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Characteristics of Dry Carrot Noodle (*Daucus carota L*) with Proportion of Wheat Flour and White Oyster Mushroom Flour (*Pleurotus ostreatus*)

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Abstract. Dry noodles are food processed products made from wheat flour with or without the addition of other food ingredients with a moisture content of around 8 to 10%, this product is very popular with the public. This study studied the effect of the proportion of white oyster mushroom flour with wheat flour on the characteristics of dry carrot noodles. The proportions given include; 100% wheat flour, 20% mushroom flour with 80% wheat flour, 40% mushroom flour with 60% flour, 60% mushroom flour with 40% wheat flour, 80% mushroom flour with 20% wheat flour, and the proportion of mushroom flour 100 %. The experimental design used a single randomized block design, then statistical analysis was performed using ANOVA and further test of BNJ 5%. The results showed that the proportion of mushroom flour with wheat flour had a very significant effect on cooking loss, physical color redness, moisture content, protein content and color sensory tests, aroma, texture, and taste on dry carrot noodles. Also had a significant effect on physical texture and beta-carotene levels, and had no significant effect on lightness and yellowness on the physical color test. The best treatment in making dry carrot noodles is the proportion of 20% wheat flour with 80% mushroom flour, which shows the results of the analysis of cooking loss (6.46%), lightness (15.76), redness (-2.4), yellowness (4.95).), physical texture (1.57 kg / cm²), water content (50.82%), protein content (15.45%) and organoleptic test for color 3.67 (neutral), aroma 4.00 (like), texture 3.33 (neutral), taste 3.67 (neutral).

1. Introduction

Noodles are a food product processed by wheat flour that is very popular among people because it is easy and fast in serving and filling, so it is often used as a substitute for rice [1]. Dry noodles are food processed products made from wheat flour with or without the addition of other food ingredients with a moisture content of around 8 to 10%, this product is very popular with the public. Several studies have used non-wheat ingredients in the manufacture of noodles including sorghum, corn starch, a combination of corn sprouts and seaweed and also oyster mushrooms. Oyster mushroom is not only



known as a delicious and nutritious food mushroom. White oyster mushroom has high antimicrobial and antioxidant properties therefore it is known as a nutraceutical ingredient [2]. White oyster mushrooms contain nutrients per 100 grams of Protein 7.8-17.72 grams, fat, 1-3 grams, carbohydrates, 57.6-81.8 grams, fiber 5.6-8.7 grams, Ca 21 mg, Calories (kcal / 100gram) 328-367 cal, Riboflavin 7.09 g [3]. Giving six capsules of white oyster mushroom (*Pleurotus ostreatus*) can significantly reduce blood cholesterol levels in elderly people with hypercholesterolemia significantly [4].

Carrots are vegetables that is rich in beta-carotene as an antioxidant that can prevent heart disease, skin cancer. Carrots are known to have a very high vitamin A content. Carrots have other nutrients such as calories, protein, calcium, and iron [5].

It is necessary to do research on the Effect of the Proportion of White Oyster Mushroom Flour (*Pleurotus ostreatus*) with Wheat Flour on the Characteristics of Carrot Dried Noodles.

2. Experimental Method

The study was conducted using a single factor randomized block design (RBD), namely the proportion of white oyster mushroom flour with wheat flour and the addition of carrot extract (PB) consisting of 6 levels, namely 0%: 100% (PB1), 20%: 80% (PB2), 40%: 60% (PB3), 60%: 40% (PB4), 80%: 20% (PB5), and 100%: 0% (PB6) and repeated 3 times to get 18 experimental units. Data were analyzed using analysis of variance, if it shows a real effect, the test is continued with the Honestly Significant Difference (BNJ) test with a level of 5%. The organoleptic test was analyzed using the Friedman test. The parameters tested include; cooking loss, physical color with color reader, texture (hardness), moisture content, protein, and organoleptic..

The process of making dry carrot noodles, prepared 100 ml carrot extract, then made a mixture of wheat flour and mushroom flour according to the proportion of flour (treatment). The 200 gram flour mixture is made into a dough by adding enough salt, knead until smooth. Then it is printed in the form of dough sheets, then the noodles are printed. Then the noodles are boiled for about 1 minute, drained and placed in a drying place with a stable temperature of 80 oC for 5 hours. Schematic of making dry carrot noodles can be seen in Figures 1.

