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Hedonic Test on Pempek with Beta Carotene Fortification from Different Concentrations of Carrot Puree

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ABSTRACT

Pempek is a traditional food from South Sumatra that is highly regarded and very popular among the people of Indonesia. This food is usually made with tapioca, minced fish, water, salt and MSG. This study aims to create an innovation, namely beta carotene fortification in pempek dough. Hedonic tests were conducted to determine the level of respondent preference for the addition of carrot concentration in terms of color, aroma, flavor and texture. This study employed a Completely Randomised Design (CRD) with four treatments and three replications, namely: P0 (0% carrot puree), P1 (5% carrot puree), P2 (10% carrot puree), and P3 (18% carrot puree). Hedonic test data were analysed statistically using analysis of variance, and further DMRT tests were conducted. The results of this study indicate that the addition of 10% carrots to making snakehead fish pempek has a very significant effect ($P < 0.01$) on improving the hedonic colour, taste, aroma, and texture. It can be concluded that the addition of carrot, up to 10% as a source of beta-carotene, in making pempek can increase the level of panellists' preference for colour, taste, aroma, and texture. The best treatment is the addition of 10% carrots to the formulation of snakehead fish pempek, in terms of its colour, taste, aroma, and texture.

Contribution to Sustainable Development Goals (SDGs):

SDG 2: Zero hunger

SDG 3: Good health and Well-Being

SDG 12: Responsible Consumption and Production

1. INTRODUCTION

1.1. Research Background

Stunting is a persistent nutritional issue in Indonesia. Based on the results of the 2019 Survey, 27.7% indicated that 3 out of 10 toddlers in Indonesia suffer from stunting. This is still far from the standard set by the World Health Organisation (WHO), which recommends a maximum of 20% of the population in each country [1]. Micronutrient deficiencies have short-term impacts, primarily affecting the development of the toddler's brain and intelligence, which can be physically evident in the form of

growth disorders or metabolic disorders in the toddler's body. In the long term, it can affect the body's immunity, making it easy to get sick and other risks such as diabetes, heart disease, stroke, and others [2].

Food fortification is a method that can be a solution to nutritional problems in Indonesia. The definition of food fortification is the addition or increase of specific nutrients in food to enhance food quality [2]. Fortification is typically used to add nutrients that are not naturally present in certain foods or beverages. It can also be done to restore nutrients that are lost in the processing of food or drinks. The primary purpose of food fortification is to ensure that children and adults receive a sufficient amount of essential nutrients. There are several types



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of fortification based on the purpose of use. Mandatory fortification is a type of fortification designed to address micronutrient problems on a large scale. It has several requirements, such as national urgency, the food to be fortified being a food ingredient consumed by most people, produced in limited quantities, and remaining safe in the sense that it does not pose a health risk [3].

One of the products that can be fortified is Pempek. Pempek is a food consumed by almost all people in South Sumatra Province. Fortification of Pempek products with vegetables is expected to provide a solution to overcoming nutritional problems, as advocated by the WHO. The strength of the combination of Pempek and Vegetables lies in the nutritional content of the two food ingredients, such as Carbohydrates, protein, fat, and vitamins, which are rarely found in any Pempek dishes. The fortification of Pempek products will also impact the economic value of the product. The economic value of Pempek fortification is evident in its uniqueness, which allows it to serve as a diversification tool for businesses and products. Therefore, the objective of this study is to elucidate the relationship between adding carrots as a source of beta-carotene and fibre and the quality of snakehead fish pempek, as assessed by organoleptic tests. The results of this study can serve as a reference for developing fortified pempek that will benefit the community by enhancing the nutritional value of their daily food intake.

1.2. Literature Review

Organoleptic assessment, also known as sensory assessment, is the oldest and most established assessment method. Organoleptic testing is widely used to measure the quality of food products and other agricultural products. This assessment can provide a more accurate explanation of product quality in terms of flavour, aroma, texture, and colour [4].

Organoleptic assessment is a science used to express, measure, analyse, and interpret a person's reactions to the characteristics of food and other ingredients, as perceived by sight, taste, touch, and smell [5]. Organoleptic testing is a test in which panellists express their responses in terms of whether they are satisfied with the properties of the ingredients being tested. This test is generally used to assess consumer reactions to an ingredient [6].

