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Acceptability of Grasshopper Nugget Flour as a High-Protein Functional Food

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ABSTRACT

Background: Nugget products enhanced with locust flour are being explored as a novel source of functional food due to their high protein content, which plays a vital role in maintaining human health. Locusts, commonly consumed in parts of Africa and Asia, offer a promising alternative protein source. This study investigated the consumer acceptability of nuggets formulated with grasshopper flour as a nutrient-dense, functional food option. **Methods:** A Completely Randomized Design (CRD) was employed, and data were analyzed using the Friedman Test to assess differences among treatments. If significant differences ($p < 0.05$) were found, further analysis was performed with the Wilcoxon Test through SPSS version 20. Organoleptic evaluation was carried out by 30 semi-trained panelists. The nugget formulations tested were: P1 (100% tapioca flour, 0% grasshopper flour), P2 (95% tapioca flour, 5% grasshopper flour), and P3 (85% tapioca flour, 15% grasshopper flour). **Results:** Findings indicated that P1 (without grasshopper flour) received the highest scores in terms of color and aroma. For texture, both P1 and P2 (5% grasshopper flour) were equally preferred. In terms of taste, P1 remained the most favored. **Conclusion:** Overall, nuggets without any addition of grasshopper flour (P1) achieved the highest level of acceptability across all sensory attributes.

Keywords: Functional food; grasshoppers; nuggets

1. INTRODUCTION

Functional Food is food (fresh / processed) that contains components that are beneficial for improving certain physiological functions, and/or reducing the risk of disease which is proven based on scientific studies must show its benefits in the amount that is usually consumed as part of a daily diet.[1] Apart from that, public awareness and knowledge of many instances of complex diseases, for example, diabetes, which is widespread not only in developing countries but also in developed countries, is thought to be one of the causes, namely unhealthy eating patterns and lifestyles. Functional food is not only digested in the digestive tract but has become a means or tool to prevent and even treat certain diseases. Because of several essential ingredients, functional foods can have a beneficial effect on human health if they are consumed regularly and the diet products are varied every day.[2] Nuggets are fast food that many people like. Nuggets are made from seasoned ground meat, mixed with a binder, then molded into a certain shape,

steamed, cut, coated with a flour adhesive (batter), and covered with breadcrumbs (breading). Nuggets are ready-to-eat frozen food products that have been partially cooked (pre-cooked) and then frozen.[3] The texture of the inside of a quality nugget is that it sticks together and is soft while the texture of the outside is crispy and dry. Commercial nuggets are generally made with chicken or fish and beef. Making nuggets usually uses fillers in the form of wheat flour or wheat flour, but there are still many other ingredients that can be used as fillers for nuggets, one of which is grasshopper flour.[4]

Grasshoppers are a high-protein food source that is currently known to be widely consumed by people in Africa and Asia.[5] This food potential must be empowered simultaneously to deal with the explosion of the grasshopper population and the opportunity to increase the community's economy. To realize its benefits slowly through a substitution approach by adding grasshopper flour to tapioca flour, as well as developing regular nuggets mixed with grasshoppers. Research on the use of grasshoppers as food has attracted the attention of several experts to utilize insects as a human food reserve in the future.[6] Eighty species of grasshoppers are safe for consumption.[7] Wandering grasshoppers have a higher protein content than shrimp and are equivalent to chicken meat with little fat. 100 grams of raw grasshopper meat contains 26.8% protein, while dried grasshoppers contain 62.2% protein.[8] Eating this type of raw food is often viewed negatively because many people still feel strange or even dislike it because they still see the original physical form of the grasshopper.[6]

