



Plant-based Milk Alternatives - An Emerging Segment of Functional Beverages: A Review

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10.18805/ajdfr.DR-2316

ABSTRACT

Plant-based milk alternatives have emerged as an important segment of functional beverages, driven by increasing consumer demand for health-conscious, sustainable and ethical food choices. This review examines consumer awareness, preferences and consumption patterns related to plant-based milk alternatives, with particular attention to legume-derived options. This review synthesizes findings from a structured consumer survey conducted using Google Forms, involving 64 respondents. The survey explored awareness and usage patterns, factors influencing purchase decisions, perceptions of taste and nutritional value and preferences related to packaging and communication channels for plant-based milk alternatives. The findings indicate that 58.1% of respondents were familiar with legume-derived milk alternatives. Coconut milk, a plant-based but non-legume option, was the most frequently consumed alternative (30.6%) in the preceding three months. Health benefits (54%) and environmental sustainability (34.9%) emerged as the primary drivers of consumer choice, while taste and ingredient transparency influenced 15.9% of respondents. Although most participants (67.2%) felt sufficiently informed about plant-based milk alternatives, 32.8% expressed a need for additional information. The review highlights the growing role of plant-based milk alternatives as functional beverages within the evolving dairy alternatives market. The results underscore opportunities for industry stakeholders to improve consumer education, enhance communication of functional and nutritional benefits and adopt environmentally friendly packaging. Overall, this review contributes to a deeper understanding of consumer behavior and supports future product development and marketing strategies in the plant-based beverage sector.

Key words: Consumer preferences, Environmental sustainability, Functional beverages, Legume-derived dairy substitutes, Plant-based milk alternatives.

The dietary landscape is continually evolving, reflecting shifting consumer preferences, health considerations and environmental concerns. The growing popularity of plant-based substitutes for conventional animal-derived goods, especially in the dairy sector, has been a notable trend in recent years. Dairy alternatives made from legumes have surfaced as viable alternatives as a response to this pattern, providing several advantages that appeal to an increasing number of customers (AlZubi, 2023; AlZubi and Al-Zubi, 2023; Kim and AlZubi, 2024). Plant-based substitutes for dairy and meat are becoming more and more popular, which is indicative of this trend. The nutritional benefits of plant-based substitutes have been the subject of numerous research (Craig and Brothers, 2021).

Plant-based dairy substitutes can be categorised into five types: seed-based (from seeds like flax and hemp), vegetable-based (from potatoes), legume-based (from soy and peas) and nut-based (from almond, cashew and coconut) and cereal-based (oat and rice) (Bridges, 2018). They also contain plant-based water extracts that can be used as substitutes for dairy products viz., cheese, yoghurt, ice cream, cream and butter (Good Food Institute U.S., 2020; Mylan *et al.*, 2019). The change in consumer tastes, food surroundings, labelling laws and demographics have all been linked to the shift in dairy consumption (Stewart *et al.*, 2020).

Apart from the objective nutritional attributes of plant-based dairy substitutes, the viewpoints of customers on

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How to cite this article: Jain, N., Desai, S., Puri, D., Karthikeyan, S. and Chandrayan, B. (2026). Plant-based Milk Alternatives - An Emerging Segment of Functional Beverages: A Review. *Asian Journal of Dairy and Food Research*. **45(5)**: 751-758. doi: 10.18805/ajdfr.DR-2316.

Submitted: 09-02-2025 **Accepted:** 25-02-2026 **Online:** 23-03-2026

this particular product category have significant importance. Consumer willingness to pay for dairy-alternative beverages is influenced by health-related nutritional features, such as calories, protein, fat, vitamin A and vitamin D, which are widely recognised by consumers (Yang and Dharmasena, 2020). According to reports, the nutritional characteristic with the greatest bearing on cost is the amount of protein consumed. Environmental concerns could be a factor in people's decision to switch to plant-based dairy substitutes in addition to benefits to their health, finances and taste (Schiano *et al.*, 2020). Furthermore, people view animal welfare as a critical consideration when choosing foods and plant-based dairy alternatives are thought to be more ethical for these reasons (Laila *et al.*, 2021; Sharun *et al.*, 2024; Desfita *et al.*, 2025; Hu *et al.*, 2024).

