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Investigation of Consumer Preferences and Purchase Intentions in Health-conscious Markets for Legumes as a Sustainable Protein Source

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ABSTRACT

Background: In this technologically advanced era, lifestyle-related diseases are increasing at an alarming rate worldwide. The prevention of these diseases is crucial and has been widely discussed, albeit sometimes losing its value. Despite their benefits, legumes remain an underutilized food source. Incorporating legumes into diets can enhance nutritional value and their usage largely depends on consumer preferences and purchasing intentions, which can be influenced by increased awareness and knowledge about legumes.

Methods: The present study is a narrative review that focuses on the benefits legumes provide, the factors influencing consumer preferences and purchase intentions. It also examines legumes as a sustainable protein alternative to animal meat.

Result: The findings of the study indicate that increasing the usage of legumes in traditional diets can be facilitated by incorporating legume-derived components into other food items. The research highlights the necessity of focusing on “easy-to-cook”/prepare meals to appeal to consumers who often avoid legumes due to lengthy preparation times. This convenience factor is especially important in industrialized nations and may lead to increased legume consumption. Additionally, future research should aim to enhance quality, improve consumer acceptance, overcome production obstacles, address regulatory concerns and ensure the cost-effectiveness of legume-based meat analogues to successfully commercialize and sustain demand for legumes.

Key words: Consumer choices, Legumes, Sustainable crop, Willingness to buy.

INTRODUCTION

Animal products have traditionally served as the primary protein source for much of the global population. However, animal-based agriculture contributes significantly to environmental degradation. With the global population expected to reach 10.4 billion by 2100, ensuring sufficient food production without overburdening natural resources remains a major challenge (Kumar *et al*., 2018). The rising demand for meat is projected to intensify agriculture’s negative environmental impact, including increased greenhouse gas emissions and land degradation. Current global food systems and consumption patterns are unsustainable for the health of humans, animals and the planet (Untari and Satria, 2022).

In response, plant-based diets have emerged as a sustainable and health-promoting alternative (Bhatia *et al*., 2021; Rolla, 2023). Among plant-based protein sources, legumes have garnered particular attention due to their dual benefits: promoting human health and supporting environmental sustainability. They are foundational components of traditional diets like the Mediterranean and low-glycemic index diets, supplying essential amino acids and often replacing meat in the form of soybean extracts and other products (Kim, 2021). Legumes also offer agroecological benefits such as nitrogen fixation, improved soil fertility and reduced greenhouse gas emissions, positioning them as key crops in sustainable agriculture (Semba *et al*., 2021; Drożdżyk, 2012). The increasing

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popularity of legume products is partly driven by growing consumer awareness and interest in environmentally friendly and health-conscious diets (Yanni *et al*., 2023). Governments also play a role in promoting legumes by providing support through subsidies, fertilizers and agricultural equipment, factors that have contributed to increased production and improved farm income (Hamadani *et al*., 2022; Ma *et al*., 2024; Al-Sharqi *et al*., 2025).

Research gap

Despite the well-documented nutritional and environmental benefits of legumes, their adoption as a staple protein source remains limited in many health-conscious and industrialized markets. While several studies have examined legume production, health effects and environmental sustainability, there is a lack of comprehensive analysis focused on consumer preferences and purchase intentions toward legumes as sustainable meat alternatives. Additionally, few studies explore the interplay between consumer awareness, convenience and market demand for legume-based products. This gap is especially critical given the increasing interest in sustainable diets and the need for scalable protein alternatives to meet future food security demands.

This paper explores legume products' acceptance by examining factors influencing their cultivation and consumption. It highlights legumes as a sustainable, nutritious food source that can enhance public health, reduce greenhouse gas emissions and promote food system sustainability. Encouraging legume consumption supports long-term food security and resource management.