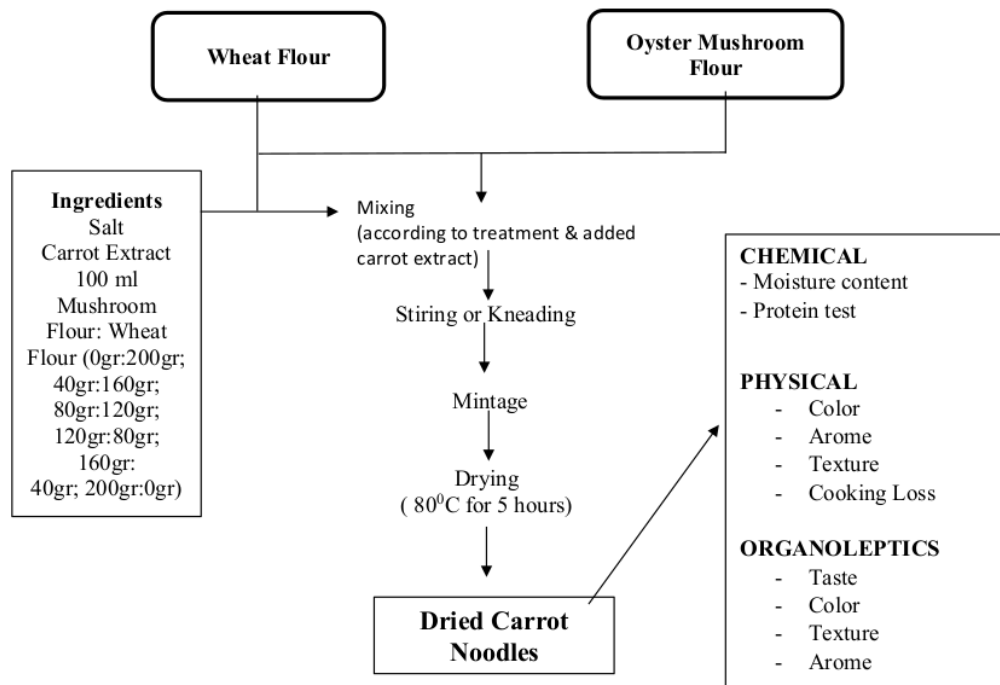


Figure 1. Schematic of making dry noodles with modification

3. Results and Discussion

3.1 Physical Analysis

3.1.1. Cooking Loss

The value of cooking loss ranged from 1.00% - 6.46%, the highest cooking loss was PB2 noodles (20% mushroom flour with 80% wheat flour) which showed a value of 6.46% although not significantly different from PB1 and PB3 treatments but different very real with other treatments. The lower the proportion of mushroom flour used, the higher the cooking loss value. The protein content of white oyster mushrooms converts gluten into water-soluble fiber in the form of β -glucans. Water binds to hydrophil groups of white oyster mushroom protein. Therefore, as the proportion of mushroom flour decreases, the substances contained in dry noodles are also dissolved in the water when the cooking process occurs [7].

Table 1. Average Cooking Loss

Treatment	Cooking Loss(%)
PB1 (100% wheat flour)	5,6 d
PB2 (20% mushroom flour: 80% wheat flour)	6,46 d
PB3 (40% mushroom flour: 60% wheat flour)	4,69 cd
PB4 (60% mushroom flour: 40% wheat flour)	2,06 ab
PB5 (80% mushroom flour: 20% flour)	3,67 bc
PB6 (100% mushroom flour)	1,00 a
BNJ 5%	2,39

Note: Numbers followed by the same letter in the same column show insignificant differences based on the 5% BNJ test..

3.1.2 Physical Color

The analysis of variance showed that the proportion of white oyster mushroom flour and wheat flour had no significant effect on the brightness and yellowness value of white oyster mushroom dry noodles.

The BNJ 5% test to determine the differences in the mean color of dry carrot noodles is presented in Table 2. The reduced proportion of oyster mushroom flour used, the higher the redness value. That is because the fungus flour is not contaminated with light brown color due to the drying process. Enzymatic browning occurs in fruit or vegetables, when the fruit or vegetable is subjected to mechanical treatment (peeling, cutting, bruising) of damaged tissue quickly brown after contamination with air. This is due to the conversion of phenolic compounds by the phenolase enzyme into melanin which is brown in color [8].

