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Characteristics And Acceptability Of Crispy Noodles Made With Corn (Zea Mays L.) And Inulin Flour Substitutes

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Abstract

Obesity is a growing nutritional problem, including in Indonesia. The habit of consuming high-calorie, low-fiber foods such as noodles contributes to the risk of obesity. Corn silk, often considered waste, is rich in fiber, flavonoids, saponins, tannins, beta-carotene, and other vitamins that are beneficial to health. Corn silk is produced in abundance; specifically, for every 5 tons of corn, 3.5% consists of corn silk. The potential for utilizing this byproduct can be combined with inulin flour, which is high in fiber content and has prebiotic properties. This study aims to determine the effect of substituting corn silk flour and inulin flour on the acceptability of crispy noodle products. The research design used was a pure experimental design with a completely randomized design (CRD), consisting of 3 formulations: one control formulation (F0) and two modified formulations (F1, F2). The panelists were 30 adults aged 18 years and older. The acceptability test results showed that the modified formula most preferred by the panelists was F1. There were significant differences in color, taste, texture, and aftertaste characteristics ($p \leq 0.05$). Thus, the substitution of corn silk flour and inulin flour in crispy noodle products is still sensorially acceptable, with F1 as the best modified treatment formula.

Keywords: Acceptance, Corn Silk, Crispy Noodles, Inulin, Sensory Characteristics.

INTRODUCTION

Nutrition problems, namely obesity, are a problem faced by various countries, including Indonesia. The percentage of obesity among adults aged 18 years and older in Indonesia reached 23.4%, which is an increase of 1.6% when compared to 2018 (Ministry of Health of the Republic of Indonesia, 2023). The causes of obesity itself are multifactorial. An unbalanced diet is one of the significant risk factors for obesity (Khohir et al., 2024). An unbalanced diet is defined as a diet with a high consumption of energy and low in fiber and other nutrients. Individuals with obesity tend to have higher energy intake and lower fiber intake than individuals with normal nutritional status (Putri et al., 2023).

Noodles are one of the favorite foods of people in various countries including Indonesia, this is reflected in the amount of domestic consumption which reaches tens of billions of servings in a year (Sariyani et al., 2023). Over time, noodles are not only consumed as a staple food but also as a snack, one of which is noodle kremes which is also quite popular in various circles. In BPOM regulation Number 13 of 2023 which discusses the food category, kremes noodles are included in the category of 15.0 ready-to-eat snacks where this category is formed based on raw materials, processing processes, and target allocations. Despite having a high level of consumption, noodles generally have a low nutritional profile of fiber, protein, vitamins and minerals, which if not balanced with sufficient fiber intake has the potential to increase the risk of obesity. The role of fiber itself is important in regulating energy metabolism, increasing satiety, slowing down stomach emptying, and supporting gastrointestinal health, so it is very relevant in obesity management (Deehan et al., 2024).

One of the local commodities that has the potential to be developed as a product with higher functional value is corn hair. Corn hair is a part of the corn plant that has been considered agricultural waste. Corn hair contains a lot of fiber, protein, flavonoids and other bioactive compounds as well as various vitamins and minerals that are beneficial for health (Ramli et al., 2021). One of the largest corn production centers in Indonesia itself is in East Java with a production rate of 4,595,792 tons (Indonesian Central Statistics Agency, 2024). Each hectare of corn crop area will produce 5 million tons of corn and 3.5% of it is corn hair. The utilization rate of corn hair is generally only for animal

feed after it has been cut or milled. One alternative to processing corn hair is to make it in flour form. Corn hair in the form of flour has good physical, functional, and antioxidant properties, so it has the potential to be used in the food industry as a raw material for food development (Singh et al., 2023).

As a further effort to improve the nutritional quality of products, the addition of other functional foods is a relevant approach. One of the ingredients that is widely used in the development of high-fiber foods is inulin. Inulin plays a role in increasing satiety, slowing down glucose absorption, and helping to control energy intake, making it relevant in the prevention and management of obesity (Hiel et al., 2020). Increasing fiber content through the addition of inulin makes the product potentially claimed as a source of fiber or foods high in fiber, which is relevant for the prevention and management of obesity (Yazici et al., 2023).

