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RESEARCH PAPER

Comparative study on hedonic preferences and consumer acceptability of glucomannan-based fiber drinks from porang (*Amorphophallus oncophyllus*)

Rachma Wikandari[1,2], Kapela Vena Mahardika[1], Muhammad Hafizhuddin Royyan[1], Fayza Allya Kallista[1], Dwi Larasatie Nur Fibri[1,2], Rochmad Indrawanto[3]

1 *Department of Food and Agricultural Product Technology, Faculty of Agricultural Technology, Universitas Gadjah Mada, Jl. Flora, Bulaksumur, Yogyakarta, 55281, Indonesia*

2 *Center of Excellence for Indonesian Gastronomy, Universitas Gadjah Mada, Yogyakarta, 55218, Indonesia*

3 *PT Lautan Natural Krimerindo, Mojokerto 61383, Indonesia*

Corresponding author: Rachma Wikandari (rachma_wikandari@mail.ugm.ac.id)

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Abstract

Glucomannan derived from porang (*Amorphophallus oncophyllus* Prain), an underutilized crop adaptable to marginal land, offers strong potential as a functional ingredient for fiber-enriched beverages. However, its translation into consumer-acceptable products remains limited. This study provides a comparative evaluation of sensory acceptance and consumer behavior toward a porang glucomannan-based fiber drink and a commercial counterpart. Sensory evaluation involving 350 panelists showed that the porang-based formulation achieved significantly higher scores across all key attributes, including appearance, aroma, taste, texture, and overall acceptability. Consumer testing (n = 350) further revealed high purchase intention (94.29%), with a notable proportion of respondents indicating regular consumption willingness and acceptable price ranges (USD 0.31–0.63 per serving). These findings demonstrate that porang glucomannan can be successfully formulated into a highly acceptable functional beverage. By integrating product performance with consumer-driven insights, this study contributes to bridging the gap between functional ingredient potential and market acceptance, while supporting sustainable utilization of porang and promoting increased dietary fiber intake.

Keywords

Amorphophallus oncophyllus, glucomannan, fiber-enriched beverage, sensory analysis, consumer acceptance, purchase intention

Introduction

In recent years, there has been a significant increase in the consumption of fiber drinks, driven by growing public awareness of digestive health, weight management, and functional food trends (Gupta et al. 2023). Fiber drinks are now widely regarded as convenient and effective vehicles for delivering dietary fiber, particularly in urban populations where fiber intake is often inadequate due to lifestyle and dietary changes (Seljak et al. 2021). Various fiber sources have been employed in the formulation of fiber drinks, including inulin, pectin, guar gum, and cellulose derivatives (Dhingra et al. 2012). However, many of these ingredients are relatively expensive and often have undesirable effects on the sensory properties of the final product, particularly in terms of taste, aroma, and color (Tolve et al. 2024). For instance, inulin and some

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fruit-based fibers may impart a slightly bitter or earthy aftertaste and affect the clarity or color of the drink, thus limiting consumer acceptance (Garcia-Amezquita et al. 2018). Therefore, it is essential to explore affordable and neutral-tasting fiber sources that do not compromise sensory quality.

Glucomannan, a polysaccharide composed primarily of mannose and glucose, emerges as a promising alternative. Extracted from the tubers of *Amorphophallus* sp., glucomannan is nearly white in color and has a neutral taste, making it highly suitable for incorporation into beverages without affecting appearance or flavor (Behera and Ray 2016). Beyond its technological benefits, glucomannan is also associated with a range of health-promoting effects. It has been shown to reduce cholesterol levels, support glycemic control in diabetic individuals, promote satiety, and improve bowel movement regularity (Au-Yeung et al. 2018; Devaraj et al. 2019). In Indonesia, glucomannan can be sourced from *Amorphophallus muelleri* (locally known as porang), a plant that can thrive on marginal lands and requires minimal agricultural inputs, making it a cost-effective and environmentally sustainable raw material (Nurhidayati et al. 2025). Despite these advantages, most existing studies and commercial applications still rely on konjac-derived glucomannan, while the utilization of porang remains relatively underexplored, particularly in beverage systems. Moreover, recent developments in functional food formulation have emphasized the synergistic use of dietary fiber and prebiotics to enhance health benefits. Isomaltooligosaccharides (IMO), a well-known prebiotic, have been reported to support gut microbiota balance and improve digestive health (Lestari et al. 2025). However, the combined application of porang-derived glucomannan and IMO in beverage formulations has received limited attention. Furthermore, although previous studies have investigated fiber-enriched beverages and their sensory acceptance (Kanca 2026), these are often limited to descriptive evaluations and do not adequately incorporate consumer behavior factors that influence real-world product adoption.