In biology, proteins are vital macromolecules that are important for many physiological functions and greatly enhance the nutritional value of our diet. Their digestibility, the bioavailability of amino acids, and the physiological reactions they elicit in the body are all determined by their structure. Dietary proteins' amino acid composition and bioavailability are important since they dictate the source of protein's nutritional value. Making better food choices and making sure the body gets enough nutrients requires an understanding of protein structure and how it relates to nutrition, digestibility, and bioavailability. A balanced intake of essential amino acids is crucial for supporting healthy growth, immunological response, and general well-being, according to recent studies.[9,10] The macromolecular component of all living cells and the second major compound of the human body is protein. Protein forms part of the human body cells that contain hydrogen, carbon, nitrogen, phosphorus, and sulfur. Unlike other macronutrients such as carbohydrates and fats, protein plays an important role in the formation of biomolecules rather than as an energy source. Protein also plays a role in determining the size and structure of cells. Protein is an important component of the intercellular communication system and a catalyst for various biochemical reactions in cells.[11] Therefore, innovation in processed functional food products with the substitution of grasshopper flour is expected to add positive effects on human health, especially in terms of protein intake. In addition, processing high-protein grasshoppers into processed foods that no longer display their original form can reduce negative consumer views. In addition, processing grasshoppers into processed foods that no longer present the original form of the insect can reduce consumers' negative views on the consumption of grasshoppers which are high in protein.

2. METHODS

The tools used are a frying pan, bowl, blender, spatula, strainer, spoon, plate, bowl, and knife. Panelists conducted organoleptic acceptance tests on 4 parameters, namely color, aroma, texture, and taste on this product made in three ratios of tapioca flour and grasshopper flour, namely P1 (100%: 0%), P2 (95%: 5%), P3 (85%: 15%). The formulation of the "Grasshopper Nugget" product as follows is modified from the research of Usfinit, A. M. M. et al, 2023.[6]

Table 1. Grasshopper nugget formulation

Ingredients	Formulation		
	F1	F2	F3
Tapioca flour	90 g	64.3 g	51.5 g
Grasshopper flour	-	25.6 g	38.5 g
Cornstarch	24 g	24 g	24 g
Skim milk	7 g	7 g	7 g
Chicken meat	300 g	300 g	300 g
Egg	100 g	100 g	100 g
Salt	2 g	2 g	2 g
Pepper	2 g	2 g	2 g
Water	50 ml	50 ml	50 ml

Organoleptic data collection was carried out from the established Grasshopper Nugget formula. The results of data processing of physical and organoleptic properties tests are presented in tabulation form. Data

analysis using the Friedman Test and if there is a significant difference will be continued by the Wilcoxon Test. The stages of making Grasshopper Nuggets are: blend the grasshoppers until smooth, pour into a container, and strain the oil in the grasshoppers. Wash the chicken until clean, and mix the dough. Prepare a bowl, add the chicken, grasshoppers, eggs, tapioca flour, rice flour, sugar, salt, and pepper then blend until well blended. Pour the dough into a container, and prepare the breadcrumbs. Form the dough into small pieces and coat it with breadcrumbs.

3. RESULTS AND DISCUSSION

3.1 Color

Color is the first thing that someone sees. Color will make an impression or mood better. Colors possess extraordinary ability to evoke feelings, memories and even influence the processes of enactment decisions.[12] Color can give deep suggestions to humans. The percentage of color acceptance by panelists for Grasshopper Nugget products can be shown in the following diagram.

Table 2. Panelists' preference for grasshopper nugget color

Replication	Grasshopper nugget (formulation)		
	P1 (100% : 0%)	P2 (95% : 5%)	P3 (85% : 15%)
1	4.06	4.47	4.88
2	6.85	7.21	4.68
3	7.8	4.52	3.8
Mean	8.81	5.52	5.61
Mean rank	2.62	1.92	1.46
Modus	4	4	3

In the grasshopper nugget diagram, it can be seen that the color acceptability of the grasshopper nugget product that has the highest value is P1 and P3 with a percentage of 78% while the low acceptability is P2 with a percentage of 60%. The color of P1 is more prominent like nuggets in general because P1 does not contain the addition of grasshopper flour and in P2 there is the addition of grasshopper flour as much as 5%. Therefore, the panelists prefer the color of the grasshopper nuggets in P1 and P3. This is influenced by the dark brown color of the grasshopper so that the color of the nugget dough becomes dark and less attractive.[6] From the table above, it can be concluded that at the level of panelists' preference for the color of grasshopper nuggets P1 (0% grasshopper flour) has an average preference level of 8.18%, for the average value of P2 (substitution of the addition of grasshopper flour 5%) as much as 5.52%, and the average value in P3 (substitution of the addition of grasshopper flour 15%) as much as 5.61%.

