The Quality Analysis of Vermicelli From Corn *(Zea mays L)* and Potato *(Solanum tuberosum L)* Starch

Banun Diyah Probowati[*,1] , Burhan[1], Cahyo Indarto[1] and Muhammad Dawil Farikh[2]

[1]Lecturer of Agroindustrial Technology Study Program, Faculty of Agricultural, Universitas Trunojoyo Madura, Gedung RKBI, Jl. Raya Telang Kamal, Bangkalan, Jawa Timur, Indonesia.

[2]Graduate of Agroindustrial Technology Study Program, Universitas Trunojoyo Madura

Email: banun.diyahp@trunojoyo.ac.id*

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Abstract

Vermicelli was a food made from flour with a particular characteristic in the form of transparent thread and could be produced from corn and potato starch. It must appropriate the quality standards. The Objectives of the research are: (1) to determine the effect of formulation and drying time on the water content of vermicelli, (2) to determine the appropriate formulation of corn and potato starch, (3) to evaluate the quality of durability, (4) to determine the quality of the total protein content in vermicelli made from corn and potato starch. The experimental design of making vermicelli used the complete random design (CRD) method with 2 factors (composition of corn and potato starch) and drying time (120 and 180 minutes). The quality parameters of vermicelli are water content, sensory analysis, durability, and protein content. The results showed that the drying time has a significant effect on the water content of vermicelli. Still, the interaction of formulation and drying time factors did not significantly influence the water content of vermicelli. The overall preference for sensory analysis showed that the vermicelli formulation of 60:40 for corn and potato starch in 180 minutes of drying was the best formulation for Vermicelli-based corn and potato starch. The durability of this vermicelli was appropriate to quality standards (not easily crushed). The protein content was 1.53%, which is not appropriate to the quality standard of SNI 01-2975-2006 (minimum 4%). The novelty of the research was the best composition of materials to produce vermicelli from corn and potato starch and the drying time to produce it. Suggestions for further research could be to produce vermicelli with the composition of materials by adding nuts, eggs, or other ingredients to increase protein content and to analyze its quality.

Keywords: *corn starch, potato starch, quality analysis, vermicelli*

1. INTRODUCTION

Vermicelli was the one variant of noodles. Noodles were a popular food among the public. Noodles are generally made from wheat flour that contains (Julianti et al., 2018). Gluten is a protein found in whole grains. Wheat is an example of a grain that contains gluten (Lu et al., 2022). In the manufacture of noodles (Rara et al., 2020), gluten was served to make the dough elastic (Edun et al., 2019). Gluten (Tortoe et al., 2017) has elastic properties (Jatmiko and Estiasih, 2014) are caused by glutenin compounds (Edun et al., 2019) Not everyone can consume noodles that contain gluten (Zhang et al., 2022). People who have particular diseases such as celiac disease and Autism Spectrum Disorder (ASD) should not consume foods that contain gluten.

Celiac disease is an immune disease in which people cannot consume gluten because it damages their small intestines. People with this disease should avoid gluten for life (Rifa'i, 2013). At the same time, ASD is a disorder in a person that affects verbal and nonverbal abilities. ASD also affects a person's interaction patterns with the social environment (Irvan, 2017). With these conditions, it was necessary to find alternative noodles (Kumalasari et al., 2018) that did not contain gluten. Vermicelli was a gluten-free noodle solution.

Generally, vermicelli is made from rice flour (Hasrini and Hasanah, 2013). Vermicelli could be produced from other materials. Corn starch and potato starch (Julianti et al., 2017), could be used to produce vermicelli. The characteristic advantages of corn and potatoes would be utilized in the vermicelli process. Corn could be processed into starch because it contains 71.35% starch, 2.4% fiber, 4.72% fat, and 0.11% protein (Aini et al., 2016; Siwale et al., 2023) vermicelli produced from corn starch had a soft texture and low protein content. This soft texture caused vermicelli to break easily. The addition of potato starch was expected to be a solution to overcome the shortage.

