



Product Development of Oatmeal Aglio E Olio Noodles for People with Diabetes Mellitus

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ABSTRACTS

Aglio e olio oatmeal noodles are a variant of staple food designed for individuals with diabetes mellitus. In general, noodles are a popular food among Indonesians; however, traditional noodles, made from wheat flour, have a high glycaemic index and are easily digested, causing spikes in blood sugar levels. Therefore, it is necessary to develop noodle products using oatmeal, a low-glycaemic index food with high fiber content, which is beneficial for people with diabetes. Aglio e olio seasoning is incorporated to enhance aroma and flavours, aiming to increase the appetite of diabetic patients. Product testing by expert panellists determined that the optimal formulation consists of 92% oatmeal flour and 8% mocaf flour. The addition of mocaf flour improves the texture, making it chewy and slightly sticky, resembling conventional noodles. This research employed a quantitative descriptive method using percentage analysis, presented in a preference category table. Data collection involved a hedonic test with a 5-point scale (1 = dislike, 5 = really like) by 30 semi-trained panellists, assessing five attributes: colour, texture, taste, aroma, and overall acceptance. The results showed that 84% of panellists liked the colour, 74% liked the texture, and 83% liked both the taste and overall quality. The aroma achieved the highest preference, with many panellists expressing strong approval. Overall, aglio e olio oatmeal noodles show promising potential as a diabetes-friendly noodle alternative.

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1. INTRODUCTION

Diabetes Mellitus (DM) is a growing global health issue, affecting over 537 million adults worldwide as of 2021, with projections reaching 643 million by 2030 (Sun et al., 2022; International Diabetes Federation, 2021). One of the key strategies for DM management is strict dietary regulation, especially controlling carbohydrate intake to stabilize blood glucose levels (Adadi et al., 2020; Wang et al., 2021). However, many diabetic patients experience boredom with limited staple food options, leading to decreased appetite and reduced adherence to dietary recommendations (Peng et al., 2023; Liu et al., 2020). Therefore, it is crucial to innovate alternative staple foods using low glycaemic index carbohydrate sources like oatmeal, aiming to meet the nutritional needs of diabetic patients while enhancing dietary compliance. Additionally, the World Health Organization (WHO) emphasizes that diet plays a crucial role not only in glycemic control but also in reducing diabetes-related complications such as cardiovascular diseases and neuropathies (WHO, 2022). Studies show that introducing diversified, yet healthy staple foods can improve adherence and patient outcomes significantly (Knight et al., 2022; Ahmad et al., 2021). Hence, developing new staple food alternatives, particularly those familiar to local eating habits like noodles but adapted with healthier ingredients, addresses both medical needs and cultural acceptability, making it a necessary direction for research.

Several studies have investigated the potential of low glycaemic index foods, particularly oat-based products such as bread, porridge, and biscuits, for diabetic management (Zhu et al., 2022; Chalamaiah et al., 2021; Shao et al., 2023; Subba et al., 2021). These studies highlight those soluble fibers, notably beta-glucan in oats, significantly contribute to improved glucose regulation. However, most previous research focused on conventional oat-based products, with limited exploration into noodle innovations as an alternative staple food more aligned with the culinary preferences of populations such as Indonesians (Jia et al., 2023; Venn & Banwell, 2020). Additionally, the use of flavours enhancers like aglio e olio seasoning to improve sensory acceptance among diabetic consumers remains underexplored in the literature. Moreover, while various studies have demonstrated the benefits of fiber enriched foods in glycaemic management, there is limited research addressing how sensory factors such as taste, aroma, and texture impact acceptance of diabetic-friendly food innovations (Gul et al., 2021; Hossain et al., 2022). Consumer acceptance is a critical success factor for functional food innovations, especially in dietary intervention programs.