These two ingredients, corn hair flour and inulin flour have previously been studied by several researchers, one of which is the use of corn hair flour as a fibrous and functional food. Fortification of corn hair flour in flour-based food products such as cookies and bakery, which is able to increase the content of fiber, phenolics, and antioxidant activity with an acceptable level of sensory acceptance (Asiri et al., 2024). Inulin has been extensively researched as a functional dietary fiber in pasta and noodle products, with the rate of addition resulting in increased fiber content and potentially lowering starch availability and glycemic index values (Yazici et al., 2023). However, until now there has been no research that comprehensively examines the use of a combination of corn hair flour and inulin flour, especially in noodle kremes and its relationship with acceptability. Thus, the development of noodle kremes products through the substitution of corn hair flour and inulin flour needs to be carried out in order to determine its effect on sensory characteristics including, color, aroma, taste, texture and aftertaste, which also determines the level of consumer acceptance of the product. This study aims to analyze the characteristics and acceptability of kremes noodles substituted with corn hair flour and inulin flour, and determine the best formula based on the level of consumer acceptance.

RESEARCH METHODS

This study applied a purely experimental design using a Complete Random Design (RAL), which consisted of four substitution treatments of corn hair flour and inulin flour, involving free variables and bound variables, and a number of repetitions ($r \geq 6$). This research begins with the product formulation stage to determine the composition of the kremes noodles used in the main study. Then an acceptance test was carried out on the selected formula, namely F0 (control), F1, and F2.

Table 1. Kremes Noodle Product Formulation

Ingredients		**1 recipe (2 servings)**		
		F0	**F1**	**F2**
Main ingredient				
Wheat flour	(g)	100	82	75
Corn hair flour	(g)	0	10	15
Inulin flour	(g)	0	8	10
Air	(ml)	32	32	32
Chicken eggs	(g)	10	10	10
Salt	(g)	0,5	0,5	0,5
Complementary materials				
Seaweed powder	(g)	5	5	5
Cooking oil (frying)	(ml)	30	15	15

The tools used in this study include digital food scales, noodle printing machines, frying pans, and other supporting equipment. Raw materials such as corn hair flour (Zea Mays L.), inulin flour, wheat flour, water, chicken eggs, salt, and other supporting materials are obtained from commercial distributors of food ingredients to ensure consistent quality.

The process of making kremes noodles begins with mixing dry ingredients, namely wheat flour, corn hair flour, inulin flour, and salt, then stir until all ingredients are homogeneously mixed. Next, add wet ingredients such as water and eggs that are poured gradually into the dry ingredients mixture while continuing to stir until a perfectly mixed dough forms. The dough is left to sit for 30 minutes, then passes the noodle formation stage, starting with the process of grinding the dough into thin sheets and cut into noodle strands using a special noodle cutting tool. The final stage is the process of cooking and drying the noodles, the noodles are steamed for 5 minutes then fried for 3 minutes to reduce the moisture content. The finished noodles are then mixed with seaweed powder and stored in a sealed container before testing.

The population in this study was untrained panelists whose determination was made using Federer's formula with a sample of 30 people. The panelists involved were young adults aged 19-29 years, were in good health, were willing to participate in the entire series of studies, and had no history of allergy to the ingredients used. This research has been approved by the Ethics Committee, and all panelists have provided informed consent before the implementation of the research.

The research data was collected through a hedonic test using six levels of the assessment scale, namely a score of 1 = very dislike, 2 = dislike, 3 = somewhat disliked, 4 = somewhat liked, 5 = like, 6 = very like. The parameters evaluated included color, taste, aroma, texture, and aftertaste. To reduce potential bias in the study, each sample was presented randomly using a different three-digit code.

Statistical software will be used to analyze the hedonic test data that has been collected. The Shapiro-Wilk test is used to test normality at a significance level of 0.05. Since the data showed an abnormal distribution, the analysis was continued using the Kruskal-wallis to find out the difference in the level of preference in each parameter tested. If a significant difference is obtained ($p < 0.05$), then the analysis is continued with the test Mann Whitney to identify differences in the level of preference between formulas.