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According to (Budiarti, 2016), potatoes could be processed into flour because they have carbohydrate content in starch. Potato flour has protein content and low fat (Panghal et al., 2018), as well as a low gelatinization temperature (Aini et al., 2016). Potato starch also had large starch granules as well as high viscosity levels. Another advantage of potato starch is that it contains vitamins B1 and B2, starch, ash, fiber, and essential amino acids used to increase energy (Feng et al., 2022). The use of potato starch covered the deficiencies found in corn starch to produce vermicelli. Vermicelli, with characteristics the same as wheat flour-based noodles, was obtained by experimenting with suitable formulations of corn and potato starch. Therefore, research is needed to determine the effect of formulation and drying time on the water content of vermicelli, determine the appropriate formulation of corn and potato, evaluate the quality of durability, and determine the quality analysis of the total protein content in vermicelli made from corn and potato starch.

2. MATERIAL AND METHODS

The materials of this research are corn and potato starch by added water to produce vermicelli. The materials used to laboratory analysis are filter paper, SeO_2, K_2SO_4, $CuSO_45H_2O$, H_3BO_3 2%, H_2SO_4, NaOH 30%, aqua dest, red methyl, HCl 0.01N, alcohol, and *bromocresol* green 0.1%. This research used analytical balance, Kjeldahl, grinder, drying oven, gas stove, pan, hot plate, desiccator, cup, knife, and porcelain cup.

This research began with making vermicelli using ingredients such as corn starch and potato starch. These two ingredients are added to water and mixed evenly. The resulting mixture will be steamed for 30 minutes. After steaming, it will continue with compression and forming. The vermicelli formed will be dried according to the desired research time. The procedure of making vermicelli can be seen in Figure 1.

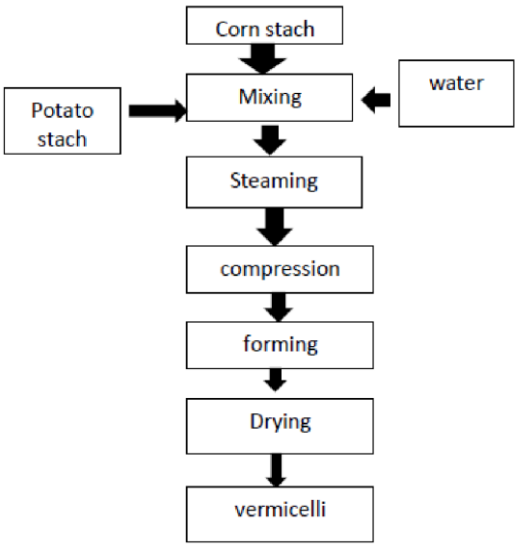

Figure 1. The Procedure for Making Vermicelli

The experimental design of making vermicelli used the complete random design (CRD) method with factorial analysis (2 factors) with two repetitions. The two factors of vermicelli formulation were the composition of corn and potato starch and drying time. The study used 10 combination samples with two repetitions so there were 20 combinations of treatments. All data were processed for analysis of variance on a statistical package SPSS version 25.0. Table 1 shows the design of the experiments in this study.

An experimental design was carried out to determine the effect of formulation and drying time on the water content of vermicelli. This water content is one of the quality parameters of vermicelli. Water content used the gravimetric method (AOAC). Determining the best vermicelli formulation for the composition of corn starch and potato starch to make vermicelli is based on the overall preference value sensory evaluation of vermicelli. The sensory evaluation was performed involving 25 semi-trained panelists. To figure out their preference for vermicelli, panelists were asked to score their preference of smell, color, taste, texture, and overall preference of vermicelli, from 1 to 5. Durability was measured

as SNI 01-2975-2006. The vermicelli produced in the study was soaked at room temperature, stirred for 10 minutes, and showed that conditions were not crushed. The protein content of vermicelli was measured by the Kjeldahl method. The analysis of protein content and durability of vermicelli was carried out based on the best formulation.

Table 1. Design Experiment of Vermicelli Based on Corn and Potato Starch.