3.2 Aroma

Aroma is the smell of food products. In the test of preference for aroma, sensitivity greatly affects the assessment. One of the key characteristics of food that influences how well-liked it is by people is its flavor. Thus, obtaining a thorough and precise examination of food flavor may offer insights into ongoing food research inquiry.[13] The percentage of aroma acceptance by panelists for Grasshopper Nugget products can be shown in the following diagram.

Table 3. Panelists' preference for grasshopper nugget aroma

Replication	Grasshopper nugget (formulation)		
	P1 (100% : 0%)	P2 (95% : 5%)	P3 (85% : 15%)
1	3.50	3.43	3.26
2	3.53	3.43	3.23
3	3.46	3.36	3.30
Mean	3.49	3.40	3.26
Mean rank	2.11	2.03	1.86
Modus	4	4	2

In the Grasshopper Nugget diagram, it can be seen that the aroma acceptance of the Grasshopper Nugget product which has the highest value is in P1 with a percentage of 93% while the lowest acceptance is in P3 which has a value of 88%, but in P2 it has an average that is not far from P1 which is 89%. The aroma of nuggets in P1 (0% grasshopper flour) tends to have a distinctive savory nugget aroma because it has not been mixed with grasshopper flour. After all, grasshopper flour has a distinctive savory aroma. Therefore, the panelists prefer the aroma of nuggets in P1 which does not have an additional substitution of grasshopper flour. From the table above, it can be concluded that at the level of panelists' preference for the aroma of grasshopper nuggets P1 (0% grasshopper flour) has an average level of preference of 3.49%, for the average value of P2 (5% grasshopper flour substitution) as much as 3.40%, and the average value in P3 (15% grasshopper flour substitution) as much as 3.26%. Judging from the mode or from the values that frequently appear from the three treatments, the value of treatment 1 is 4, treatment 2 is 4,

and treatment 3 is 2. Treatment 1 and treatment 2 have the same mode, indicating that P1 and P2 are not much different in terms of aroma.

Aroma is a smell produced in a food that can stimulate the sense of smell and can arouse a person's appetite. Aroma is a sense of smell that is difficult to measure and subjective because each person has different preferences and sensitivities.[18] The aroma of nuggets has characteristics in each treatment seen from their different compositions. The more grasshopper flour is added, the more the distinctive aroma of grasshoppers sticks to the nuggets. The level of panelists' preference for the aroma of P1 nuggets is because the nuggets have an original aroma like the typical aroma of processed chicken meat in general. After all, there is no addition of grasshopper flour so panelists prefer P1. By research conducted by Usfinit in 2023, the more substitutions of grasshopper flour, the more pungent the aroma produced will be.[6]

3.3 Texture

Texture is one of the factors that influence consumer choice of a food product. Food ingredients that can affect texture value are the ratio of protein content, fat, processing temperature, water content, and water activity. The texture is greatly influenced by water content, the lower the water content, the more compact and dense the resulting texture.[14] Texture can be seen directly using the sense of sight, namely hard, smooth, soft, rough, intact, solid, liquid, moist, dry, crunchy, tough, soft, and chewy.[15] The first factor can be detected by the sense of smell and the last two factors can be detected by sensory cells on the tongue.[16]

Table 4. Panelists' preference for grasshopper nugget texture

Replication	Grasshopper nugget (formulation)		
	P1 (100% : 0%)	P2 (95% : 5%)	P3 (85% : 15%)
1	2.96	2.90	3.10
2	3.10	3.00	3.26
3	3.06	3.20	3.20
Mean	3.04	3.03	3.18
Mean rank	1.97	1.91	2.12
Modus	3	3	4