This gap is particularly relevant in Indonesia, one of the leading producers of porang, where the potential of this crop remains underutilized in value-added food applications. At the same time, national health surveys showed that inadequate fruit and vegetable consumption remained highly prevalent in Indonesia, increasing from 93.5% among individuals aged ≥ 10 years in 2013 to 95.5% among those aged ≥ 5 years in 2018 (Ministry of Health of the Republic of Indonesia 2019). This finding indicates low consumption of major dietary fiber sources, although the surveys did not directly measure total daily fiber intake. Therefore, this study aims to evaluate the sensory characteristics and consumer acceptance of fiber drinks formulated with porang-derived glucomannan in combination with isomaltooligosaccharides. By integrating functional ingredient innovation with consumer-driven assessment, this study provides a more comprehensive understanding of product feasibility and acceptance. This approach offers a novel contribution by bridging the gap between ingredient functionality, formulation performance, and consumer behavior, particularly in the development of locally sourced functional beverages in Indonesia.

Materials and methods

Material

Chocolate flavored fiber drink containing glucomannan and isomaltooligosaccharide (GIFD) is produced at PT. Lautan Natural Krimerindo. Chocolate flavored GIFD is made with FiberCreme™, sugar, milk powder, glucomannan, salt, cocoa powder, and chocolate flavoring. FiberCreme™ contains isomalto-oligosaccharide, coconut oil, sodium caseinate, phosphate stabilizer, vegetable emulsifier and anti-caking agent. Chemicals were provided by Sigma Aldrich (Burlington, Massachusetts, United States) and Merck (Darmstadt, Germany).

Methods

Sensory evaluation (acceptence test)

A sensory evaluation was conducted to assess consumer acceptance of the glucomannan fiber drink compared to a commercially available product, following the methodology of Meilgaard et al. (2007). A total of 350 untrained panelists aged 15–65 years participated in the test. Each panelist received a tray containing two coded samples: sample 798 (commercial fiber drink) and sample 546 (porang glucomannan fiber drink, chocolate flavor), along with a cracker and mineral water to cleanse the palate between samples. The use of three-digit random codes was applied to minimize bias, and panelists were allowed to determine the order of tasting based on their preference to reduce order effects.

Panelists evaluated five sensory attributes: appearance, aroma, taste, texture, and overall liking using a structured 7-point acceptence scale (1 = extremely dislike to 7 = extremely like) (Meilgaard et al. 2007). Data were analyzed using IBM SPSS Statistics version 25. A paired sample t-test was applied to compare mean sensory scores between samples, with the level of significance set at $p < 0.05$ (margin of error 5%).

Consumer testing

a. Respondents

The consumer test was conducted with a total of 350 participants residing in Yogyakarta, Indonesia, aged between 15 and 65 years. The test was administered in two public locations: a university campus and a shopping center. A non-probability sampling method was employed for participant recruitment. Data were collected using both digital and printed versions of the questionnaire.

b. Questionnaire and research design

The questionnaire was developed and validated by an expert in institutional board and comprised three sections: (1) sociodemographic characteristics, (2) consumption and purchasing habits of high-fiber drinks, and (3) consumer attitudes toward glucomannan-based fiber

drinks. The third section applied a 5-point Likert scale (1 = not at all, 5 = very much) to assess respondents' levels of interest, purchase intention, willingness to pay, recommendation, and expectation fulfillment.

Prior to the main study, the questionnaire was pre-tested on 150 respondents. Validity was assessed using the Pearson product–moment correlation method, with items considered valid when r calculated > r table (0.159 at α = 0.05). Items that did not meet this criterion (age and gender) were excluded from further correlation analysis. Reliability testing was performed using Cronbach's alpha on valid items, resulting in a value of 0.655, indicating acceptable internal consistency. Detailed results of the validity and reliability tests are provided in the Suppl. material 1.