Producers, retailers, legislators and other participants in the food business must understand customer preferences about dairy alternatives generated from legumes. Companies can create focused strategies to successfully satisfy the customer wants and preferences by investigating elements including taste preferences, health factors, concerns about the environment and price sensitivity. Furthermore, this research might provide insights for public health campaigns that support sustainable and healthy eating habits.

This review examines the multifaceted dimensions of consumer preferences for plant-based milk alternatives, with particular emphasis on legume-derived options as an emerging category of functional beverages. Drawing on quantitative survey evidence, the review addresses the following objectives:

1. To explore the factors influencing consumers' decisions to purchase and consume legume-derived dairy substitutes.
2. To investigate the consumers' perceptions of the taste, nutritional value and environmental sustainability of legume-derived dairy substitutes compared to traditional dairy products.
3. To identify the demographic and psychographic characteristics associated with consumer preferences for legume-derived dairy substitutes.
4. To understand the primary barriers to consumer adoption of legume-derived dairy substitutes and explore potential strategies for overcoming these barriers.

By addressing these objectives, the research aims to provide valuable information on the consumer preferences for legume-derived dairy substitutes, offering actionable data for those in the industry and contributing to a deeper understanding of the evolving landscape of dairy consumption.

Review of literature

The majority of the literature currently in publication regarding the dietary composition of dairy substitute beverages is in the form of reviews. Sethi *et al.* (2016) presented the useful elements of dairy-free beverages, their health benefits, various products that have hit the market and the technological advancements that need to be made to raise the standard and acceptability of plant-

based milk substitutes. According to Vanga and Raghavan's (2018) analysis, soy milk is the most nutritious substitute for cow's milk in a person's diet. They also described the variations in nutritional content between several dairy replacement milks (such as almond milk, soy milk and rice milk) and dairy milk. Verduci *et al.* (2019), examined the various macronutrient and micronutrient contents of milk from several mammalian species, including dairy substitute drinks and specific milk formulae recommended for cow's milk allergies. The study of consumer preferences for dairy alternative products is supported by empirical research conducted by Laassal and Kallas, (2019). They used Home-Scan data from 343 households to analyse consumer preferences for dairy-alternative products in Catalonia using a revealed preference discrete choice experiment. The results indicated that price was the primary motivator, followed by the flavour attribute of the original non-dairy beverage. An assessment of the production technique, nutritional characteristics, consumer acceptability and environmental effects of dairy replacement beverages was provided by Mäkinen *et al.* (2016).

Waugh (1929), initially proposed the idea of food hedonic pricing to analyse vegetable prices. He made the case that the costs of vegetables are directly correlated with their lengths, sizes, contents and other attributes. Dharmasena and Capps (2014), assessed the market for soy milk, white milk and flavoured milk in light of the increased desire for plant-based alternative milk beverages in the United States. Furthermore, Copeland and Dharmasena (2016), examined the impact of rising demand for dairy substitute beverages on the well-being of dairy farmers as well as the demand for these goods themselves. Funke and Lancaster (1976), suggested that utility was determined by the good's possession of certain product features (or characteristics), not only by the amount of the commodity consumed. According to Epplé (1987), figuring out how a commodity's price changes its features or collection of characteristics is one area of interest in the empirical study of hedonic models.

In addition to demonstrating that econometric techniques may be used to determine a product's intrinsic value and analyse the demand for a particular product's bundle of qualities, Rosen (1974) offered mathematical support for the hedonic pricing model.

Numerous fields of study have used the hedonic approach to gauge consumers' willingness to pay for goods. In a developing nation, for instance, Ghali (2020), used structural equation modelling to investigate the impact of perceived values for organic food (utilitarian vs. hedonic) on the willingness of consumers to purchase and willingness to pay for organic oil. She discovered that both hedonic and utilitarian principles have a significant impact on consumer willingness to purchase and pay for organic olive oil. Nepal *et al.* (2020), employed the hedonic pricing model in Nepal to examine the features that influence consumer choices for residential units, drawing from a

subsample of nationwide household survey data from urban regions and primary data gathered from one of the major cities.