MATERIALS AND METHODS

This study followed a narrative review approach to explore the role of legumes in public health, global consumption patterns and factors influencing their inclusion in diets. A narrative review was chosen over a systematic review because the research questions span multiple disciplines-including nutrition, agriculture, sustainability and consumer behavior-which require broader flexibility in interpreting heterogeneous data sources (Agumas *et al*., 2025). This method allows for integrating findings from a wide array of studies to provide contextual insight and identify emerging themes across diverse geographical and socioeconomic settings. A literature search was conducted using major scholarly databases including PubMed, Scopus and Science Direct. The search focused on studies published in the last 10 years (May 2014 to May 2024). Additionally, relevant articles cited within these primary sources were reviewed and included if they contributed substantively to the topic.

Keywords used in the search included: legumes, legume cultivation, legume production, sustainability, consumer awareness, consumer preference, ready-to-eat legumes and health benefits, among others. These keywords were applied individually and in various combinations to ensure comprehensive coverage of relevant literature. The inclusion criteria were peer-reviewed journal articles and official reports in English, available in full text and relevant to human consumption and health, sustainability, or consumer perspectives. The exclusion criteria included in vitro or animal studies, research focused on pediatric or pregnant populations and those dealing solely with environmental or economic aspects outside the context of legume consumption. After initial screening and removal of duplicates and irrelevant studies, a total of 78 peer-reviewed articles and official reports were included in the final review. The selection process is summarized in a PRISMA-style flowchart (Fig 1).

Narrative reviews are flexible and allow a broader interpretation of research, but they can be limited by subjectivity and a lack of reproducibility. Without strict inclusion criteria, there is a risk of bias in selecting and analyzing studies. However, efforts were made to include reliable sources and maintain consistent themes throughout the review.

RESULTS AND DISCUSSION

The following section presents the findings of this review in different categories related to the benefits of legumes for human and environmental health in a scientific context as well as from the perspective of consumers. It also includes information about legume cultivation and farmers' preferences, including factors affecting their choices. Additionally, the discussion covers how these factors have influenced the global legume market in recent times.

Nutritional benefits of legumes

Legumes are excellent sources of plant-based protein and are especially important in vegetarian and vegan diets (Table 1). They are a major source of protein and calories in Afro-Asian diets due to their high nutrient content. They provide essential amino acids like arginine, histidine and

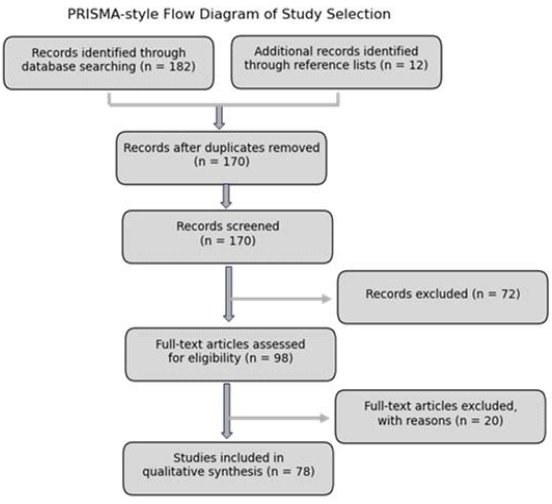

Fig 1: PRISMA-style flowchart to select 78 peer-reviewed articles.

methionine. Cowpeas have the highest content of essential amino acids, while lentils contain high levels of non-essential amino acids like glutamic and aspartic acid (Iqbal, 2006). In addition to protein, legumes are rich in dietary fibre, which supports digestion and helps prevent constipation (Trinidad *et al*., 2010). They are also packed with important minerals such as iron, magnesium, potassium and folate, which contribute to overall health (Maphosa and Jideani, 2017). The soluble fibre in legumes helps lower bad cholesterol (LDL), reducing the risk of heart disease. Potassium in legumes supports healthy blood pressure (Greer *et al*., 2020). Their high protein content increases feelings of fullness and reduces hunger, supporting weight control (Semara *et al*., 2024). Low in fat and rich in nutrients, legumes help prevent obesity (Desai *et al*., 2024). Due to their low glycemic index, legumes help control blood sugar levels and are useful in managing type 2 diabetes. Regular consumption improves blood sugar control in diabetic patients (Bielefeld *et al*., 2020). Legume fibre also acts as a prebiotic, feeding healthy gut bacteria. Including more pulses in the diet is a low-cost way to prevent obesity, heart disease, diabetes and some cancers. Overall, legumes are a valuable part of a healthy diet.