Data analysis

Descriptive statistics were used to summarize respondent characteristics and consumer behavior. Inferential analysis included Pearson correlation to evaluate relationships between variables. All statistical analyses were conducted using IBM SPSS Statistics version 26, with a significance level set at $p < 0.05$.

Results and discussion

The growing interest in functional foods has emphasized not only the physiological benefits of bioactive ingredients but also their acceptance in real consumer settings. Dietary fibers such as glucomannan and isomaltooligosaccharides (IMO) have been widely reported for their health-promoting properties, including antidiabetic and hypocholesterolemic effects, as well as their role in improving gut health through prebiotic activity (Michelle and Indrawanto 2022). In particular, glucomannan contributes to enhanced satiety and reduced food intake, supporting its application in weight management products (Lestari et al. 2025). The incorporation of these fibers into beverage systems represents a practical strategy to increase daily fiber intake; however, most existing products rely on konjac-derived glucomannan, while the use of porang (*Amorphophallus oncophyllus*) remains limited. Furthermore, although the functional benefits of glucomannan- and IMO-containing beverages are well recognized, their success in the market is strongly influenced by consumer-related factors, including consumption habits, purchasing behavior, and sensory acceptance. Therefore, understanding the sociodemographic profile and consumption patterns of potential consumers is a critical first step in evaluating the feasibility and market potential of porang glucomannan and isomaltooligosaccharide-containing fiber drinks.

Sociodemographic profile

The sociodemographic characteristics of the 350 respondents are summarized in Table 1. The age range of participants was 15–65 years, with a balanced representation across age groups. The gender distribution was relatively even between male and female respondents. In terms of educational attainment, the largest proportion of respondents held a secondary education qualification (corresponding with national data indicating that 29.97% of Indonesians over age 15 are secondary school graduates), followed by undergraduate, graduate, and postgraduate levels. Monthly income was classified into three categories: less than USD 310.40; USD 310.40–620.72; and more than USD 620.72.

Table 1. Sociodemographic characteristics of the respondents.

Variable	Total Respondent	%
Age		
15–20 years old	89	25.43
21–30 years old	131	37.43
31–40 years old	49	14.00
41–50 years old	41	1171
51–60 years old	36	10.29
61–70 years old	4	1.14
Gender		
Male	112	32.00
Female	238	68.00
Education level		
Secondary	195	55.71
Undergraduate	133	38.00
Graduate	15	4.29
Postgraduate	7	2.00
Income		
Less than USD 310.40	295	84.29
USD 310.40–USD 620.72	41	11.71
More than USD 620.72	14	4.00

Habits related to high-fiber drink consumption and purchase

To explore consumer behavior toward high-fiber beverages, a questionnaire was used to assess consumption frequency, purchasing habits, preferred serving size, and price range. The results are summarized in Table 2. The most common consumption frequency reported was once per week (21.43%), followed by twice per week (19.43%) and no consumption at all (18.86%). Daily consumption (seven times per week) was relatively low, with only 6% of respondents consuming high-fiber drinks every day. These findings suggest that while some awareness of high-fiber drinks exists, they are not yet part of daily routines for most individuals. Similar trends have been reported in other countries, where functional beverages are often consumed irregularly due to cost, taste, or limited integration into daily habits (Mohammad et al. 2024; Toorani et al. 2024).

In terms of purchasing frequency, a similar pattern emerged. The highest proportion of respondents (28.86%) reported buying high-fiber drinks once per week, while 19.71% reported not purchasing them at all. Daily purchases were

rare (2.86%). This may reflect the status of high-fiber drinks as non-essential or occasional items for many consumers. In some cases, people may consume products without purchasing them regularly, such as receiving them from family members or institutions (e.g., schools or fitness centers).

Regarding product size, 48% of respondents preferred products with a net weight of 20–30 grams per serving, which matches the portion sizes commonly available on the market. A slightly smaller group (44.57%) reported consuming smaller portions (< 20 grams), possibly due to taste preferences, satiety, or price sensitivity. Only 7.43% preferred servings over 30 grams, indicating that larger portions may be less desirable, either due to texture or concerns about gastrointestinal discomfort (Hendriks-Hartensveld et al. 2022).