Table 2. Average Color

Treatment	Lightness	Redness	Yellowness
PB1 (100% wheat flour)	23,55	4,84 c	8,60
PB2 (20% mushroom flour: 80% wheat flour)	15,76	2,42 ab	4,95
PB3 (40% mushroom flour: 60% wheat flour)	17,26	1,11 a	7,21
PB4 (60% mushroom flour: 40% wheat flour)	17,18	2,4 a	7,41
PB5 (80% mushroom flour: 20% flour)	17,28	1,54 a	5,04
PB6 (100% mushroom flour)	20,67	0,55 a	4,33
BNJ	tn	1.93	tn

Note: Numbers followed by the same letter in the same column show insignificant differences based on the 5% BNJ test..

3.1.3 Texture (harness)

The results of the analysis of variety showed that the proportion of mushroom flour and wheat flour had a significant effect on the texture of the noodles. The average texture of noodles due to the influence of the proportion of mushroom flour and wheat flour in table 5. The texture value of noodles is between 0.5 - 1.43 kg / cm², the highest texture value is PB6 treatment (100% mushroom flour) with a yield of 1.43 kg / cm².

White oyster mushrooms do not have starch, carbohydrates are stored in the form of glycogen and chitin which are the main constituents of mushroom fiber [9]; [10].

Table 3. Texture Average

Treatment	Textur (kg/cm ²)
PB1 (100% wheat flour)	0,5 a
PB2 (20% mushroom flour: 80% wheat flour)	0,59 a
PB3 (40% mushroom flour: 60% wheat flour)	0,55 a
PB4 (60% mushroom flour: 40% wheat flour)	1,27 ab
PB5 (80% mushroom flour: 20% flour)	1,27 ab
PB6 (100% mushroom flour)	1,43 b
BNJ 5%	0,78

Note: Numbers followed by the same letter in the same column show insignificant differences based on the 5% BNJ test.

3.2. Chemical Analysis

3.2.1 Water Content

The results of the analysis of variety showed that the proportion of white oyster mushroom flour had no significant effect on the moisture content of the dry noodles. The moisture content of dry noodles is between 3.16% -7.49%. The lowest water content was PB4 treatment (60% mushroom flour with 40% wheat flour) with a value of 3.16%.

Table 4. Moisture Content Average

Treatment	Moisture Content (%)
PB1 (100% wheat flour)	3,52%
PB2 (20% mushroom flour: 80% wheat flour)	7,49%
PB3 (40% mushroom flour: 60% wheat flour)	6,54%
PB4 (60% mushroom flour: 40% wheat flour)	3,16%
PB5 (80% mushroom flour: 20% flour)	6,37%
PB6 (100% mushroom flour)	5,68%
BNJ 5%	tn

Note: Numbers followed by the same letter in the same column show insignificant differences based on the 5% BNJ test.

3.2.2. Protein Content

The results of protein analysis, show that the proportion of white oyster mushrooms has a very significant effect on the protein content of dry noodles. Furthermore, the 5% BNJ test was carried out to determine the differences in each treatment. The mean protein content is presented in table 5.

The protein content of dry noodles was between 8.75-38.54. The lowest protein content was PB1 treatment (wheat flour), which was 8.75%. The highest protein content was PB6 treatment (100% mushroom flour) with a value of 38.54%. Caused by the high protein content in the basic ingredients, namely mushroom flour. Whereas in PB1 there was no addition of mushroom flour and only used wheat flour as a base ingredient. The protein content in dry noodles shows that if the proportion of oyster mushroom flour is high, the protein content in dry noodles also increases, whereas if the proportion of oyster mushroom flour is low, the protein content in dry noodles is low. This is in line with research which states that white oyster mushrooms have a protein content value. higher compared to other vegetables and eggs [11].