Organoleptic quality plays a significant role in assessing agricultural food products, raw materials for processed food products, and evaluating food dishes. Although physical, chemical, and nutritional tests can indicate a high-quality food product, they will be meaningless if the food product cannot be eaten because it lacks taste [7].

1.2.1. Color

Colour plays a crucial role in food acceptance, as Winarno notes that visually, colour is a primary factor in determining whether food is perceived as delicious or not [8]. In addition to being a factor that determines quality, colour can also be used as an indicator of whether the mixing method or processing method in the food system is acceptable, which is indicated by the presence of even and uniform colour. Among the characteristics of food products that most attract consumers' attention and convey an impression of liking or disliking the most quickly is the colour characteristic [9].

1.2.2. Taste

Taste in food ingredients is a combination of flavor and aroma [10]. Taste is formed from sensations originating from the combination of constituent ingredients and their composition in a food product, perceived by the sense of taste. It is one of the key factors that contribute to the flavour quality of a product [11].

1.2.3. Aroma

Aroma (smells) can be defined as something that can be observed with the sense of smell [12]. Aroma is one of the most easily identifiable and frequently used flavour parameters. Food ingredients can produce aroma if the compounds that produce the odor evaporate [13].

1.2.4. Viscosity

Viscosity affects how taste and aroma compounds interact with sensory receptors. Higher viscosity can impede the release and transport of these compounds, leading to a decrease in the intensity of flavour and aroma perception. This occurs because thicker substances may slow down the movement of tastants and aroma molecules to the taste buds and olfactory receptors. Additionally, increased viscosity can alter the temporal dynamics of flavour perception. Thicker foods may cause flavours to linger longer in the mouth, potentially affecting the overall sensory experience [14].

1.3. Research Objective

Specifically, the research aims to evaluate consumer preferences regarding the colour, aroma, texture, and flavour of snakehead fish pempek samples with the addition of carrot puree. This evaluation utilizes a hedonic scale to determine the level of acceptance for each formulation (Table 1).

2. MATERIALS AND METHODS

This research was conducted at the Food Technology Laboratory of the Agricultural Engineering and Business Department at Sriwijaya State Polytechnic. The materials used were tapioca flour, snakehead fish, eggs, salt, monosodium glutamate, carrots and water. While the tools used were a food processor, basin, cauldron, spatula, stove, plate, hedonic quality format and stationery. The research design employed in this study is a Completely Randomised Design (CRD) with No Factorial Components, utilising four different treatments (representing varying concentrations of carrot puree) and three replications. This design is suitable for evaluating the sensory quality of snakehead fish pempek with varying concentrations of carrot juice.

Table 1. The Carrot Pempek Formulation

No	Ingridients	P0	P1	P2	P3
1	Snakehead Fish (g)	1000	1000	1000	1000
2	Tapioca (g)	800	800	800	800
3	Water (ml)	500	500	500	500
4	Carrot (g)	0	150	300	500
5	MSG (g)	20	20	20	20
6	Salt (Gr0	40	40	40	40

3. RESULT AND DISCUSSION

Based on the three different treatments of Pempek with the addition of carrot puree, the resulting pempek exhibits distinct characteristics, as shown in **Table 2**.

Table 2. Characteristics of Carrot Pempek

Characteristics	P0	P1	P2	P3
Colour	Greyish white	Cantaloupe	Orange	Cider
Aroma	The fish aroma is quite strong	The fish aroma is less	There is no fish aroma	The slight aroma of carrot
Flavour	Quite savory	savory	Savory and sweet	Sweet
Texture	Chewy	Chewy	Chewy	Soft

3.1. Colour

The appearance of food color is the first factor assessed before considering others, such as taste and nutritional value. According to Winarno, a food that is regarded as nutritious, delicious, and has an excellent texture will not be consumed if it has an unappealing colour or gives the impression of having deviated from its expected colour. Attractive and natural-looking food colours can enhance the perception of flavour. This highlights the importance of color in food acceptance, as it can influence consumer perceptions and willingness to try a product [15]. In the context of pempek made from snakehead fish with added carrot puree, maintaining an appealing and natural color is crucial for consumer acceptance.