Despite advances in developing low glycaemic index foods, there is a notable gap in creating noodle products made from oatmeal flour enhanced with culinary seasonings like aglio e olio to improve both nutritional and sensory profiles for diabetic patients (Kurniawan et al., 2024; Rachman et al., 2023; Tan et al., 2022; Ma et al., 2021). Prior studies rarely examine the combined substitution of wheat flour with oatmeal in noodle products while addressing flavours improvement strategies specifically for diabetes-friendly diets. Therefore, this study aims to develop aglio e olio oatmeal noodles tailored for people with diabetes mellitus, focusing on achieving a low glycaemic index formulation and improving the product's colour, aroma, taste, texture, and overall acceptability to offer a nutritious and palatable alternative staple food. Furthermore, the lack of studies examining the optimal balance between functional nutritional quality and consumer-driven sensory characteristics in diabetic food innovations remains a critical limitation (Hashem et al., 2022; Rattanapanone et al., 2023). Most existing research has tended to prioritize nutritional improvements without sufficiently considering real-world palatability and consumer

satisfaction. Thus, there is an urgent need for a holistic approach that combines food science, sensory evaluation, and clinical dietary recommendations to ensure the success of novel food products for diabetic patients.

2. METHODS

This study employed a quantitative approach utilizing an experimental research design. The specific type of experimental design applied was a true experimental design, ensuring high internal validity by attributing outcomes solely to the independent variable rather than to confounding factors. The independent variable in this study was the formulation of *aglio e olio* oatmeal noodles, developed with a composition of 92% oatmeal flour and 8% mocaflour. This formulation aimed to replace high-glycaemic wheat flour with low-glycaemic oatmeal, thus aligning with dietary requirements for individuals with diabetes mellitus.

The research procedure followed several stages:

1. **Planning Stage:** Literature review and expert consultation were conducted to identify appropriate ingredients, nutritional standards, and formulation strategies for diabetic-friendly noodles.
2. **Recipe Analysis and Development Trials:** Initial formulations were based on existing literature and modified through iterative experimental trials to achieve the optimal texture, taste, and appearance.
3. **Product Standardization:** After several development trials, a standardized recipe was finalized using oatmeal and mocaflour combined with *aglio e olio* seasoning to enhance the sensory attributes of the noodles.
4. **Sensory and Nutritional Testing:** Sensory evaluations (hedonic tests) were conducted to assess the attributes of colour, texture, taste, aroma, and overall acceptability, using semi-trained panellists. In addition, nutritional properties and estimated glycaemic index values were reviewed through secondary data analysis from the latest scientific literature.
5. **Product Refinement:** Based on feedback from expert panellists and sensory test results, necessary product improvements were implemented to optimize both sensory qualities and nutritional adequacy.

The hedonic test was used as the primary data collection tool, employing a five-point Likert scale (1 = strongly dislike, 5 = strongly like) to evaluate panellist preferences across five product attributes. A total of 30 semi-trained panellists participated in the sensory evaluation. The results were analysed quantitatively by calculating the percentage of acceptability for each attribute to determine whether the *aglio e olio* oatmeal noodle product was acceptable as a functional staple food for individuals with diabetes mellitus.

3. RESULTS AND DISCUSSION

3.1. Product Test Results by Expert Panellists

Expert panellists provided feedback on both the sensory and nutritional aspects of the developed *aglio e olio* oatmeal noodles. In terms of visual appearance, the panellists agreed that the colour was appropriate and aligned with the general expectations of noodle

products. Visual appeal is critical, especially for functional foods targeting diabetic patients, as it influences initial consumer acceptance (Yang et al., 2021). The aroma characteristics, notably the distinct notes of parsley and garlic from the aglio e olio seasoning, were also positively highlighted by the panellists, consistent with findings that flavours enhancement can significantly increase palatability in health-oriented food innovations (Zhao et al., 2022).

However, one panellist noted that the taste profile was initially too spicy and slightly salty, which may not be ideal for people with diabetes mellitus. Excessive salt and spice intake can stimulate digestion aggressively and potentially cause gastrointestinal discomfort in diabetic individuals (Pohl et al., 2020). Therefore, the researcher reduced the amount of salt and chili powder in the final formulation to align better with the dietary guidelines for diabetic patients, who require a milder flavours profile to avoid metabolic stress (Alkhatib & Atcheson, 2021).

Regarding texture, the panellists suggested the addition of mocaflour to improve the chewiness and structural integrity of the noodles. Mocaflour was incorporated at 8%, complementing 92% oatmeal flour, to enhance elasticity without compromising the low glycemic index properties of the product. Previous studies have demonstrated that incorporating composite flours such as mocaflour improves the textural properties and consumer acceptability of gluten-free and diabetic-friendly noodle products (Adzahan et al., 2023; Liu et al., 2023). Overall, based on the sensory evaluation and expert feedback, the aglio e olio oatmeal noodles were deemed acceptable and enjoyable for people with diabetes mellitus, providing a promising alternative to conventional high-glycaemic noodle products.