Price was a significant factor influencing consumer behavior. The majority (37.43%) usually spent USD 0.31 – USD 0.63 per serving, while 32.29% preferred products priced below USD 0.31. Only a small group (6%) were willing to pay more than USD 0.94. These results indicate strong price sensitivity, a trend commonly observed in emerging markets where functional foods are still considered luxury or non-essential items (Karelakis et al. 2019; Safraid et al. 2024).

In this study, respondents' monthly income data were collected, allowing analysis of its relationship with purchasing behavior. Consumers with higher income are more likely to regularly buy functional products (Uliano et al. 2024), while those with lower income may avoid them due to perceived high prices. In Indonesia, where a large portion of the population falls into the aspiring middle class category (BPS-Statistics Indonesia 2024), price becomes a critical factor in both the decision to try and to continue consuming high-fiber drinks.

Table 2. Summary of consumer behavior toward high-fiber beverages.

Variable	Total Respondents	%
Habits in consuming high-fiber drinks		
0 per week	66	18.86
1 per week	75	21.43
2 per week	68	19.43
3 per week	56	16.00
4 per week	27	7.71
5 per week	23	6.57
6 per week	14	4.00
7 per week	21	6.00
Habits in purchasing high-fiber drinks		
0 per week	69	19.71
1 per week	101	28.86
2 per week	62	17.71
3 per week	50	14.29
4 per week	29	8.29
5 per week	13	3.71
6 per week	16	4.57
7 per week	10	2.86
Habits in consuming measured by net weight of a high-fiber drink		
Less than 20 gram	154	44.00
20 gram–30 gram	168	48.00
More than 30 gram	28	8.00
Habits in purchasing measured by the range of price of a high-fiber drink		
Less than USD 0.31	112	32.00
USD 0.31–USD 0.63	133	38.00
USD 0.63–USD 0.94	63	18.00
USD 0.94–USD 1.25	21	6.00
More than USD 1.25	21	6.00

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The observed gap between purchase and consumption frequency also suggests that price is not the only barrier. Factors such as flavor, convenience, and perceived effectiveness may also play roles. As shown in previous studies, consumers are more likely to adopt functional products when they are affordable, palatable, and easy to integrate into daily routines (Ervina and Cicilia 2024; Safraid et al. 2024; Uliano et al. 2024).

Overall, these findings provide valuable insight for the development of affordable, acceptable high-fiber beverages in Indonesia. New products made with local ingredients such as porang-derived glucomannan should aim to match consumer preferences in portion size and price range. Additionally, public education campaigns could improve awareness of the health benefits of dietary fiber, especially among target populations such as adolescents and young adults.

Sensory evaluation of glucomannan fiber drink

To assess the commercialization potential of a newly developed glucomannan-based fiber drink, a sensory preference test was conducted in comparison with an

existing commercial fiber drink. Preference testing is an essential step in new product development, as early consumer impressions are highly predictive of purchasing intent (Dean et al. 2022). In this study, panelists were allowed to freely select which of the two samples they wished to taste first. As shown in Fig. 2, a greater number of panelists chose to sample the glucomannan fiber drink first, suggesting initial visual or perceptual appeal and indicating a higher level of curiosity or immediate interest (Ervina and Cicilia 2024). These results are supported by the acceptence test scores shown in Fig. 1, where the glucomannan fiber drink received consistently higher ratings across all evaluated sensory attributes, appearance, aroma, taste, texture, and overall compared to the commercial product. This broad preference suggests that the formulation has high potential to compete in the functional beverage market.

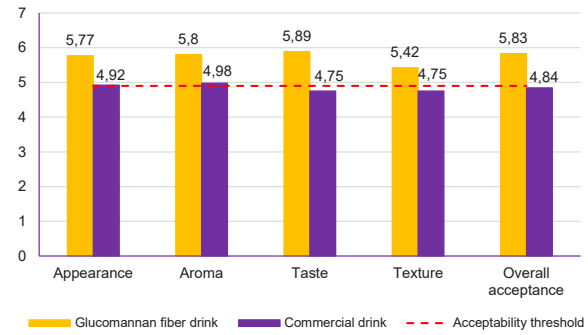

Figure 1. Sensory acceptance scores of the fibre drink compared with a commercial drink.