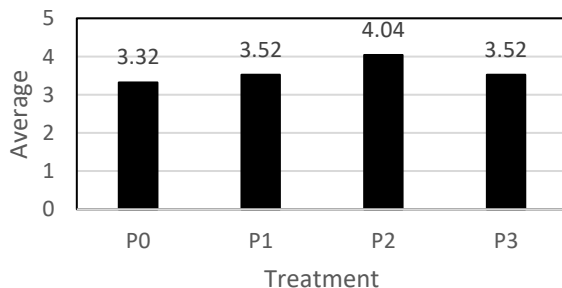


Figure 1. The Average of Color Assessment in Hedonic Test.

Based on Figure 1, it can be seen that the total score of the four treatments in the organoleptic test of colour is as follows: Pempek P2 with the addition of carrots (10%) has the highest score, with an average score of 4.04. This is because the colour obtained by Pempek P2 is bright orange, unlike Pempek without the addition of carrots, which produces a greyish-white colour that is less preferred by students of Sriwijaya State Polytechnic.

The results of the ANOVA test indicate that the F-count exceeded the F-table value of 5%. However, the different result was conducted at a 1 F-table so that the data can be concluded as significant with a probability of significance of 95%. Further testing was carried out using the least significant difference, Tukey, and Duncan tests.

368 Inayatullah et al.

Unfortunately, the results were not statistically significant, indicating that there was no difference between the treatments and the parameters tested. This could have happened due to the coefficient of diversity being too advanced [16].

3.2. Aroma

Aroma can significantly influence the deliciousness of a dish, food, or beverage product. Aroma is influenced by the sense of smell, which is generally received by the nose and brain, typically a mixture of fragrant, sour, rancid, and burnt odours. Aroma is one way to attract consumer interest in a product [17]. Food that emits a distinctive aroma (vapor) will be received by the olfactory cells in the nose and continued to the brain in the form of electrical impulses [18].

The results of the hedonic test on the aroma of carrot pempek showed that the average value for liking the aroma of carrot pempek was 4.36, and the same results were obtained by P1, P2, and P3, with an average hedonic test value of 4.44 (**Figure 2**).

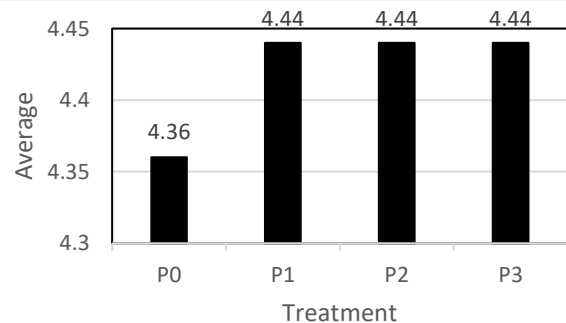


Figure 2. The Average of Aroma Assessment in Hedonic Test.

The results of the analysis of variance (ANOVA) on the texture of pempek are presented in Table 3, which shows no significant difference. This is evident from the calculation of the f-value, which is less than the f-table value of 5% and 1%. The comparison determines the relationship between the aroma and carrot is not significant. The carrots were used in the dough to cover the fishy smell of pempek, so the panellists prefer carrot pempek. The proportion of ingredients in carrot pempek is very useful in covering the fishy smell of the original one. As shown in Figure 2, carrot pempek is more preferred compared to the control sample (P0).

Table 3. ANOVA test of Aroma Assessment in Hedonic Test.

SK	DF	Sum Square (SS)	Mean Squares	F Count	F5%	F1%	Conclusion
Sample	3	0.12	0.04				
Respondent	24	19.36	0.80667	0.59	2.73	4.07	No Significant
Error	72	4.88	0.06778				
Total	71	24.36					

3.3. Flavour

Based on the hedonic test, it was found that pempek with 10% carrot content (P2) was most preferred by respondents with an average value of 4.44. Pempek P2 is preferred because it has a balanced combination of flavours between the savoury taste of snakehead fish and the sweet taste of carrots, unlike pempek P3,

which has a carrot concentration of 18 per cent, resulting in a stronger carrot flavour that eliminates the distinctive flavour of the pempek itself (**Figure 3**).

The test was continued with an analysis of variance on the flavour of the four treatments of carrot pempek, and an F-count of 77.93 was obtained. This value exceeded the F-table values at 5% and 1%, indicating that the addition of carrots with varying concentrations has a highly significant effect on the flavour of carrot pempek (**Table 4**). Based on the significant ANOVA test results, the Duncan test was continued, and it can be concluded that the level of respondents' preference for the flavour of pempek P2 differs from that of samples P1 and P3.