Table 5. Protein Content Average

Treatment	Protein Content (%)
PB1 (100% wheat flour)	8,75a
PB2 (20% mushroom flour: 80% wheat flour)	14,29ab
PB3 (40% mushroom flour: 60% wheat flour)	15,45ab
PB4 (60% mushroom flour: 40% wheat flour)	17,21bc
PB5 (80% mushroom flour: 20% flour)	27,71cd
PB6 (100% mushroom flour)	38,54d
BNJ 5%	8,13

Note: Numbers followed by the same letter in the same column show insignificant differences based on the 5% BNJ test

3.3. Organoleptic Test

3.3.3. Color

The results of the Friedman test analysis showed that the proportion of mushroom flour had a very significant effect on the panelists' preference for the color of dry noodles. Panelists' preference for dry noodle color ranged from 2.63 (dislike - neutral) to 3.63 (like - very much). The color most favored by the panelists was PB1 treatment (100% wheat flour). The color of dry noodles with PB4-PB6 treatment tends to be slightly yellowish white.

Table 6. Average Dried Noodle Color Favorite in Various Treatments

Treatment	Average	Total Ranking
PB1 (100% wheat flour)	3,63	48,75 c
PB2 (20% mushroom flour: 80% wheat flour)	3,27	40,25 b
PB3 (40% mushroom flour: 60% wheat flour)	3,13	37,75 b
PB4 (60% mushroom flour: 40% wheat flour)	3,37	40,50 bc
PB5 (80% mushroom flour: 20% flour)	2,63	27,75 b
PB6 (100% mushroom flour)	1,77	12,00 a
Critical point		13,76

Note: The numbers followed by the same letter in the same column show insignificantly different results based on the Friedman test ($\alpha = 0.05$)

3.3.3. Aroma

The results of the Friedman test analysis showed that the proportion of mushroom flour had a very significant effect on the panelists' preference for the aroma of dry noodles. The panelists' preference for the aroma of dry noodles ranged from 2.03 (dislike - neutral) to 4.00 (very like). The aroma that the panelists liked the most was PB1 treatment (100% wheat flour). Although it was not significantly different from PB2, it was significantly different from the treatment of PB2, PB4, and PB5. The aroma of mushroom noodles tends to be unpleasant as the proportion of mushroom flour used increases. This is because the oyster mushroom itself has a pleasant aroma. The unpleasant smell will disappear if there is a cooking process in mushroom noodles.

Table 7. Average Preference of Dried Noodle Aroma in Various Treatments

Treatment	Average	Total Ranking
PB1 (100% wheat flour)	4,00	49,50 c
PB2 (20% mushroom flour: 80% wheat flour)	3,57	42,00 bc
PB3 (40% mushroom flour: 60% wheat flour)	3,57	38,50 b
PB4 (60% mushroom flour: 40% wheat flour)	3,57	36,50 b
PB5 (80% mushroom flour: 20% flour)	2,87	30,00 b
PB6 (100% mushroom flour)	2,03	13,00 a
Critical point		13,76

Note: The numbers followed by the same letter in the same column show insignificantly different results based on the Friedman test ($\alpha = 0.05$)

3.3.3 Texture

The results of the Friedman test analysis showed that the proportion of mushroom flour had a significant effect on the panelists' preference for the texture of dry noodles. The panelists' preference for the dry noodle texture increased with the increasing proportion of the mushroom flour used. This is because the increasing use of mushroom flour causes the texture of the dry noodles to become more elastic. Oyster mushrooms contain high protein and dietary fiber, namely 30.40% and 33.44% in 100 g serving. High content of dietary fiber has a good effect on digestive health. Meanwhile, gluten that comes from the extraction of wheat flour dough can be used as a source of vegetable protein which is abundant in raw materials, non-cholesterol, and has a chewy texture [12; 13; and 14]

Table 8. Average Preferred Dry Noodle Texture in Various Treatments

Treatment	Average	Total Ranking
PB1 (100% wheat flour)	1,97	19,50 a
PB2 (20% mushroom flour: 80% wheat flour)	2,43	23,50 ab
PB3 (40% mushroom flour: 60% wheat flour)	2,30	21,00 a
PB4 (60% mushroom flour: 40% wheat flour)	3,37	40,50 b
PB5 (80% mushroom flour: 20% flour)	3,53	46,50 bc
PB6 (100% mushroom flour)	3,98	55,00 c
Critical Point		13,76

Note: The numbers followed by the same letter in the same column show insignificantly different results based on the Friedman test ($\alpha = 0.05$)

3.3.4 Taste

The results of the Friedman test analysis showed that the proportion of mushroom flour had a very significant effect on the panelists' preference for the taste of fry noodles. The panelists' preference for dry noodle flavors ranged from 3.53 to 3.83.