Time of Drying	Formulation				
	X1	X2	X3	X4	X5
T1	X1T1	X2T1	X3T1	X4T1	X5T1
T2	X1T2	X2T2	X3T2	X4T2	X5T2

T1 = 120 minutes
T2 = 180 minutes
X1 = 30 : 70
X2 = 40 : 60
X3 = 50 : 50
X4 = 60 : 40
X5 = 70 : 30

3. RESULTS AND DISCUSSION

3.1. Effect of formulation and drying time on water content

Based on Table 2, it can be seen that formulation factors do not significantly influence the water content of vermicelli. Meanwhile, the drying time factor has a significant effect on the water content of vermicelli. The interaction of formulation factors and time factors did not significantly influence the water content of vermicelli.

Table 2. ANOVA of Water Content

Source	Df	SS	MS	F Value	Sig.
Formulation	4	12.218	3.054	1.584	0.253
Drying time	1	10.976	10.976	5.690	0.038
Formulation * Drying Time	4	5.042	1.261	0.653	0.638
Error	10	19.289	1.929		

There were ten samples in the water content analysis of vermicelli. The results of the water content values for vermicelli using the gravimetric method can be seen in Table 3. The water content of vermicelli with a drying time of 180 minutes has a lower water content compared to vermicelli dried for 120 minutes. The Water content is the water component contained in a material. The percentage of water content in the material needs to be measured because if the water content capacity does not match the desired product standard, it will have the potential for microorganisms to grow(Prasetyo et al., 2019) . The water content of a material is influenced by the drying time and temperature. The longer the drying time and higher the drying temperature, the lower the water content of a material (Rosidin et al., 2012).

Table 3. The Results of Water Content Analysis

Formulation (%)	Time (minutes)	Water Content (%)
30: 70	120	8.049
	180	7.166
40: 60	120	10.573
	180	7.094
50: 50	120	8.633
	180	7.727
60: 40	120	8.282
	180	6.320
70: 30	120	9.456
	180	7.285

The drying time factor has a significant effect on the water content analysis of vermicelli. The results of the water content analysis based on the length of drying time can be seen in Table 3. It can

be seen that the drying times of 120 minutes and 180 minutes are significantly different. The long drying time causes the water content of vermicelli to be different.

3.2. Sensory Analysis of Vermicelli

The sensory analysis (Rodrigues Júnior et al., 2016) was used to assess the level of consumer preference for smell, color, taste, texture, and the overall preference for vermicelli. Table 4 shows the results of the average score of sensory properties e.g. smell, color, taste, and texture. The highest score of the sensory analysis became an indicator of the panelist's preferred level.

Table 4 shows the 70:30 formulation of corn starch and potato starch at 120 minutes is the highest score (3.80). The smell that was most selected by panelists was the corn smell. The highest average score occurred at the concentration of 70% cornstarch and 30% potato starch with a drying time of 120 minutes. This showed that the less concentration of corn starch, the smell of vermicelli couldn't be smelled perfectly. The panelist's preference level will decrease along with the increase in flour or starch concentration because the distinctive smell of the flour or starch itself will be more pronounced (Biyumna et al., 2017).

Table 4. Sensory Analysis Score Of Smell, Color, Taste, and Texture

Formulation (%)	Time (minutes)	Sensory Properties			
		Smell	Color	Taste	Texture
30: 70	120	3.40	3.13	3.27	3.20
	180	3.20	3.33	3.20	3.80
40: 60	120	3.60	3.53	3.13	3.93
	180	3.33	3.13	3.47	3.93
50: 50	120	3.27	3.87	3.53	3.27
	180	3.60	3.47	3.40	3.67
60: 40	120	3.73	3.60	3.33	3.33
	180	3.47	3.93	3.60	3.83
70: 30	120	3.80	3.40	3.47	3.47
	180	3.73	3.73	3.53	3.67

Based on the color sensory analysis score in Table 4, it can be seen that the highest score of 3.93 is for vermicelli with a formulation of 60:40 and a drying time of 180 minutes, indicating that the panelists like the color of vermicelli. The highest score indicates the panelists' preference. In this condition, the color of vermicelli is yellow. The color of this vermicelli tends to be yellow because the formulation contains more corn starch. Corn influences the level of yellowness of the product (Xiang et al., 2019). The yellow color in vermicelli is due to the carotenoid content in corn, which is 6,4-11,3 µg/g. Carotenoid is one of the essential pigments that contribute red, yellow, and orange colors to corn. Some kinds of carotenoids include β-carotene, lycopene, lutein, α-carotene, γ-carotene, bixin, norbixin, capsanthin, and β-apo-8- carotene (Hu & Zhang, 2022; Lalujan et al., 2017).

