treatment		Rehydration Power (%)	DMRT (5%)
Flour Proportions	Addition of STPP		
70:30	0.1%	88.00 ± 1.41f	3.109
	0.2%	90.39 ± 0.55f	3.245
	0.3%	97.00 ± 1.41e	3.323
60:40	0.1%	100.29 ± 0.44d	3.372
	0.2%	102.00 ± 1.41cd	3.403
	0.3%	105.01 ± 0.04bc	3.424
50:50	0.1%	106.00 ± 2.83b	3.436
	0.2%	108.00 ± 1.41b	3.443
	0.3%	127.50 ± 0.71a	-

Note: The average value accompanied by different letters shows a noticeable difference at p≤0.05

Table 9 shows that the higher the proportion of corn flour and the higher the addition of STPP, the rehydration power increases. This is because the starch content of modified white corn flour is higher than the starch content of rice flour. The rehydration power increases with an increased number of hydroxyl groups in starch [16]. The analysis results show that rice flour has a starch content of 70.11%, while modified white corn flour has a starch content of 71.11%. The starch content in the material can accelerate starch gelatinization and water absorption. Water's rehydration power increases with the addition of flour rich in amylose, so the incoming water will be high [17]. Rehydration power is influenced by the amylose content of the material [18]. Amylose has high rehydration capacity because it has hydrophilic groups and larger pores than amylopectin, making it easier for water to move out and evaporate when heated [19].

3.4. Determination of The Best Treatment

Determination of the best treatment using the de Garmo effectiveness test. From this test, it was found that the best treatment was the treatment with the proportion of modified rice flour and white corn (Zea mays L) (50:50) with the addition of 0.3% STPP which had the highest total NH, namely 1.8969. In the best treatment, water content was 8.65%, ash content 0.72%, protein content 5.60%, starch content 72.27%, amylose content 23.27%, elasticity 52.50%, rehydration power 127.50 % and organoleptic test scores for color were 4.04 (like), aroma 4.20 (like), taste 3.88 (like), and texture 4.16 (like).

4. CONCLUSION

Based on research on vermicelli treated with the proportion of rice flour and modified corn flour with the addition of STPP, the results were: (1) there was a significant interaction (p≤0.05) between treatments on water content, ash content, protein content, starch content, amylose content, elasticity and rehydration power; (2) The best treatment for vermicelli was the modified proportion of rice flour and white corn (Zea mays L) (50:50) with the addition of 0.3% STPP and obtained a water content of 8.65%, ash content of 0.72%, protein content 5.60%, starch content 72.27%, amylose content 23.27%, elasticity 52.50%, rehydration power 127.50% and organoleptic test score color of 4.04 (like), aroma 4.20 (like), taste 3.88(like), and texture 4.16(like).

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REFERENCE

[1] Roman, L., Yee, J., Hayes, A. M. R., Hamaker, B., Bertoft, E., & Martinez, M. M. 2020. On the role of the internal chain length distribution of amylopectins during retrogradation: double helix lateral aggregation and slow digestibility. Carbohydrate Polymers, 116633. doi:10.1016/j.carbpol.2020.11663

[2] Sari. R. A., Y. Martono, dan F. S. Rondinuwo. 2020. Potensi subtitusi beras putih dengan beras merah sebagai makanan pokok untuk perlindungan diabetes mellitus. Jurnal Ilmiah Multi Sciences, 12(1): 24-30.

[3] Misgiyarta, Suismono, Suyanti. 2009. Tepung Kasava Bimo Kian Prospektif. Warta Penelitian dan Pengembangan Pertanian Vol 31 (4):1-4. Balai Besar Penelitian Pascapanen, Bogor.

[4] Wiriani, D. 2015. Pemanfaatan pati termodifikasi fisik dari pisang dan kentang, tepung jagung serta karaginan untuk pembuatan bihun instan berdaya cerna rendah. (Skripsi). Universitas Sumatera Utara, Medan

[5] Romadhoni, M., dan Harijono, 2015. Karakteristik Pasta Tepung Gembili, Pati Sagu Dan Karagenan Potensinya Sebagai Bihun. Jurnal Pangan dan Agroindustri. 3(1): 53- 54.

[6] Aini, N., Wijonarko, G., dan Sustriawan, B. 2016. Sifat Fisik, Kimia, dan Fungsional Tepung Jagung Yang Diproses Melalui Fermentasi. *Jurnal Agritech* 36(2): 160- 169.