In the grasshopper nugget diagram, it can be seen that the texture acceptability of the grasshopper nugget product that has the highest value is P1 and P2 with a percentage of 76% while the low acceptability is P3 with a percentage of 73%. The texture of P1 and P2 tends to be softer because P1 does not have the addition of grasshopper flour and P2 has the addition of 5% grasshopper flour. Therefore, the panelists prefer the texture of grasshopper nuggets in P1 and P2. From the table above, it can be concluded that at the level of panelists' preference for the texture of grasshopper nuggets, P1 (0% grasshopper flour) has an average preference level of 3.04%, for the average value of P2 (substitution of 5% grasshopper flour) as much as 3.03%, and the average value of P3 (substitution of 15% grasshopper flour) as much as 3.18%, and it can be concluded that the mode in P1 and P2 is 3 then P3 is 4.

Texture is the overall assessment of food ingredients that are felt by the mouth. The elasticity of nuggets is influenced by the binding ingredients in making nuggets, namely powdered milk, flour, and eggs. In flour, there is starch which can bind water. In eggs, there is ovalbumin which is a protein in egg whites that will harden.[19] Food texture is the result of the tactile sense response to the form of physical stimulation when there is contact between the inside of the oral cavity and food.[20]

3.4 Taste

In terms of food, taste is one of the most important things to determine whether the food has good acceptance or not by the panelists. According to research, many have revealed the taste of food, one of which is a study in 2020 that states that taste is a way to distinguish food or drinks from texture, smell, temperature, and shape. In addition, taste can also be interpreted as the process of choosing food or drinks that can be distinguished from several aspects, namely texture, smell, temperature, and shape.[17] Research on the manufacture of grasshopper products was carried out with Organoleptic Testing and in this test, the results showed that the taste or flavor of the functional food product grasshopper nuggets was the main criterion for the product to be successful. This can be written because it has conducted an "Organoleptic Test of Grasshopper Nuggets" targeting 30 trained panelists.

Table 5 shows the percentage of acceptability of the taste of grasshopper nuggets from all treatments with 3 replications, namely in treatment 1 with a ratio of (100%: 0%) getting an average of 3.50%, then treatment 2 with a ratio of (95%: 5%) getting an average of 3.45% and treatment 3 with a ratio of (85%: 15%) getting an average of 3.49%. For the results of the percentage of acceptability, it can be seen that the highest acceptability

is in treatment 1, which is 83.33% and the lowest acceptability is in treatment 2, which is 80%. It can be concluded that the percentage results of each treatment have a very small difference from all treatments, this shows that the panelists gave a relatively similar score range to all treatments on grasshopper nugget products.

Table 5. Panelists' preference for grasshopper nugget taste

Replication	Grasshopper nugget (formulation)		
	P1 (100% : 0%)	P2 (95% : 5%)	P3 (85% : 15%)
1	3.63	3.43	3,46
2	3,33	3,40	3,50
3	3,56	3,53	3,53
Mean	3,50	3,45	3,49
Mean rank	1,98	1,98	2,04
Modus	4	4	4

Taste can be influenced by several factors such as texture, temperature, chemical compounds, and interactions with other components. From the acceptability table above, the grasshopper nugget product that has the highest acceptability in treatment 1 with a percentage of 83.33% has a ratio of (100%: 0%) which means 0% addition of grasshopper flour. Therefore, treatment 1 is widely preferred with the highest acceptability because when viewed from the results of the organoleptic test description, few panelists disliked grasshopper flour. After all, in its formulation with the addition of grasshopper flour, it tasted like the grasshopper taste was too dominant. However, when viewed from the results of the acceptability of treatment 2 compared to treatment 1, the percentage results were obtained with a very slight difference in results, which was approximately 1%.[17]