Environmental contributions

Legumes significantly improve soil fertility and reduce environmental impacts. They enhance soil organic carbon (SOC) through carbon sequestration, storing up to 30% more than other crops due to their natural nitrogen fixation ability (Kuyah *et al*., 2023; Kumar *et al*., 2018). In mixed cropping systems like vetch and rye, legumes boost biomass and nitrogen levels via biological nitrogen fixation (Sadra *et al*., 2023). Their symbiotic relationship with rhizobia bacteria converts atmospheric nitrogen (N,) into nutrients for plants and companion crops (Kebede, 2021).

Legumes also lower greenhouse gas (GHG) emissions. Crop rotations involving legumes reduce nitrous oxide emissions and enhance soil nitrogen for subsequent cereal crops. When used in animal feed, tannin-rich legumes can reduce methane emissions, helping address the 15% of GHGs attributed to livestock (Króliczewska *et al*., 2023; DiLorenzo, 2001). Beyond carbon and GHG benefits, legumes help control pests and weeds, improve soil structure, water retention and pH balance, making them vital for sustainable farming (Franke *et al*., 2018). Table 2 summarizes the environmental advantages of legume plants.

Legume consumption

Legumes are a staple in many cultures, with high consumption in Asia (India, China), Latin America (Brazil, Mexico) and Africa (cowpeas, chickpeas, lentils). Mediterranean countries have higher intake than northern Europe and North America sees increasing consumption

Table 1: Key nutrients in legumes and their health benefits.

Nutrient	Common legume sources	Health benefit
Protein	Lentils, chickpeas, beans	Supports muscle development and maintenance, especially important in plant-based diets
Fiber	Black beans, peas	Promotes digestive health, lowers LDL cholesterol and aids in weight management
Iron	Lentils, soybeans	Helps prevent iron-deficiency anemia, especially important for women and children
Folate	Chickpeas, pinto beans	Essential for fetal neural development and reduces risk of birth defects
Magnesium	Soybeans, kidney beans	Supports cardiovascular health, muscle function and bone strength
Potassium	White beans, lima beans	Helps regulate blood pressure and supports heart and muscle function
Zinc	Chickpeas, black-eyed peas	Supports immune function and wound healing
Able	Red kidney beans, black beans	Protect cells from oxidative stress and reduce the risk of chronic diseases

Table 2: Environmental advantages of legume production.

Metric	Legume impact	Comparison	Source
GHG emissions	Reduced by up to 30%	Compared to conventional cereal crops	FAO, 2022
Water use	Reduced by up to 80%	Compared to animal protein production	FAO, 2023
Nitrogen fixation	Natural biological process	Reduces or eliminates the need for synthetic fertilizers	Kuyah *et al*., 2023
Soil organic carbon	Increased up to 20-30%	Compared to non-leguminous crop rotations	Kumar *et al*., 2018
Fertilizer dependency	Reduced Up to 50%	Less nitrogen fertilizer required in rotational systems	Vanlauwe *et al*., 2019
Methane reduction	Reduced by up to 16% in livestock feed use	Compared to traditional grass-based feeds	Króliczewska *et al*., 2023
Energy use in production	Reduced due to reduced fertilizer and irrigation needs	Compared to input-intensive monoculture systems	Sadra *et al*., 2023
Land degradation risk	Reduced lower erosion and higher ground cover	Compared to continuous cereal cultivation	Franke *et al*., 2018