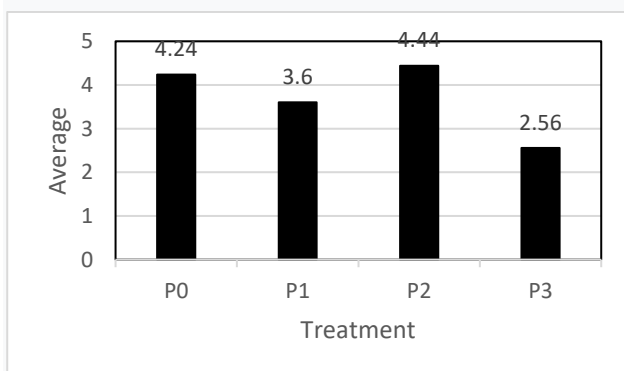


Figure 3. The Average of Flavour Assessment in Hedonic Test.

Table 4. ANOVA test of Flavor Assessment in Hedonic Test.

SK	DF	Sum Square (SS)	Mean Squares	F Count	F 5%	F 1%	Conclusion
Sample	3	53.71	17.90	77.93	2.73	4.07	Significantly difference
Respondent	24	8.34	0.347				
Error	72	16.54	0.2297				
Total	71	78.59					

Flavour is related to the sense of taste and utilises the tongue as a tool to recognise the ingredients contained in food or beverage products. These ingredients contain compounds related to microvilli and impulses that are formed and transmitted through nerves to the central nervous system. Chemical compounds, temperature, concentration and interaction with other taste components influence the flavor of a food ingredient. Each person has a lowest concentration limit for a taste that can still be perceived (threshold). This limit is not the same for each person, and a person's threshold for different tastes also varies [19].

3.4. Texture

The difference in the number of carrots affects the hardness level of the snakehead fish pempek. Based on the results of organoleptic tests on texture by respondents, it is evident that the texture of pempek without the addition of carrots is preferred over the texture of carrot pempek (P1, P2, and P3). While the texture of carrot pempek with the addition of 18% is less preferred with an average result obtained of 1.6 (**Figure 4**). The physical characteristics obtained in P3 carrot pempek have a soft texture. Adding carrots in excessive amounts causes the water content in the dough to increase, resulting in a softer dough compared to other pempek (P0, P1 and P2) [20]. In the Duncan test, it was found that carrot pempek P1 and P2 had no significant difference with control pempek (P0). The result occurred because the

coefficient of variation between the three treatments was very large, so it can be concluded that the use of carrots at low concentrations (less than 18%) does not affect the texture of the dough (**Table 5**).

Table 5. ANOVA test of Texture Assessment in Hedonic Test.

SK	DF	Sum Square (SS)	Mean Squares	F Count	F 5%	F 1%	Conclusion
Sample	3	116.4	38.8	97.678	2.73	4.07	Significantly difference
Respondent	24	7.64	0.3183				
Error	72	28.6	0.3972				
Total	71	152.64					

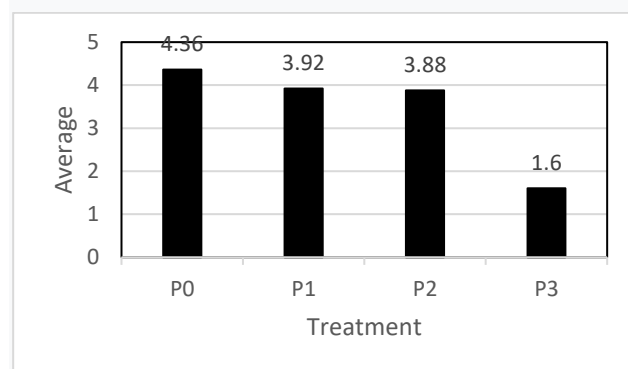


Figure 4. The Average of Texture Assessment in Hedonic Test.

4. CONCLUSION

Based on the results of this study, it can be concluded that: The addition of carrots as a source of beta carotene and also fiber up to 10% can increase the level of respondents' preference for color, taste, aroma and texture and can improve the physical characteristics of pempek including brighter colors compared to control pempek (P0), a slightly sweet taste typical of carrots, a fish aroma that is not too strong and a texture that is still chewy. The addition of carrots to making snakehead fish pempek has a significantly different effect on organoleptic assessment, especially in terms of colour, flavour, and texture.

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