[7] Astuti, S., Setyawati, H. 2016. Peningkatan Nilai Gizi Umbi Talas Melalui Proses Fermentasi Menggunakan Starter Bimo CF dan Pegagan (Centella Asiatica Linn Urban). Seminar Nasional Inovasi dan Aplikasi Teknologi di Industri (SENIATI). Malang: Institut Teknologi Nasional Malang.

[8] Akbar, M. R, dan Yunianta. 2014. Pengaruh Lama Perendaman Na2s2o5 Dan Fermentasi Ragi Tape Terhadap Sifat Fisik Kimia Tepung Jagung.Jurusan Teknologi Hasil Pertanian. Universitas Brawijaya Malang.

[9] Polnaya, F. J., Haryadi, Marseno, D. W., & Cahyanto, M. N. 2013. Effects of phosphorylation and cross-linking on the pasting properties and molecular structure of sago starch. International Food Research Journal , 20(4), 1609– 1615.

[10] Widhaswari, V. dan W. Putri. 2014. Pengaruh modifikasi kimia dengan STPP terhadap karakteristik tepung ubi jalar ungu. Jurnal Pangan dan Agroindustri 2: 121-128.

[11] Yasni, W., Ansharullah, & Asyik, N. 2018. Pengaruh Substitusi Tepung Tempe Terhadap Penilaian Organoleptik Dan Nilai Gizi Kue Karasi. Jurnal Sains Dan Teknologi Pangan, 3(6), 1724–1734.

 https://doi.org/10.29165/ajarcde.v8i2.400

[12] Widhaswari, V.A dan Putri, W.D.R. 2014. Pengaruh Modifikasi Kimia Dengan STPP Terhadap Karakteristik Tepung Ubi Jalar Ungu (Ipomea batatas L.). Jurnal Pangan dan Agroindustri Vol. 2, No 3. p.121-128. Jurusan Teknologi Hasil Pertanian Fakultas Teknologi Pertanian. Universitas Brawijaya Indonesia

[13] Nugraha, E.P., Karyantina, M., dan Kurniawati, L. 2016. Sodium Tripolyphosphate (STPP) Sebagai Bahan Pengganti Bleng Padat Pada Pembuatan Karak Dengan Variasi Jenis Beras. Jurnal Ilmiah Fakultas Teknologi dan Industri Pangan Universitas Slamet Riyadi. Surakarta.

[14] Rahim. V.S. dan Liputo S.A. 2021. Sifat Fisikokimia Dan Organoleptik Mi Basah Dengan Subtitusi Tepung Ketan Hitam Termodifikasi Heat Moisture Treatment (HMT).

[15] Handayani T.D. dan Putri N.E. 2020. Pengaruh Jenis Pati Ubi Kayu Terhadap Karakteristik Mi Pentil Kering Yang Dihasilkan. Jurnal Teknologi Pertanian.2(2):6-14

[16] Biyumna, U.L., Windrati, W.S., Diniyah, N. 2017. Karakteristik Mie Kering Terbuat Dari Tepung Sukun (Artocarpus Altilis) Dan Penambahan Telur. Jurnal Agroteknologi Vol. 11 No. 01. Jurusan Teknologi Hasil Pertanian, Fakultas Teknologi Pertanian, Universitas Jember, Jember.

[17] Meiheski, R., Koapaha, T., dan Rawung, D. 2019. Sifat Fisik Dan Organoleptik Mie Dari Tepung Talas (Colocasia Esculenta) dan Terigu Dengan Penambahan Sari Bayam Merah (Amaranthus Blitum). *Jurnal Teknologi Pertanian* 10(2): 102-112.

[18] Pudjihastuti, I., Sumardiono, S., dan Dwi Nurhayati, O. 2017. Kontribusi Modified Casava Flour Terhadap Daya Mekar Krupuk Ketumbar Kalirandu Petarukan Pemalang. In: Prosiding Seminar Nasional Teknik Kimia. Semarang.

[19] Nisah, K. 2017. Study pengaruh Kanndungan Amilosa dan Amilopektin Umbi-umbian Terhadap Karakteristik Fisik Plastik Biodegradable Dengan Plastizicer Gliserol. *Jurnal Biotik I*SSN: 2337-9812 Vol. 5, No. 2.