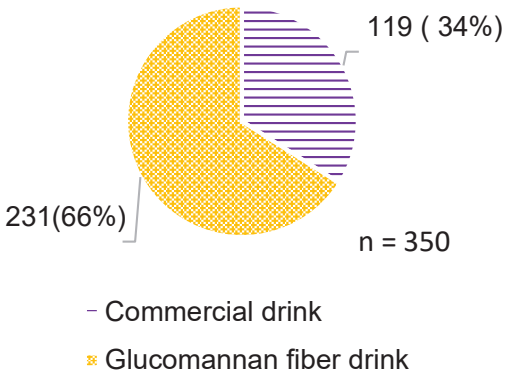

Figure 2. The selection of the first sample that the panelists tasted.

In terms of appearance, the glucomannan fiber drink received a mean score of 5.77 (between "like" and "very like"), which was significantly higher than the commercial fiber drink, which scored 4.92 (neutral to "like"). The enhanced visual appeal may be attributed to its deeper brown color, which is commonly associated with rich flavor and natural ingredients. This finding aligns with previous research by Khattak et al. (2021), who noted that up to 90% of initial product judgments are based on color alone, and that consumer decisions are typically made within the first 90 seconds of visual exposure.

On the aroma attribute, the glucomannan fiber drink again outperformed the commercial product, scoring 5.80 versus 4.98, respectively. The stronger and more pleasant chocolate aroma was frequently cited by panelists and may have been enhanced by both the ingredient profile and the visual color cues. This result supports the findings of Palma-morales et al. (2024), who reported that darker-colored samples with more intense brown aromas were significantly more preferred by consumers in beverage products.

The taste of the glucomannan drink was also highly rated, with a score of 5.89, significantly higher than the commercial counterpart (4.75). Panelists described the taste as richer and more chocolate-forward, possibly due to optimized sweetener and cocoa content in the formulation. Donadini et al. (2012) similarly found that enhanced chocolate flavor and sweetness levels increase hedonic ratings and overall acceptance of functional beverages, particularly among young adult consumers. In terms of texture, the glucomannan fiber drink scored 5.42, compared to 4.75 for the commercial product. The thicker, smoother mouthfeel was well received by panelists and is attributed to the presence of glucomannan, a water-soluble dietary fiber known for its high viscosity. As noted by McCrickerd et al. (2015) beverages with moderate to high viscosity levels are generally preferred, as they are perceived as more indulgent and satisfying.

Finally, the overall liking score for the glucomannan fiber drink was 5.83, compared to 4.84 for the commercial drink, confirming a strong panelist preference across all sensory dimensions. This suggests that the glucomannan-based formulation offers a favorable balance of sensory attributes, including a more appealing appearance, stronger aroma, better taste, and more desirable texture, all of which are crucial for consumer acceptance and potential market success. Taken together, these findings highlight the potential of glucomannan fiber drink not only as a functional product but also as a sensorially acceptable alternative to current commercial offerings. These results are particularly promising given that sensory acceptability remains one of the main barriers to the widespread adoption of fiber-enriched functional beverages.

Consumer test

The consumer test was conducted to assess the level of acceptability, willingness to consume and purchase, and the perceived value of the glucomannan-based fiber drink among respondents. Additionally, the study evaluated the alignment of consumer expectations with product performance, as well as the extent to which sensory experience and health-related claims influenced consumer behavior. The findings revealed that 330 (94.29%) of respondents expressed a willingness to consume the glucomannan fiber

drink (Fig. 3). Among these, the most frequently selected consumption frequencies were three times per week (24.00%) and twice per week (23.43%), followed by four times per week (14.86%). Only 20 (5.71%) of respondents reported no willingness to consume the product. This high level of acceptance is consistent with prior studies which emphasize that health claims, such as weight management and digestive health benefits, positively influence consumer intentions toward functional food consumption (Alsubhi et al. 2023; Salmean 2017).