due to plant-based diets. Their sustainability makes legumes crucial for cropping systems (Kushwaha and Badhera, 2022; Yanni *et al*., 2023). An analysis of food-based dietary guidelines (FBDG) and intake data from 93 countries is presented in Fig 2. It shows a wide disparity in daily median legume intake, ranging from 1.2 g/day in Norway to 122.7 g/day in Afghanistan. The Asia-Pacific (APAC) region showed the greatest variation (9.7-122.7 g/day), with six out of eleven countries exceeding the 50 g/day target. In contrast, no country in Africa or North America met this target. In Europe, consumption was generally low, with 36% of countries reporting intakes below 10 g/day. Interestingly, countries that classified legumes as part of protein-rich foods or gave them a distinct food group in their national dietary guidelines tended to report higher intakes. For instance, 71% of countries that placed legumes in their own group consumed more than 25 g/day. These findings underscore the influence of national food guidelines on dietary behavior and highlight the need to promote legumes more prominently to improve intake globally.

Legumes and public health

Legumes play a crucial role in public health due to their nutritional value, ability to prevent chronic diseases and contribution to food security. Protein intake is vital in reducing childhood undernourishment, especially in low-income groups where protein-energy malnutrition (PEM) is prevalent (Vanlauwe *et al*., 2019). Traditional diets rich in legumes are linked to better health. Legumes help lower heart disease risk by reducing blood pressure and cholesterol. Their low glycemic index aids in managing diabetes, while high fibre promotes satiety and weight management. Some studies suggest legumes may reduce the risk of colorectal cancer due to their fibre and bioactive compounds. Public health organizations, including the Dietary Guidelines for Americans, recommend legumes for better nutrition. Educational campaigns promote legume consumption in school meal programs and community initiatives. Technological advancements in food security and disease management have further enhanced legume usage globally (Taylor and Carrigan, 2022; Cho, 2024).

Factors affecting inclusion of legume and legume products in diets: Dietary habits of people, their preferences and consumer purchase intention

Dietary recommendations must balance health and environmental impact. Nutrient-rich diets can have high environmental costs, while low-GHG diets may lack nutrients (Macdiarmid, 2013). Despite health benefits, legume consumption remains below recommendations. Strategies must address consumer habits, pricing and accessibility to promote legume adoption effectively. However, regular consumption of legumes is constrained by many barriers, such as:

- **Taste and texture**

Taste and texture can deter legume consumption due to unfamiliarity or past experiences. Developing palatable legume-based products is crucial. Gitau *et al*. (2019) found legume-enriched porridge was favored for taste (38.9%) and texture (32.2%).

- **Poor knowledge about health benefits**

Lack of knowledge about legumes' health benefits, such as blood sugar control, cholesterol reduction and weight management, may deter consumption (Affrifah *et al*., 2023). Many people are unaware of their nutritional value.

- **No familiarity with legume cooking techniques**

Legumes may be perceived as time-consuming due to soaking and long cooking times, which can deter consumption.

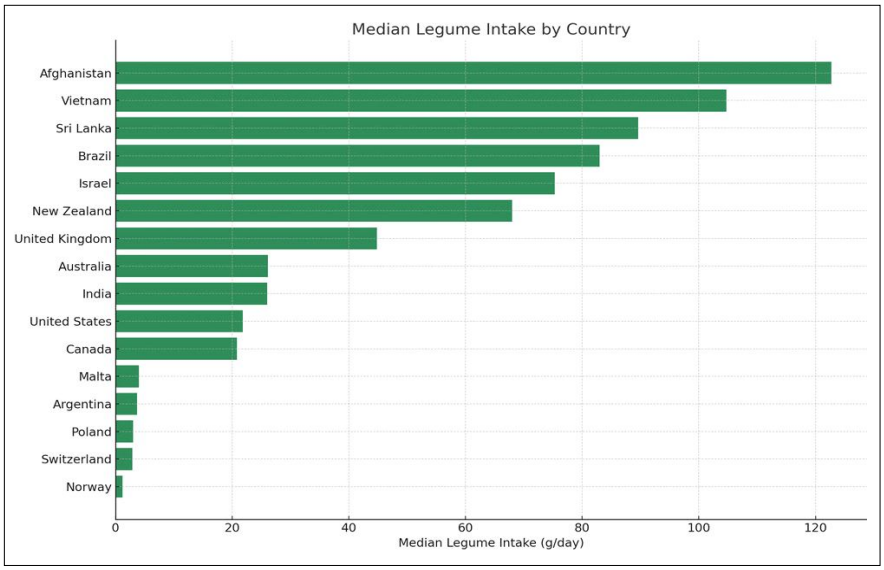

Fig 2: Median legume intake (g/day) by country.