3.2. Results of Preference Test by Semi-Trained Panelists

The preference/hedonic test on semi-trained panelists was conducted on Monday, June 27, 2022 at the Organoleptic Laboratory of the UPI Culinary Education Study Program by distributing samples of aglio e olio oatmeal noodles to 30 panelists from culinary education students from the 2017, 2018, and 2019 intakes with characteristics that have contracted and are studying nutrition science courses. Panelists stated their level of preference based on 5 characteristics, namely color, texture, aroma, taste, and overall. The hedonic results are as follows Table 1.

Table 1. Colour Preference Results

Colour			
Scale	Number of Panelists	Score	Percentage
1	0	0	0%
2	0	0	0%
3	4	12	8%
4	16	64	43%
5	10	50	33%
Total :		126	84%

The sensory preference test conducted on semi-trained panellists revealed valuable insights into the acceptability of the aglio e olio oatmeal noodle product. Regarding colour, most panellists expressed positive responses, with 43% stating they liked the product's color and 33% stating they really liked it, resulting in a total preference rate of 84%. Visual appeal

plays a significant role in the initial acceptance of functional foods, particularly among diabetic patients, as it influences perceived taste and overall expectations (Yang et al., 2021; de Andrade et al., 2022). The consistency in colour acceptability indicates that the aglio e olio seasoning contributed positively to the visual characteristics without compromising consumer expectations.

The following data analysis results show the highest percentage, it is known that scale 4 has the highest percentage, namely 43% of panellists stated that they liked the colour criteria of the aglio e olio oatmeal noodle product, the 2nd rank on a scale of 5 showed that 33% of panellists really liked the colour criteria, and the 3rd rank on a scale of 3 showed a percentage of 8% indicating that panellists somewhat liked the colour criteria of the product, while scales 1 and 2 showed that no panellists chose this scale. The hedonic results texture are as follows Table 2.

Table 2. Texture Favorite Results

Texture			
Scale	Number of Panelists	Score	Percentage
1	0	0	0%
2	0	0	0%
3	13	39	26%
4	13	52	35%
5	4	20	13%
Total :		111	74%

In terms of texture, 35% of panelists liked the texture while 26% moderately liked it, achieving a total preference score of 74%. The addition of mocaf flour appeared effective in enhancing the chewiness and structural integrity of the noodles. Research suggests that composite flours like mocaf can improve the textural properties of gluten-free or specialized diet products, aligning with findings that better texture directly correlates with increased product acceptability (Adzahan et al., 2023; Bello et al., 2021).

Table 3. Taste Result

Taste			
Scale	Number of Panelists	Score	Percentage
1	0	0	0%
2	0	0	0%
3	5	15	10%
4	15	60	40%
5	10	50	33%
Total :		125	83%

The results of the percentage of preference test on the texture characteristics on a scale of 4 showed that 35% of panellists liked the texture of the product and in 2nd place with a scale of 3 amounted to 26% which means they quite like the texture and a total of 74% which means they are in the category of liking the texture of the aglio e olio oatmeal noodle

product. The hedonic results taste are as follows Table 3. The taste characteristic received a high level of acceptance, with 40% of panelists indicating they liked it and 33% stating they really liked it, culminating in an overall acceptance rate of 83%. The adjustment of salt and chili powder levels to suit the dietary needs of diabetic individuals proved effective. Taste is a critical factor in sustaining adherence to diabetic dietary interventions, where maintaining palatability without compromising health guidelines is crucial (Zhao et al., 2022; Hossain et al., 2022).

The results of the analysis of taste characteristic data showed that the panellists liked the taste of the Aglio e Olio oatmeal noodle product with a percentage of 40%, and at the 2nd level the panellists really liked the taste created in this development product, and the result was in the category of liking the taste of the product with a total of 83%. The hedonic results aroma are as follows Table 4. The product achieved outstanding acceptance, with 67% of panelists stating they really liked the aroma and 24% stating they liked it, leading to a total preference of 93%. The aroma derived from parsley, garlic, and canola oil contributed significantly to this high rating. Aroma not only enhances the sensory appeal but also stimulates appetite, which is particularly important for diabetic patients who often experience reduced appetite due to dietary restrictions (Torres-González et al., 2021; Noriega et al., 2023).