In conclusion, the literature on consumer preferences for legume-derived dairy substitutes underscores the importance of taste perception, health considerations, price sensitivity, environmental sustainability, consumer segmentation and product innovation in shaping purchasing behaviour and market dynamics. Companies in the food business can create goods and advertising strategies that appeal to consumers' tastes and support a more environment friendly and health-conscious food system by understanding these elements and how they cooperate. The dairy alternatives market requires more investigation into new trends, customer perceptions and market dynamics.

Study design

This study investigates consumer preferences for legume-derived and plant-based dairy substitutes through a quantitative survey conducted via Google Forms. The survey was designed to capture detailed responses regarding consumer preferences, perceptions and purchasing behaviours related to legume-based and other plant-based dairy alternatives.

Questionnaire development

A structured questionnaire was developed and administered using Google Forms. The questionnaire included demographic information, awareness and usage of legume-derived and plant-based dairy substitutes, taste and texture preferences, perceived health benefits, environmental concerns and purchasing behaviour. The questionnaire consisted of the following sections

Demographic information

Age, gender, educational background and household income.

Awareness and usage

This section examines respondents' awareness of and consumption frequency of legume-derived dairy substitutes (e.g., soy milk and pea milk) as well as commonly consumed plant-based alternatives.

Consumer preferences and purchase decisions

This section explores the factors that influence respondents' decisions when they buy dairy substitutes derived from legumes. Available options were selected and questions may address availability, health benefits, sustainability, dietary preferences (e.g., lactose intolerance, veganism), brand reputation and availability.

Packaging and presentation

In exploring the importance of packaging design and presentation in influencing purchasing decisions, the questionnaire asked respondents how significant packaging design was to their decision-making process. It also inquired about their preferences regarding types of

packaging, such as glass bottles or Tetra Paks and the reasons behind those preferences, including considerations of sustainability and aesthetics. The responses provided valuable insights into how packaging design influences consumer choices when selecting legume-derived dairy substitutes.

Consumer information and communication

The study examined how the respondents found out about new products that substituted dairy; what they preferred as sources of information included TV, radio, online and social media ads; in-store sampling and promotions; product reviews or blogs and other sources. It also evaluated respondents' perceptions of how well-informed they were about these products and whether they needed more information. The results offered valuable information about how well different communication channels reach and satisfy consumers' informational needs about products that substitute dairy.

Sample and data collection

A total of 64 respondents participated in the survey. Participants were recruited through convenience sampling, utilizing social media platforms, email invitations and personal networks to ensure diverse demographic representation. The survey was open for responses for four weeks.

Data analysis

The data collected from the Google Forms survey were exported to Microsoft Excel for preliminary analysis and were analyzed using SPSS statistical software. Descriptive statistics such as percentages were used to summarize demographic characteristics, awareness levels, preferences and purchasing behaviours related to legume-derived dairy substitutes.

Ethical considerations

Participants were informed about the purpose of the study and their consent were obtained before participation. The survey was anonymous to ensure confidentiality and participants were assured that their responses would be used solely for research purposes. By employing this methodology, the study aimed to gain information into consumer preferences for legume-derived dairy substitutes, thereby contributing to the understanding of market trends and potential areas for product development in the dairy alternatives sector.

Demographic profile

The study impacts younger, with 65.7% of respondents aged 20-40. While males made up the majority (54.1%), a significant proportion (9.8%) did not disclose their gender. The study included a well-educated demographic, with more than half (58.7%) having at least a bachelor's degree. Income distribution was generally balanced, with around 20% falling into each income range. This demographic profile gives an understanding of who took the survey,

allowing researchers to analyse how successfully it reached the target demographic (Table 1).

Awareness and usage

Table 2 summarizes respondents' levels of awareness and usage of legume-derived dairy substitutes. Overall, 58.1% of respondents reported familiarity with dairy replacers derived from legumes, while 41.9% indicated unfamiliarity. Although coconut milk is not a legume-derived product, it was included as a commonly consumed plant-based dairy alternative and was the most popular option (30.6%) during the past three months. Notably, despite partial unfamiliarity, a substantial proportion of respondents (41.3%) reported regular consumption of dairy alternatives, with 14.3% consuming them multiple times per day. This finding suggests diverse consumption preferences, even among individuals who may not be fully aware of all available options.