RESULTS AND DISCUSSION

Acceptability

The acceptance test of three dry noodle formulas, namely F0 (control), F2 and F3, was conducted on 30 untrained panelists. The assessment of sensory characteristics including color, aroma, taste, texture, and aftertaste was carried out using a hedonic test with six levels of assessment. The entire manufacturing process and research stages of kremes noodles with corn hair flour and inulin flour substitution were carried out at the Processing Laboratory and Nutrition Presentation Laboratory, Faculty of Public Health, Airlangga University in the period November 2025 to February 2026.

The results of the panelists' research on the three formulas of kremes noodles are presented in Table 2.

Table 2. Hedonic Test Results of Noodle Kremes Products

Parameters	F0	F1	F2	p-value
Color	5,33	4,17	3,97	<0.001*
Aroma	5,03	4,73	4,6	0,158
Taste	5,1	4,6	4,13	<0.001*
Tekstur	5,17	4,83	4,33	0,002*
Aftertaste	4,8	4,27	3,87	0,006*
Overall average	5,08	4,55	4,2	-

*) Significant difference ($p < 0.05$) based on the Kruscal-wallis Test

Color

Color plays an important role in influencing consumer perception, preference, and judgment, as well as being an indicator of quality, food safety, and taste expectations in products. The results showed that the substitution process caused the color of the noodles kremes to be darker than the

control formula. Based on the results of the hedonic test, the color attribute showed a significant difference ($p < 0.05$). The findings indicate that the variation in corn hair flour and inulin flour substitution in the modified formula had a significant effect on the panelists' acceptance rate of color attributes. These results are in line with research conducted by Rozan et al. (2022), which states that an increase in the proportion of corn hair flour results in a change in the color level of the product.

The darker color of this product is due to the use of brownish corn hair. In addition, the phenolic components present in corn hair also play a role in the product browning process (Asiri et al., 2024). In addition, there is also a maillard reaction triggered by temperature during the manufacturing process so that melanoidin accumulates which causes excessive browning (Qi et al., 2025).

Aroma

Aroma is one of the sensory attributes that has an important role in determining the level of consumer acceptance of a food product. Food aromas are formed from volatile compounds such as aldehydes, esters, furans, and pyrazines produced during production processes such as cooking, fermentation, and storage (Al-Khalili et al., 2025). Based on the results of the hedonic test, the aroma attributes of the three kremes noodle formulas showed no significant difference ($p>0.05$). The results showed that the variation in corn hair flour substitution and inulin flour did not have a significant effect on the panelists' acceptance rate on aroma attributes.

The aroma produced by the kremes noodles is also closely related to the addition of seaweed powder which has the ability to masking effect against volatile compounds that cause unwanted odors. Based on research Li et al. (2023) The main volatile compounds of seaweed, namely ketones such as β-ionone, were detected to have a very low odor threshold, so they were able to produce high aroma intensity even in small concentrations.

Taste

Taste is the most important sensory quality in food which is a combination of the taste buds on the tongue and the sense of smell in the nose that are released during chewing (Chen et al., 2023). The results showed that the substitution process produced a more bitter taste of the noodle kremes than the control formula. Data from the hedonic test confirmed the existence of a difference ($p < 0.05$) in taste attributes. This condition proves that the variation in formulation through the substitution of corn hair flour and inulin flour has a real (significant) impact on the panelists' assessment and acceptability in terms of taste. These results are in line with research conducted by Aukkanit et al. (2015), which states that an increase in the proportion of corn hair flour results in an acceptable change in the flavor level of the product.

This more bitter taste is produced due to the substitution of corn hair flour which chemically increases the content of antioxidant compounds such as total phenols, flavonoids, and tannins, as well as bioactive compounds such as saponins and alkaloids. This higher phenolic and flavonoid content is related to the flavor produced (Asiri et al., 2024). In addition, in the final stage of the maillard reaction, compounds such as pyrazine, pyrrol and furan are produced, where pyrazine is a flavor compound that if found in excessive concentration will be felt as a bitter taste (Flores-Sauceda et al., 2025).