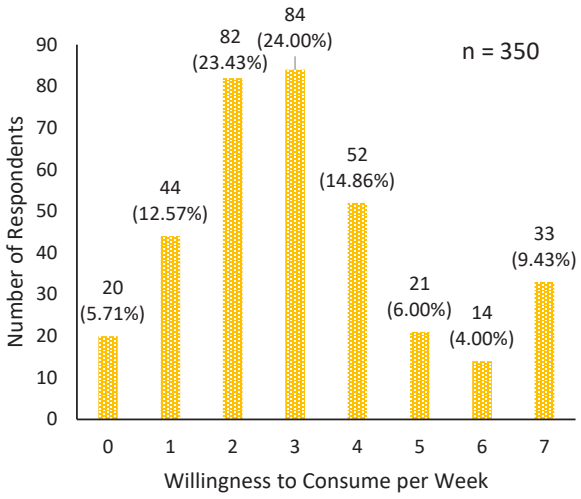

Figure 3. Number of respondents based on willingness to consume.

Regarding consumer interest, Fig. 4 shows that 333 (95.14%) of respondents reported moderate to high levels of interest in the product. Specifically, 39.14% were interested and 35.14% were very interested, indicating that the concept of a fiber-rich, functional beverage was well-received. This level of interest may be attributed to growing awareness of the importance of dietary fiber and the appeal of natural ingredients such as glucomannan.

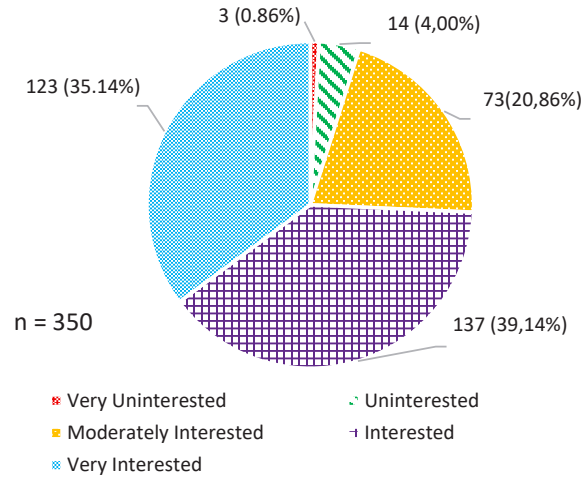

Figure 4. Number of respondents based on interest level towards fiber drink glucomannan.

The product also demonstrated strong potential for organic promotion via word-of-mouth, with 329 (94.00%) of respondents indicating their willingness to recommend the glucomannan fiber drink to others (Fig. 5). Of these, 39.14% expressed a clear intent to recommend, while 30.86% stated that they would strongly recommend the product. Such responses are typically driven by positive consumption experiences and a perception of product efficacy, which have been shown to significantly influence consumer advocacy (Meeprom et al. 2023).

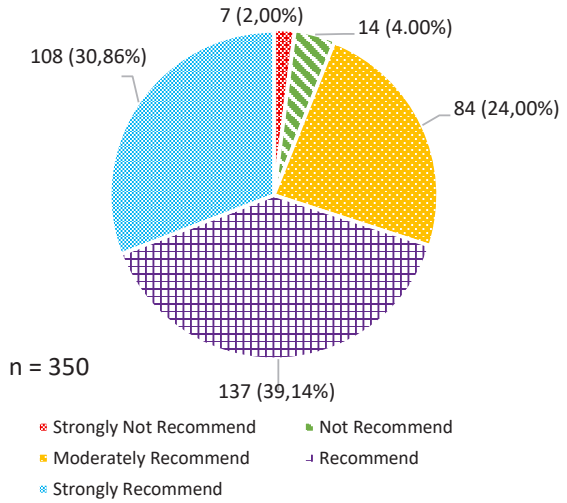

Figure 5. Number of respondents based on recommendation level to relatives.