Consumer preferences and purchase decisions

Table 3 presents consumer preferences and key purchase decision factors influencing the selection of legume-derived dairy substitutes. The study results provide numerous findings into consumer preferences and behaviours regarding legume-derived dairy alternatives. Health benefits are the most important element affecting purchasing decisions, with 54% of respondents identifying this as their top priority. Other important criteria are these items' sustainability and environmental effect (34.9%), dietary choices such as vegetarianism or lactose sensitivity (27%) and availability (25.4%). Brand reputation also had an impact, affecting 22.2% of respondents, while 7.9% cited other unknown variables. When choosing a legume-based dairy substitute, over half of respondents (49.2%) prioritise nutritional value as the most essential factor. Taste and ingredient transparency were equally significant to 15.9%

of respondents, whereas just 7.9% saw price as the most essential part. Environmental sustainability was also important to 11.1% of customers. When it comes to moving from traditional dairy products, 54% of respondents say they are either very willing or likely to do so, indicating an important market change. Meanwhile, 23.8% stay neutral and a total of 22.2% are unlikely or extremely unlikely to make a decision, indicating a wide variety of customer views regarding these items.

Packaging and presentation

Table 4 summarizes consumer preferences regarding the packaging and presentation of legume-derived dairy

Table 1: Demographic profile of respondents.

Age	Percentage (%)
20-30	31.3
30-40	34.4
40-50	21.9
50+	12.5
Gender	
Male	54.1
Female	36.1
Prefer not to say	9.8
Education	
High school	19
Bachelor's degree	36.5
Master's degree	22.2
Doctorate or professional degree	22.2
Monthly income (Rs.)	
Less than 15000	24.6
Less than 25000	21.3
Less than 35000	19.7
More than 35000	34.4

Table 2: Awareness and usage of legume-derived dairy substitutes.

a. Are you familiar with legume-derived dairy substitutes (e.g., soy milk, almond milk, pea milk)?	Percentage (%)
Yes	58.1
No	41.9
b. Which plant-based dairy substitutes have you consumed in the past 3 months?	
Soy milk	17.7
Almond milk	24.2
Coconut milk†	30.6
Oat milk	19.4
Pea milk*	9.7
Others	24.2
c. How frequently do you consume legume-derived dairy substitutes?	
Multiple times a day	14.3
Once a day	27
Occasionally	22.22
Rarely	20.6
Never	15.9

Notes: *Pea milk refers to milk derived from yellow split peas (*Pisum sativum*) and does not include peanut-based products.

†Coconut milk is a plant-based (non-legume) dairy substitute included due to high consumer usage.

substitutes. The study results present information on customer preferences for the package design and presentation of legume-derived dairy alternatives. Packaging design and presentation were major factors in many customers' purchase decisions, with 19.4% thinking them very important and 45.2% regarding them as important. This suggests that approximately two-thirds of respondents place a high importance on how their items were packed. Meanwhile, 21% are indifferent, indicating that packaging design was not an important issue for them. A smaller number believe it's less significant, with 11.3% saying it's not very important and 3.1% saying it's not at all. In terms of packaging type preferences, 40.3% choose glass bottles, indicating a strong preference for this choice. Tetra Paks are another popular option, with 21% of respondents choosing them. Cartons and plastic bottles are less popular, with 14.5% and 9.7%, respectively. Furthermore, 14.5% of respondents reported a preference for different forms of packaging. This study shows the importance of package design and customers' desire for sustainable and costly packaging alternatives such as glass bottles when it comes to legume-derived dairy replacements.

Information and communication

Table 5 presents consumer preferences regarding information sources and communication channels for legume-derived dairy substitutes. Advertisements in different media, such as TV, radio and online platforms, are the most popular techniques for discovering new items, with 39.3% of respondents selecting this method of research. In-store

promotions or sampling are also popular, with 21.3% preferring to sample the product directly before purchasing. 19.7% of respondents preferred social media networks such as Facebook and Instagram, demonstrating the impact of digital and social channels. Product reviews or blogs are less popular, with 11.5% of respondents depending on them for information. Furthermore, 8.2% prefer other unknown means of learning about new items.