From the results of the organoleptic test on taste, it can be concluded that some panelists like adding grasshopper flour, and some do not like grasshopper flour so the average results are not much different. In addition, from the Organoleptic Test on taste, it can also be concluded that the results of panelists who liked the treatment of adding grasshopper flour gave relatively low scores compared to panelists who did not like grasshoppers who gave relatively very low scores. The product tastes savory from the grasshopper. This is what makes the results of the acceptability of the taste of grasshopper nuggets get results that many panelists like treatment 1 compared to treatments 2 and 3 with a formulation of 0% addition of grasshopper flour.[21]

4. CONCLUSION

The aroma acceptance of the grasshopper Nugget product which has the highest value is in treatment 1 with a percentage of 93% because the aroma of nuggets in treatment 1 (0% grasshopper flour) tends to have a distinctive savory nugget aroma. After all, it has not been mixed with grasshopper flour because grasshopper flour has a distinctive aroma. The texture acceptance of the grasshopper nugget product which has the highest value is treatment 1 and treatment 2 with a percentage of 76%. The texture of treatment 1 and treatment 2 tends to be softer because treatment 1 does not have the addition of grasshopper flour and in treatment 2 there is the addition of grasshopper flour as much as 5%. The highest taste acceptance is in treatment 1, which is 83.33%.

Ethical Approval

Not required

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Competing Interests

All the authors declare that there are no conflicts of interest.

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Underlying Data

Derived data supporting the findings of this study are available from the corresponding author on request.

REFERENCES

1. FGD of P3FNI Professional Association. Indonesian Society for Functional Food and Nutraceutical (ISFFN). 2020. Pengertian Pangan Fungsional. Available from: https://p3fni.org/ (Accessed on 13 Dec 2024)
2. Abbas. Potensi Pangan Fungsional dan Perannya dalam Meningkatkan Kesehatan Manusia yang Semakin Rentan — Mini review. Jurnal Teknosains. 2020;14(2):176–186. https://doi.org/10.24252/teknosains.v14i2.14319
3. Revitriani M, Puspitasari D, Rejeki FS. Characteristic of Wheat Flour Nuggets: study of cooking process and proportion of red beans. Food Science and Technology Journal (Foodscitech). 2022;5(2):114–122. https://doi.org/10.25139/fst.vi.5085
4. Pardianti NPIA. Pembuatan dan Karakteristik Nugget

Jamur Tiram (Pleurotus ostreatus) dengan Penambahan Tepung Kedelai (Glycine max) sebagai Alternatif Pangan Fungsional. FAKULTAS PERTANIAN, UNIVERSITAS HASANUDDIN; 2022. Available from: http://repository.unhas.ac.id/id/eprint/13111/2/G031171507_skripsi_26-01-2022 1-2.pdf (Accessed on 13 Dec 2024)