Furthermore, 329 (94.00%) of respondents indicated that the product met or exceeded their expectations (Fig. 6). Among them, 41.14% felt their expectations

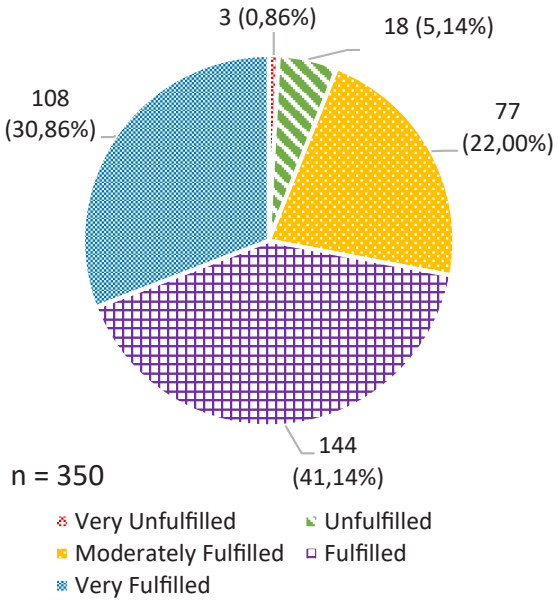

Figure 6. Number of respondents based on expectations fulfillment level towards fiber drink glucomannan.

were fulfilled, and 30.86% reported that their expectations were highly fulfilled. Key consumer expectations for functional beverages generally include appealing taste, convenience, nutritional benefits, and affordability (Ervina and Cicilia 2024), all of which were satisfied by the glucomannan fiber drink. In terms of purchasing behavior, Fig. 7 illustrates that 94.29% of respondents reported a willingness to purchase the product. The most common purchase frequency was once per week (32.29%), followed by twice (22.00%) and three times per week (18.57%). This purchasing intent was likely influenced by both sensory appeal (such as flavor, aroma, and mouthfeel) and trust in the product's functional benefits (Ervina and Cicilia 2024; Mohammad et al. 2024).

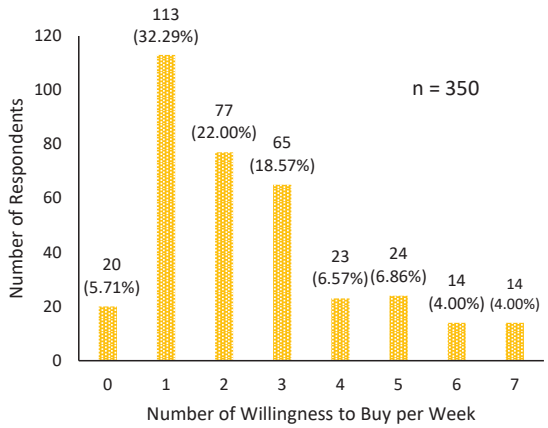

Figure 7. Number of respondents-based willingness to buy.

With regard to price sensitivity, Fig. 8 shows that 45.43% of respondents indicated a willingness to pay between USD 0.31 and 0.62 per serving. This is considerably lower than the average price of commercial fiber drinks currently available in the market (typically USD 0.93–1.24), suggesting that the product may hold a competitive advantage if priced appropriately. Previous studies have noted that consumers are generally willing to pay a premium for functional food products that demonstrate tangible health benefits (Alsubhi et al. 2023; Uliano et al. 2024).

To better understand the behavioral drivers, a Pearson correlation analysis was conducted (Table 3). The

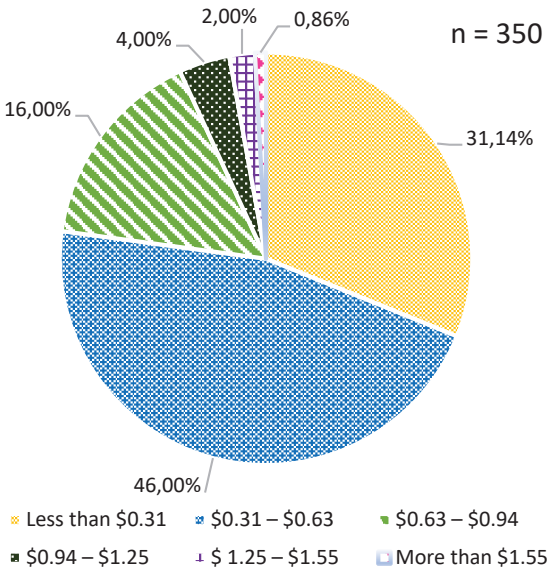

Figure 8. Number of respondents based on range of price they willing to pay.