- **Availability**

Geographical location and market supply can have a major impact on the availability of a wide variety of legumes. It might be difficult to include a wide variety of legumes in the diet when there is a restricted availability of legumes in some places. Seasonal availability may also make fresh legumes more difficult to get.

- **Lack of awareness about alternative sources of animal protein**

Although legumes are a great source of plant-based protein, not many people know that they may also serve as viable substitutes for animal protein. This ignorance can result in a preference for animal-based proteins like dairy, meat and eggs, which makes it more difficult to incorporate legumes into daily diet planning.

Studies show consumers perceive beans and pulses as healthy, often due to long-term consumption (Appleton, 2024). However, likability isn't always considered. Didinger and Thompson (2022) suggest that discrepancies in terminology hinder the clear communication of legumes' benefits, leading to confusion and affecting consumers' dietary decisions (Affrifah *et al*., 2023).

Purchase intention

There is a rising demand for environmentally friendly products, including legumes. Several key factors influence consumer purchase intentions.

Cost

Price is a major barrier. Legumes can be expensive due to import fees or limited local production. Processed or pre-cooked varieties are often pricier than raw ones. This makes them less accessible to low-income households. Marette and Roosen (2022) found that higher prices reduce purchase intention.

Place of residence

Location affects buying habits. Urban consumers eat more legumes and spend more on them than rural consumers. This is likely due to better availability and higher income levels in cities.

Health and environmental awareness

Awareness is growing. Consumers are more informed about the health and environmental benefits of legumes. Educated buyers often choose products that reflect these values. According to Marette and Roosen (2022), environmental benefits influence purchase intention more than health claims.

Product origin

The source of a product matters. People prefer legumes that are local or have a clear origin. Such products are seen as authentic and trustworthy. Paffarini *et al*. (2021) found that labeling the origin can improve consumer confidence and willingness to buy. Table 3 shows uses of legumes in different countries.

Table 3: Traditional uses of legumes in various countries' diets.