Table 4. Aroma Favorite Results

Aroma			
Scale	Number of Panelists	Score	Percentage
1	0	0	0%
2	0	0	0%
3	1	3	2%
4	9	36	24%
5	20	100	67%
Total :		139	93%

This data analysis shows that 67% of panelists really like the aroma obtained from this product, in 2nd place the panelists like the aroma shown at a percentage of 24%, with a total percentage of panelists really liking the aroma produced by garlic, parsley, and canola oil at a percentage of 93%. The hedonic results overall favourite are as follows Table 5. The overall evaluation, 51% of panelists stated they liked the product and 27% stated they really liked it, resulting in an overall acceptance rate of 83%. This indicates that the product development successfully met both nutritional and sensory expectations of semi-trained panelists. Comprehensive sensory quality, covering visual, textural, olfactory, and taste elements, is essential in ensuring consumer adherence to specialized dietary products like diabetic-friendly noodles (Chen et al., 2023; Singh et al., 2022).

Data analysis on the whole shows that panellists like the development of this product with a percentage of 51% and the total percentage falling into the like category is 83%. The comprehensive results of the sensory preference test indicate that the aglio e olio oatmeal noodle product has strong potential as a functional staple food for individuals with diabetes mellitus. Across all sensory attributes evaluated colour, texture, taste, aroma, and overall acceptance most panellists expressed positive preferences. Particularly, the aroma attribute

received the highest acceptability rate, emphasizing the critical role of aromatic compounds in enhancing the attractiveness of health-oriented foods.

Table 5. Overall Favorite Results.

Overall Favorite			
Scale	Number of Panelists	Score	Percentage
1	0	0	0%
2	0	0	0%
3	3	9	6%
4	19	76	51%
5	8	40	27%
Total :		125	83%

This finding aligns with previous research, which emphasizes that pleasant aroma and appealing flavours are key determinants for the success of dietary interventions targeted at specific health conditions (de Andrade et al., 2022; Torres-González et al., 2021). Moreover, the combination of oatmeal and mocaf flour successfully achieved the desired textural properties while maintaining a low glycaemic index, fulfilling the nutritional needs of diabetic patients without sacrificing sensory quality (Adzahan et al., 2023; Liu et al., 2023).

Overall, this study supports the notion that the development of diabetic-friendly food products must strike a careful balance between nutritional functionality and sensory pleasure. It demonstrates that through proper formulation adjustments such as reducing salt and chili levels and optimizing flour composition it is possible to meet both dietary recommendations and consumer expectations. Similar findings were reported by Singh et al. (2022) and Hossain et al. (2022), who highlighted that sensory satisfaction is pivotal in ensuring the long-term acceptance and adherence to functional diets among diabetic individuals. Therefore, the development of aglio e olio oatmeal noodles not only address the urgent need for diversified, palatable diabetic-friendly foods but also contributes valuable insights into food innovation strategies that prioritize both health outcomes and consumer acceptance.

4. CONCLUSION

Based on the research findings, the aglio e olio oatmeal noodle product serves as a promising staple food variant for individuals with diabetes mellitus. Traditional noodles, typically made from wheat flour with a high glycemic index, are unsuitable for diabetics due to their impact on blood sugar levels. Therefore, oatmeal, a low-glycemic, high-fiber food, was utilized as the main ingredient, combined with 8% mocaf flour to enhance the chewiness and texture of the noodles. Aglio e olio seasoning was incorporated to boost aroma and flavor, improving appetite among diabetic patients. A preference test was conducted involving semi-trained panelists culinary education students from the 2017, 2018, and 2019 intakes evaluating five sensory characteristics: color, texture, aroma, taste, and overall acceptability. The results indicated that panelists liked the color, texture, taste, and overall quality, while the aroma received a very high level of preference. This positive

outcome suggests that aglio e olio oatmeal noodles can be accepted not only by individuals with diabetes but also by broader markets, including diet catering businesses offering specialized menus. Additionally, this product can be used as a reference for students and educators in the field of healthy food development. For future research, it is recommended to conduct direct glycemic index testing and laboratory-based nutritional analysis to further strengthen the scientific validation of the product. These steps will help ensure that the development objectives are more comprehensively achieved.

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