5. Siddiqui SA, Ghisletta M, Yunusa BM, Jiddum FA, Saraswati YR, Fernando I, et al. Grasshoppers and locusts as human foods – a comprehensive review. Journal of Insects as Food and Feed. 2023;9(10):1247–64. http://dx.doi.org/10.3920/jiff2023.0010
6. Usfinit AMM, Lalel HJD, Abidin Z, Rubak YT, Ndapamuri MH. Pengaruh Proporsi Daging Ayam dan Tepung Belalang Kembara terhadap Sifat Fisiko-kimia dan Organoleptik Nugget. Jurnal Pangan dan Agroindustri. 2023;11(2):79–88.
7. Wijaya H, Chalid Y, Thaharah A, Nugroho AF. Effect of Processing on Characteristic of Protein Allergen of Grasshopper (Oxya chinensis). Journal of Agro-based Industry. 2019;36(1):11–21. http://dx.doi.org/10.32765/warta ihp.v36i1.4386
8. Yang X, Zhang K, Wang J, Jia H, Ma L, Li Y, et al. Assessment of genetic diversity and chemical composition among seven black locust populations from Northern China. Biochemical Systematics and Ecology. 2020;90:104010. http://dx.doi.org/10.1016/j.bse.2020.104010
9. Millward DJ. Amino acid scoring patterns for protein quality assessment. British Journal of Nutrition. 2012;108(S2):S31–43. http://dx.doi.org/10.1017/s0007114512002462
10. Carbone JW, Pasiakos SM. Dietary Protein and Muscle Mass: Translating Science to Application and Health Benefit. Nutrients. 2019;11(5):1136. http://dx.doi.org/10.3390/nu11051136
11. Khotimah D, Faizah U, Sayekti T. Protein sebagai Zat Penyusun dalam Tubuh Manusia: Tinjauan Sumber Protein Menuju Sel. PISCES : Proceeding Of Integrative Science Education Seminar. 2021;1(1):127-133. Available from https://prosiding.iainponorogo.ac.id/index.php/pisces/article/view/117 (Accessed on 13 Dec 2024)
12. Popovski F, Popovska HD, Mijakovska S, Nalevska GP. Psychological and Graphic Aspects of Colors: Influence and Application in Product Design. International Journal of Computer Science and Information Technology. 2024;16(3):59–65. http://dx.doi.org/10.5121/ijcsit.2024.16305
13. Yu M, Yang P, Song H, Guan X. Research progress in comprehensive two-dimensional gas chromatography-mass spectrometry and its combination with olfactometry systems in the flavor analysis field. Journal of Food Composition and Analysis. 2022;114:104790. http://dx.doi.org/10.1016/j.jfca.2022.104790
14. Effendy WNA, Nadia LMH, Rejeki S, Ode Huli L. Analisis Organoleptik dan B-Karoten Nugget Ikan Nila (Oreochromis sp.) dengan Penambahan Tepung Wortel (Daucus carota L). Jurnal FishtecH. 2022;11(1):58–65. http://dx.doi.org/10.36706/fishtech.v11i1.15812
15. Sakti L. Pengaruh Substitusi Tepung Wortel (*Daucus Carota* L.) pada Pembuatan Takoyaki Terhadap Daya Terima Konsumen. Jakarta: Fakultas Teknik Universitas Negeri Jakarta; 2018.
16. Lamusu D. UJI ORGANOLEPTIK Jalangkote Ubi Jalar Ungu (Ipomoea batatas L) Sebagai Upaya Diversifikasi Pangan. Jurnal Pengolahan Pangan. 2018;3(1):9–15. http://dx.doi.org/10.31970/pangan.v3i1.7
17. Mardiyah LN. Pengaruh Cita Rasa, Desain Kemasan dan Variasi Produk Terhadap Keputusan Pembelian Minuman (Survei pada Konsumen Xi Bo Ba Bandar Lampung). Thesis: Universitas Teknokrat Indonesia; 2021. Available from: http://repository.teknokrat.ac.id/3589/ (Accessed on 13 Dec 2024)
18. Hariadi H. Nutritional Content Analysis and Appearance "Cookies" Flour Mocaf (Modified Cassava Flour) and Broccoli (Brassica oleracea L.) with the Addition of Flour Mung Bean Phaseolus radiatus L.). Jurnal Agrotek Indonesia. 2017;2(2):98–105.
19. Sinta D, Nurhaeda, Rasbawati R, Fitriani F. Uji Organoleptik dan Tingkat Kesukaan Nugget Ayam Broiler dengan Penambahan Susu Bubuk Skim pada Level yang Berbeda. Prosiding Seminar Nasional Kedua Sinergitas Multidisiplin Ilmu Pengetahuan dan Teknologi / Articles. 2019;2:26–27. Availab;e from: https://jurnal.yapri.ac.id/index.php/semnassmipt/article/view/116 (Accessed on 13 Dec 2024)
20. Hidayah RH, Oktaningrum GN, Fatikasari MH, Subiharta S. KUB Chicken Nugget Sensorical Quality. Mediagro. 2021;17(2):146–153.
21. Ratulangi YA, Siswosubroto SE, Ratulangi F, Rompis JEG. Sifat Organoleptik Naget Ayam Yang Menggunakan Tepung Kedelai Sebagai Penggantian Sebagian Daging. Zootec. 2017;38(1):131. http://dx.doi.org/10.35792/zot.38.1.2018.1856