Country	Legume	Common dishes and uses
India	Lentils (Dal)	Dal (Lentil stew), Sambar (Spiced lentil soup), Vada (Lentil fritters), Khichdi (Rice and lentil dish)
	Chickpeas (Chana)	Chana Masala (Chickpea curry), Chole Bhature (Chickpeas with fried bread), Hummus and Besan (Chickpea flour) for pakoras
	Mung beans (Moong)	Moong Dal (Split mung bean stew), Sprouted salads, Moong Dal Halwa (Sweet dessert)
Mexico	Black beans (Frijoles)	Refried beans, Black bean soup, Tacos and burritos fillings, Enfrijoladas (Beans with tortillas)
	Pinto beans	Refried beans, Pinto beans soup, frijoles charros (Cowboy beans)
Middle east	Chickpeas	Hummus (Chickpea dip), Falafel (Fried chickpea balls), Tabbouleh (Bulgur salad with chickpeas)
	Lentils	Mujadara (Lentils with rice and onions), Lentil soup, Koshari (Egyptian rice and lentil dish)
Japan	Soybeans	Tofu, Edamame (Boiled soybeans), Natto (Fermented soybeans), Miso (Fermented soybean paste)
China	Mung beans	Mung bean soup, Mung bean cakes, Douzhi (Fermented mung bean milk)
	Soybeans	Tofu, Soy milk, Soy sauce, Tempeh (Fermented soy product), Doufu (tofu)
Italy	Cannellini beans	Pasta e Fagioli (Pasta and beans), Ribollita (Bean and vegetable soup), Bean salads
	Chickpeas	Farinata (Chickpea flatbread), Pasta e Ceci (Pasta and chickpea soup), Chickpea salads
Ethiopia	Lentils	Misir Wot (Spicy lentil stew), Kik Alicha (Mild split pea stew), Shiro (Chickpea flour stew)
	Chickpeas	Shiro (Chickpea flour stew), Asa Tibs (Fried chickpeas)
Brazil	Black beans	Feijoada (Black bean stew with meat), Black bean soup, Tutu de Feijão (Bean puree)
	Pinto beans	Feijão Tropeiro (Pinto beans with cassava flour), Rice and beans
United states	Various beans	Chili (Bean stew), Bean salads, Baked beans, Bean burgers, Hummus
Mediterranean	Lentils	Lentil soup, Lentil salads, Mujadara (Lentils with rice and onions)
	Chickpeas	Hummus, Falafel, Chickpea stews and salads
France	Lentils (Puy lentils)	Lentil salad, Lentil soup, Lentils with sausage
Caribbean	Red kidney beans	Rice and beans, Bean soups, Stewed beans
Morocco	Chickpeas	Harira (Chickpea and lentil soup), Couscous with chickpeas, Bissara (chickpea dip)
	Fava beans	Bessara (Fava bean dip), Ful Medames (Fava bean stew)

In addition to their nutritional benefits, legumes are becoming more popular as people are concerned about the environmental impact of meat and animal-based foods. As a result, many are reducing or eliminating meat from their diets in favor of plant-based foods and alternative protein sources. Table 4 represents nutritional values of legumes per 100 g.

Consumer preferences, purchasing intention and sustainability

Customer demand for healthier food alternatives has led to a dramatic change in the food sector in the last several years. The emergence of "Clean Label i.e. factors related to sustainability, naturalness and health" is a result of this transition and reflects an increasing demand for goods containing natural ingredients. Studies have shown that customers are now using information provided on food labels to understand what they are consuming even more and the ethical information provided to them is shaping their decisions about the products and their inclusion in their diets (Mehanna *et al*., 2024). In addition, modern consumers are looking for products that align well with their values and lifestyle choices leading to growing demand for organic, non-genetically modified organisms (non-GMO) and locally sourced products (Paffarini *et al*., 2021; Zheng and Wang, 2021). Their purchasing decisions are driven by their considerations of health, ethical production, environmental impact and social responsibility (Toussaint *et al*., 2021). From a commercial standpoint, the availability of information about food products greatly influences purchasing decisions.

Consumers' preference shifts toward healthier options reflect growing acceptance of sustainable practices, such as promoting food products that reduce environmental impacts like greenhouse gas emissions. Studies show an increasing appreciation for plant-based foods, with legume products gaining consumer support (Nevalainen *et al*., 2023). Due to their numerous benefits food products made from legumes and whole legumes as such are growing in popularity. However, their promotion among consumers is required to utilize their benefits and for sustainability. Jallinoja *et al*. (2016) found that for beans and tofu to be included in regular diets, they must be associated with enjoyable meals, not seen as forced alternatives. Labelling also plays a key role in boosting legume-product preferences, as Marette *et al*. (2022) showed that it influenced lentil purchasing decisions. Table 5 presents the main barriers to legume consumption along with potential solutions.

Practical recommendations for policymakers and marketers

To provide clear guidance for policymakers and marketers, the following actions can be considered:

1. Subsidize Legume Products: Lower prices to increase accessibility, particularly for low-income populations.

Table 4: Nutritional values of different legume products.