In terms of the amount of information accessible concerning legume-derived dairy alternatives, the majority of respondents (67.2%) believe they are well-informed, indicating that existing information methods of distribution are effective for the majority of consumers. However, 32.8% indicate a want for additional knowledge, indicating a gap that may be filled by giving more thorough or easily available information about these items. This study underlines the need for different and successful communication methods in meeting customers' varying tastes and informational demands.

The findings of this study provide important insights into consumer behaviour and preferences for plant-based and legume-derived dairy alternatives, reinforcing patterns reported in earlier review literature. The demographic profile of respondents, largely consisting of younger and well-educated individuals, suggests a target group that is more health-conscious and environmentally aware. This observation is consistent with Sethi *et al.* (2016), who reported that younger consumers and those adopting vegan or health-oriented diets are the primary drivers of growth in the plant-based milk alternatives market. Thus, the present findings align with existing evidence that demographic

Table 3: Consumer preferences and purchase decisions for legume-derived dairy substitutes.

a. What factors influence your decision to purchase legume-derived dairy substitutes? (Select all that apply)	Percentage
Health benefits	54
Dietary preferences (e.g., vegan, lactose intolerance)	27
Sustainability/environmental impact	34.9
Brand reputation	22.2
Availability	25.4
Other	7.9
b. Which of the following attributes are most important to you when selecting a legume-derived dairy substitute?	
Taste/flavour	15.9
Nutritional content	49.2
Price	7.9
Intergradient list/Transparency	15.9
Environmental sustainability	11.1
c. How likely are you to switch from traditional dairy products to legume-derived dairy substitutes in the future?	
Very likely	12.7
Likely	41.3
Neutral	23.8
Unlikely	9.5
Very unlikely	12.7

characteristics significantly influence acceptance of functional plant-based beverages.

Consumer awareness and usage patterns

Although a majority of respondents were familiar with legume-derived dairy substitutes, a substantial proportion lacked awareness, highlighting the need for improved consumer education. Similar gaps in awareness have been discussed by Pérez-Rodríguez *et al.* (2023), who emphasized that increasing product variety and marketing claims do not always translate into better consumer understanding, making nutritional education essential.

The high preference for coconut milk, despite it being non-legume-based, indicates that consumers often perceive plant-based beverages as a single category rather than distinguishing them by botanical origin. This finding supports Sethi *et al.* (2016), who noted that consumers tend to group plant-based milk alternatives broadly, driven more by perceived health and ethical benefits than by raw material differences. Regular consumption of these beverages by a large share of respondents further suggests their integration into daily diets, provided taste and perceived functionality meet expectations.

Influential factors in purchasing decisions

Environmental sustainability was also a major consideration, reflecting increasing consumer awareness of ecological impacts. Nawaz *et al.* (2020) similarly highlighted that

environmental sustainability is a central driver behind the growing demand for legume-based beverages, positioning them as functional and environmentally responsible alternatives to dairy. The prioritization of nutritional value over price further aligns with earlier findings. However, Pérez-Rodríguez *et al.* (2023) cautioned that many plant-based beverages, particularly non-soy options, may lack nutritional balance compared to cow's milk, emphasizing the importance of transparent labelling, an issue directly reflected in respondents' emphasis on ingredient transparency in the present study.

Preferences for the packaging and presentation

The strong preference for glass bottles observed in this study suggests that consumers associate certain packaging materials with quality and sustainability. This perception aligns with the broader functional beverage narrative discussed by Sethi *et al.* (2016), who emphasized that packaging plays a critical role in reinforcing product positioning as healthy and environmentally friendly. The findings indicate that sustainable packaging may enhance consumer trust and product differentiation within the competitive plant-based beverage market.