Table 5. Overall Preference Sensory Test Score

Formulation (%)	Time (minutes)	Score
30:70	120	3.20
	180	3.67
40:60	120	3.73
	180	3.33
50:50	120	3.73
	180	3.87
60:40	120	3.73
	180	3.93
70:30	120	3.87
	180	3.39

The average score of taste sensory analysis showed vermicelli with a 60:40 formulation and 180 minutes drying time is 3.60. It is the highest score and most preferred by panelists. The preferred taste of vermicelli is the sweet taste of corn and potato starch. According to Yu & Moon (2021), the preferred taste of corn vermicelli is the sweet taste of corn.

Table 4 shows that the highest texture sensory test score is 3.93. The score of vermicelli with a formulation of 40:60 for all drying time (120 and 180 minutes). It indicates that the panelists like the texture of vermicelli. The vermicelli texture favored according to vermicelli research (Ismail et al., 2020) by panelists is chewy and not easily broken (Chen, 2020).

Table 5 shows the overall preference for sensory analysis. Vermicelli with a formulation of 60:40 and 180 minutes of drying time has the highest score (3.93). It becomes the most preferred choice of panelists and the best formula for Vermicelli-based corn and potato starch. It becomes the best formulation determined by using the overall preference sensory score (Nurdjanah et al., 2014).

3.3. Durability Test

A durability test was also conducted in this study. The indicator of this test is easily crushed by the product. The study used SNI 01-2975-2006 as the standard for vermicelli durability. This fact indicates that the vermicelli made in this study is already appropriate to the standard. The formulation's content of 60:40 and 180 minutes of drying time indicates the best vermicelli durability (not easily crushed). The content of amylose makes for good durability of vermicelli. Hydrogen (hydroxyl) bonds between amylose in starch produce insoluble crystals (Aini et al., 2016).

3.4. Protein Content of Vermicelli

The vermicelli protein analysis was based on the best formulation of vermicelli formulation of 60:40 and a drying time of 180 minutes. The analysis obtained a protein content of this vermicelli of 1.53%. According to SNI 01-2975-2006, vermicelli has a minimum protein content of 4%, so the vermicelli protein in this study is not appropriate to the standard. The low protein content of vermicelli is likely due to the raw material formulation being low in protein. The protein in corn starch is only 3.43% (Alam and Nurhaeni, 2008) and the protein content in potato starch ranges from 0.08% (Schirmer et al., 2013); (Shen et al., 2021) to 1.18% (Cruz et al., 2016) and is generally lower than that of cereal starch. Therefore, to increase the protein content of vermicelli, we must add ingredients that are high in protein, such as nuts, eggs, or other materials to fulfill SNI quality standards. According to Jumanah et al. (2017), a concentration of canna flour: green bean flour: and tapioca flour (30%: 35%: 35%) obtained a protein content of 9.83%. It can be seen that differences in the formulation can affect the total protein content of a product.

4. CONCLUSIONS

The conclusions of the research are (1). The drying time factor has a significant effect on the water content of vermicelli. A drying time of 180 minutes has a lower water content compared to vermicelli dried for 120 minutes. The interaction of formulation factors and time factors did not significantly influence the water content of vermicelli. (2). The overall preference for sensory analysis shows that vermicelli with a formulation of 60:40 for corn and potato starch in 180 minutes of drying time has the highest score (3.93). It becomes the most preferred choice of panelists and the best formulation for Vermicelli-based corn and potato starch. (3). The formulation's content of 60:40 and 180 minutes of drying time indicates the best vermicelli durability (not easily crushed). (4) The quality analysis obtained a protein content of this vermicelli of 1.53%, which is not appropriate to the SNI 01-2975-2006 standard (minimum 4%).

The novelty of the research is the best composition of materials to produce vermicelli from corn and potato starch and the drying time to produce it. Suggestions for further research could be to examine the composition of materials to produce vermicelli by adding nuts, eggs, or other ingredients to increase protein content.

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