results revealed no statistically significant association between respondents' income level and their willingness to pay ($r = 0.064$, $p = 0.233$), willingness to consume ($r = -0.043$, $p = 0.426$), or willingness to buy. This suggests that economic status was not a primary factor in determining consumer interest or purchasing behavior for the glucomannan fiber drink. Conversely, a moderate and statistically significant correlation was observed between existing habits and behavioral intentions. Specifically, habitual consumption of similar fiber drinks was positively associated with willingness to consume ($r = 0.377$, $p < 0.001$), and habitual purchasing behavior was correlated with willingness to buy ($r = 0.401$, $p < 0.001$). Moreover, consumer interest showed a positive correlation with willingness to buy ($r = 0.315$, $p < 0.001$). These findings indicate that prior experience and product relevance strongly influence consumer intention, more than socioeconomic factors.

In summary, the consumer test results highlight the strong commercial potential of the glucomannan–IMO fiber drink, with consumption habits and prior interest

Table 3. Pearson correlation coefficient between variables.

		Price Range Willing to Pay (2.06 ± 1.01)	Willingness to Consume (3.11 ± 1.87)	Willingness to Buy (2.45 ± 1.75)
Income (1.20 ± 0.49)	Pearson Correlation	0.064		−0.043
	Sig. (2-tailed)	0.233		0.426
Consumption Habit (2.38 ± 2.01)	Pearson Correlation		0.377**	
	Sig. (2-tailed)		0.000	
Purchasing Habit (2.06 ± 1.83)	Pearson Correlation			0.401**
	Sig. (2-tailed)			0.000
Interest (4.03 ± 0.90)	Pearson Correlation			0.315**
	Sig. (2-tailed)			0.000
N			350	

emerging as stronger predictors of willingness to consume and purchase than income level or price preference. These findings suggest that sensory experience, perceived health benefits, and prior engagement with similar products are key drivers of functional food acceptance. Consistent with this, the formulation incorporating porang glucomannan and IMO was shown to maintain favorable sensory attributes, demonstrating that their inclusion does not compromise product acceptability while delivering physiological benefits. Therefore, this study advances the utilization of porang glucomannan and isomaltooligosaccharide in functional beverages by bridging the gap between established health benefits and product palatability, which is critical for successful commercialization and increased dietary fiber intake.

Conclusions

This study demonstrated that the glucomannan-based fiber drink was generally well accepted, with higher overall liking scores compared to the commercial product. A considerable proportion of respondents expressed willingness to consume and purchase the product within an affordable price range.

Income level was not significantly associated with these outcomes, while prior consumption habits and product interest showed moderate associations. These findings suggest potential for glucomannan fiber drinks in the Indonesian market, particularly among consumers familiar with similar products. However, the results should be interpreted with caution due to moderate correlations and study limitations.

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Additional information

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical statement

The sensory evaluation and consumer acceptance were established to follow the guidelines presented in the Declaration of Helsinki, which was approved by the Medical and Health Research Ethics Committee of the Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia (REF no. KE/1150/09/2022).

Artificial Intelligence (AI) use

The authors accept full responsibility for the content of the manuscript, including the disclosure of any use of AI.
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Author contributions

Rachma Wikandari: Conceptualization, Writing – original draft, Writing – review and editing, Funding acquisition; Kapela Vena Mahardika: Data curation, Formal analysis; Muhammad Hafizhuddin Royyan: Data curation, Formal analysis; Fayza Allya Kallista: Formal analysis; Writing – original draft; Writing – review and editing; Dwi Larasatie Nur Fibri: Conceptualization, Supervision, Funding acquisition; Writing – review and editing; Rochmad Indrawanto: Conceptualization, Funding acquisition, Writing – review and editing.

Author ORCIDs

R. Wikandari https://orcid.org/0000-0001-5650-6092
D.L.N. Fibri https://orcid.org/0000-0001-9130-1957

Data availability

Available data are presented in the manuscript.

Supplementary material

Supplementary material 1
Validity and reliability analysis of questionnaire items
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