Communications and information channels

The reliance on advertisements and digital platforms for product discovery reflects the evolving nature of consumer engagement. Pérez-Rodríguez *et al.* (2023) similarly highlighted that effective communication and accurate

Table 4: Consumer preferences for packaging and presentation of legume-derived dairy substitutes.

a. How important is the packaging design and presentation of legume-derived dairy substitutes in your purchasing decision?	Percentage
Very important	19.4
Important	45.2
Neutral	21
Not very important	11.3
Not important at all	3.1
b. Which type of packaging do you prefer for legume-derived dairy substitutes? (Select one)	
Carton	14.5
Plastic bottle	9.7
Glass bottle	40.3
Tetra pak	21
Other	14.5

Table 5: Consumer information and communication preferences for legume-derived dairy substitutes.

a. How do you prefer to learn about new legume-derived dairy substitute products?	Percentage
Advertisement (TV, radio, online)	39.3
Social media (Facebook, Instagram, etc.)	19.7
In-store promotions or sampling	21.3
Product reviews or blogs	11.5
Other	8.2
b. Do you feel that there is enough information available about the nutritional content and benefits of legume-derived dairy substitutes?	
Yes, I feel well-informed	67.2
No, I would like more information	32.8

labelling are crucial, as marketing claims alone may mislead consumers regarding nutritional quality. Although most respondents felt adequately informed, a notable proportion desired additional information. This supports the argument by Nawaz *et al.* (2020) that clearer communication regarding processing methods, nutritional benefits and potential limitations of legume-based beverages is necessary to strengthen consumer confidence and adoption.

Future outcome

Future research based on this study could explore longitudinal trends in consumer preferences for legume-derived dairy substitutes, tracking changes over time as awareness and availability of these products evolve. Geographical variations in consumer behaviours and preferences could be further investigated to understand regional market dynamics and modify marketing strategies accordingly. Continuous product innovation remains crucial to meeting diverse consumer demands for taste, nutritional content and environmental sustainability, suggesting opportunities for improved product development. Educational programs could be developed to address knowledge gaps and raise awareness about the health and environmental benefits of plant-based dairy substitutes. Additionally, promoting laws and policies that are supportive of these alternatives may lead to a larger acceptance of them in the dairy sector. Psychographic-based segmentation studies have the potential to yield a better understanding of customer segments, hence informing focused marketing approaches. Working together, the food supply chain's joint efforts might concentrate on introducing sustainable manufacturing, sourcing and packaging techniques. Future research must also focus on analysing the long-term health effects of replacing regular dairy with plant-based substitutes and investigating customer behaviour in retail and distribution systems. Lastly, researching the effects of culture on customer acceptability around the world may provide useful data on the patterns and attitudes of the larger market. These study directions would advance our understanding of consumer behaviour in general and guide the development of health-conscious and sustainable eating methods.

CONCLUSION

This study shows the evolving environment of dairy consumption, showing a strong move towards plant-based alternatives motivated by health, sustainability and ethical issues. The study highlights the significance of health benefits and environmental effects in consumer decision-making, indicating that these factors should be important to marketing and product development methods. The focus on packaging design and presentation suggests that customer preferences reach over the product itself to include the entire consumption experience.

To make use of these findings, manufacturers of legume-derived dairy alternatives should increase product visibility and education, as well as communicate the health and environmental advantages. Managing customer

expectations requires sustainable packaging options as well as a strong internet presence. By identifying product offers with the complex preferences shown in this questionnaire, stakeholders may better meet the rising demand for plant-based dairy alternatives while also supporting a more sustainable and health-conscious food system.

Future studies should look at continuous patterns to better understand how these preferences change over time and how developing market dynamics influence them. Furthermore, looking into geographical variations and the impact of cultural variables on consumer choices might offer a more complete picture of the market for legume-derived dairy alternatives.

ACKNOWLEDGEMENT

Funding details

This research received no external funding.

Authors' contributions

All authors contributed toward data analysis, drafting and revising the paper and agreed to be responsible for all the aspects of this work.

Data availability

The data analysed/generated in the present study will be made available from corresponding authors upon reasonable request.

Availability of data and materials

Not applicable.

Use of artificial intelligence

Not applicable.

Declarations

Authors declare that all works are original and this manuscript has not been published in any other journal.

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Conflict of interest

Authors declare that they have no conflict of interest.

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