Texture

Texture refers to the physical properties of the product that triggers the organoleptic response, which includes visual, palpable, and oral sensation (kinesthetic) aspects felt by the oral cavity throughout the chewing of the product. The texture characteristics of the kremes noodles produced through the substitution method have a harder profile than the reference formula (control). The results of the organoleptic test of these texture parameters showed a significant significance value ($p < 0.05$), which means that the variation in mixing corn hair flour as well as inulin flour directly transformed the panelists' acceptance rate of the mechanical properties or crunchiness of the product. These results are in line with research conducted by Rozan et al. (2022), which states that an increase in the proportion of corn hair flour results in a change in the texture level of the product.

The texture changes that occur are supported by research Selvarajan et al. (2018), there is a major challenge in products with increased flour-based fiber which lies in the intrinsic properties of dietary fiber, in particular in its water-retaining capacity (water-holding capacity) which can provide a competitive interaction between the added fiber and the gluten in the water scramble inhibiting the functionality of the gluten so that the resulting product is denser and harder. In addition, the addition of inulin also causes a change in the structure of the product, the inulin molecule forms a protective layer around the starch particles which causes the gelatinization process to take place not optimally so that the dough becomes stiffer and denser (Shiri et al., 2021).

Aftertaste

Aftertaste is a specific taste that appears and is only realized after an immediate taste sensation such as bitter and bitter fades in the oral cavity (Yuan et al., 2025). The results of the study show that the substitution process produces aftertaste Kremes noodles are more bitter than the control formula. Based on the results of the hedonic test, the aftertaste has a significant difference ($p < 0.05$). It confirms that the modification of the formula by changing the mixing ratio of corn hair flour and inulin flour concretely affects the panelists' acceptability of the parameters aftertaste produced after consumption.

The addition of corn hair flour has an effect on the increase in total phenols, total flavonoids and other bioactive compounds. Flavonoids are known to play a direct role in triggering the perception of bitterness through sensory receptor activity (Osakabe et al., 2024).

Analyze The Best Formulas

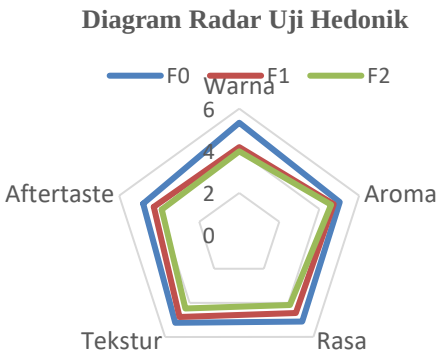

Figure 1. Salted by Radar Hedonic Test Untrained Panelists

A parameter called overall acceptance, which is based on a combination of all sensory attributes assessed, indicates the panelists' general level of preference for the product. Based on the results of the hedonic test, the F1 formula had the highest average acceptance value for the modified formula. This shows that the F1 formula has a balance of sensory characteristics that the panelists prefer. Although some sensory attributes such as color, taste, texture, and aftertaste shows a significant difference. Thus, the F1 formula can be considered as the best modified formula in the development of corn hair flour and inulin flour substitution kremes noodles.

CONCLUSIONS

Based on the sensory evaluation carried out, the hedonic test showed significant differentiation in the color, taste, texture, and *aftertaste attributes of* the noodle kremes product, while the aroma parameters showed no noticeable difference. However, the characteristics of the kremes noodles with the substitution of corn hair flour and inulin flour are still considered to be within the range of acceptability of the panelists. Judging from the overall acceptance rate, the F1 formula scored the highest among other modified variations, making it potentially the optimal formula in the development of this product. For future research, it is recommended to test the nutritional profile, including energy levels, and fiber, to comprehensively explore the functional value of the product. In addition, formulation optimization needs to be further developed to strengthen organoleptic performance, especially in the aspects of color, taste, texture, and *aftertaste* through the integration of relevant supporting materials to increase consumer appeal.

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