Product type	Examples	Nutritional values (per 100 g)
Whole legumes	Black beans	Calories: 132, Protein: 8.9 g, Fiber: 8.7 g, Iron: 2.1 mg
	Lentils	Calories: 116, Protein: 9.0 g, Fiber: 7.9 g, Iron: 3.3 mg
	Chickpeas (Garbanzo beans)	Calories: 164, Protein: 8.9 g, Fiber: 7.6 g, Iron: 2.9 mg
Processed legume products	Tofu	Calories: 76, Protein: 8.0 g, Fat: 4.8 g, Calcium: 350 mg
	Tempeh	Calories: 193, Protein: 19.0 g, Fiber: 6.0 g, Iron: 2.7 mg
	Soy milk	Calories: 54, Protein: 3.3 g, Fat: 1.8 g, Calcium: 123mg
	Hummus	Calories: 166, Protein: 7.9g, Fiber: 6.0g, Iron: 2.4mg
Legume flours	Chickpea flour (Besan)	Calories: 387, Protein: 22.4 g, Fiber: 10.8 g, Iron: 4.9 mg
	Lentil flour	Calories: 352, Protein: 25.8 g, Fiber: 10.7 g, Iron: 7.5 mg
	Soy flour	Calories: 372, Protein: 52.6 g, Fiber: 14.5 g, Iron: 8.4 mg
Plant-based alternatives	Legume-based burgers	Calories: 250, Protein: 20.0 g, Fiber: 5.0 g, Iron: 4.0 mg
	Legume-based milk	Calories: 40-60, Protein: 2-4 g, Fat: 1-3 g, Calcium: 100-120 mg
Snacks	Roasted chickpeas	Calories: 120, Protein: 6.0 g, Fiber: 5.0 g, Iron: 1.2 mg
	Edamame (Boiled soybeans)	Calories: 121, Protein: 11.9 g, Fiber: 5.2 g, Iron: 2.3 mg

Table 5: Barriers to legume consumption and potential solutions.

Barriers	Proposed solutions
Lack of awareness of health benefits	Public health campaigns, school-based nutrition education
Perceived difficulty in preparation	Promotion of ready-to-eat or pre-cooked legume products
Taste preferences	Culinary demonstrations, recipe development for diverse cultural dishes
Social stigma or outdated perceptions	Rebranding campaigns highlighting legumes as modern, sustainable superfoods
Limited availability in retail stores	Incentives for supermarkets to stock local and varied legume products
Inadequate labeling or branding	Improved packaging with clear health, environmental and local origin indicators

2. Launch Targeted Awareness Campaigns: Emphasize the health and sustainability benefits of legumes to boost consumer demand.
3. Integrate Legumes into Public Nutrition Programs: Encourage regular consumption by including legumes in school meals, community feeding schemes and other public initiatives.

Implementing these practical steps can help overcome barriers to legume consumption and promote sustainable dietary shifts.

Call to action

To ensure a sustainable future, policymakers, marketers and stakeholders must actively promote legume consumption through supportive policies, awareness campaigns and accessible products. Embracing legumes is not just a dietary choice but a vital step toward transforming food systems and combating climate change. The time to act is now, legumes can lead the way to healthier people and a healthier planet.

Research implications

The present study provides information about the factors that are responsible for consumers' preferences and purchase intentions along with the various advantages that the legume diet and its cultivation can offer. It was found that there is a necessity to educate consumers about the benefits of legumes. To make consumers aware of the health as well as environmental benefits, increased publicity as well as marketing strategies must be placed which can then bring a change in consumers' preferences and purchase intention. In addition, it is essential to develop messages highlighting the important role of legumes in promoting ecological sustainability and high-quality agricultural methods.

CONCLUSION

This study presents a detailed description of customer preferences and their purchase intents regarding legumes. It was linked to legumes' potential to be utilized as a sustainable alternative in the agricultural system as well as human diets. It was found that legumes have many health as well as environmental benefits. In addition, there is an increasing demand for ethical and sustainable products which is visible in consumer preferences and buying habits. This suggests that there is a shift towards more sustainable products having low environmental impact pushing companies to create policies that support social responsibility, environmental preservation and economic sustainability to have a more sustainable future.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

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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.

Conflict of interest

The author declares that there is no conflict of interest.

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