The most preferred taste is PB3 treatment (40% mushroom flour: 60% wheat flour) because in this treatment the dry noodle taste is predominantly savory and the mushroom taste is not felt. Although not significantly different from the treatment of PB2 and PB4, they were significantly different from the others.

Table 9. Average Dried Carrot Noodle Flavor in Various Treatments

Treatment	Average	Total Ranking
PB1 (100% wheat flour)	3,60	60,00 b
PB2 (20% mushroom flour: 80% wheat flour)	3,60	72,00 bc
PB3 (40% mushroom flour: 60% wheat flour)	3,83	80,00 c
PB4 (60% mushroom flour: 40% wheat flour)	3,97	72,00 bc
PB5 (80% mushroom flour: 20% flour)	3,53	69,00 b
PB6 (100% mushroom flour)	3,80	38,00 a
Critical Point		13,76

Note: The numbers followed by the same letter in the same column show insignificantly different results based on the Friedman test ($\alpha = 0.05$)

3.3.5. Determination of Best Treatment

Determination of the best treatment of dry carrot noodles with various proportions of mushroom flour and wheat flour with the addition was determined based on the calculation of the effectiveness value through a weighting procedure [15].

Table 10. Best Treatment Calculation

Parameter	PB1	PB2	PB3	PB4	PB5	PB6
Cooking loss	5,6	6,46	4,68	2,06	3,67	1
Color L	23,55	15,76	17,26	17,18	17,28	20,67
Color a	4,84	2,42	1,11	2,4	1,54	0,55
Color b	8,6	4,95	7,21	7,41	5,04	4,33
Texture Fisik	0,5	0,59	0,55	1,27	1,27	1,43
Moisture	3,52	7,49	6,54	3,16	6,37	5,68
Protein Conten	8,75	15,45	14,29	17,2	27,7	38,54
O. Color	3,63	3,27	3,13	3,37	2,63	1,77
O. Aroma	4	3,57	3,57	3,57	2,87	2,03
O. Texture	1,97	2,43	2,3	3,37	3,53	3,98
O. Taste	3,6	3,6	3,83	3,97	3,53	3,8
Total	0,5	0,49	0,43	0,52**	0,45	0,49

Note : ** Best Treatment

Weights given are cooking losses (0.8), physical color (0.9), physical texture (0.9), water content (1.0), protein content (1.0), organoleptic color (1.0), aroma. (1.0), texture (1.0), taste (1.0) which were adjusted according to the role of each variable on the desired quality of dry noodles. The value of each treatment based on the results of the search for the best treatment is presented in Table 15.

The best treatment was dry noodles with 60% white oyster mushroom flour with 40% cooking loss flour (2.06%), lightness (17.18), redness (2.4) yellowness (7.41), physical texture (1,27kg / cm²), moisture content (3.16%), protein content (17.2%), and organoleptic test for color (3.37), aroma (3.57), texture (3.37), and taste (3.97).

4. Conclusion

1. The proportion of white oyster mushroom flour (*Pleurotus ostreatus*) with wheat flour on the characteristics of dry carrot noodles has a very significant effect on cooking loss, physical color redness, protein content and organoleptic tests on the color, aroma, texture, and taste of dry noodles. Significantly affected physical texture, and had no significant effect on lightness, yellowness on physical color tests, and water content tests.
 2. The best treatment is dry noodles with 60% white oyster mushroom flour with 40% cooking loss flour (2.06%), lightness (17.18), redness (2.4) yellowness (7.41), physical texture (1.27kg / cm²), moisture content (3.16%), protein content (17.2%), and organoleptic test for color (3.37), aroma (3, 57), texture (3.37), and taste (3.97)
- 4.1. Suggestion
1. Based on the research results, to get the best dry noodles can use the proportion of 60 % white oyster mushroom flour and 40% wheat flour.
 2. Further research is needed on the shelf life of dry noodles with the addition of white oyster mushroom flour (*Pleurotus ostreatus*), as well as by substituting carrot extract.

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