International Journal of Emerging Research in Science, Engineering, and Management
Vol. 2, Issue 7, pp.01-08, July 2026.
www.ijersem.com eISSN- 3107-9075

Comparative Analysis of Almond and Groundnut: Nutritional, Historical, Economic and Environmental Perspectives

[1]Muchakala Venkat, [2]Muchakala Suresh

[1]UG Scholar, Department of Pharmacy, Gokula Krishna College of Pharmacy, Sullurpet, India.
[2]Principal & Professor, Department of Mechanical Engineering, Gokula Krishna College of Engineering, Sullurpet, India.
[1]muchakalavenkat@gmail.com, [2]mvenkat225@hotmail.com

Abstract: Almond *(Prunus dulcis)* and groundnut *(Arachis hypogaea)*, commonly known as peanut, are among the most important plant-based food crops due to their nutritional richness, economic value, and widespread consumption. Despite their similar culinary applications, the two crops differ considerably in botanical classification, cultivation practices, nutrient composition, and environmental requirements. This review presents a comprehensive comparative analysis of almonds and groundnuts based on published literature and authoritative databases. The study examines their botanical characteristics, nutritional profiles, historical development, global production, economic importance, and environmental sustainability. The findings indicate that almonds are an excellent source of vitamin E, dietary fiber, healthy monounsaturated fats, and antioxidant compounds, whereas groundnuts provide higher protein content, niacin, and folate, making them an affordable and accessible source of nutrition in many developing countries. From an environmental perspective, groundnuts enhance soil fertility through biological nitrogen fixation and generally require less irrigation water than almonds, contributing to more sustainable agricultural practices. Overall, both crops possess distinct nutritional and economic advantages and play complementary roles in global food security, human health, and sustainable agriculture. This comparative review provides valuable insights for researchers, nutritionists, policymakers, and the food industry in promoting informed dietary choices and sustainable crop management.

Keywords: Almond, Groundnut, Water Footprint, Food Security, Nutritional Composition.

1 INTRODUCTION

Nuts and legumes constitute an important part of a balanced diet due to their high nutritional value and health-promoting properties. They are rich sources of plant proteins, unsaturated fatty acids, dietary fiber, vitamins, minerals, and various bioactive compounds that contribute to the prevention of chronic diseases and support overall human health [1], [2]. In addition to their nutritional significance, sustainable food production has become an important consideration, with increasing attention being given to the environmental impacts associated with agricultural commodities, particularly their water requirements and resource utilization [3]. Groundnut (Arachis hypogaea), commonly known as peanut, is one of the most widely cultivated leguminous crops and serves as an economical source of protein, edible oil, vitamins, and minerals for millions of people worldwide. Besides its nutritional importance, groundnut possesses several functional properties that make it valuable in both food and industrial applications [4].

Numerous epidemiological and clinical studies have further demonstrated that regular consumption of nuts and peanuts is associated with improved cardiovascular health, reduced inflammation, and lower risks of chronic diseases [5]. Recent investigations have also highlighted the rich lipid composition, phytochemicals, and nutraceutical properties of both tree nuts and groundnuts, emphasizing their role in functional foods and preventive nutrition [6]. Furthermore, studies on metabolizable energy and lipid bioaccessibility have improved the understanding of nutrient utilization from nuts, reinforcing their importance in healthy dietary patterns [7]. Evidence from systematic reviews and meta-analyses indicates that regular consumption of tree nuts and peanuts significantly reduces the risk of cardiovascular disease and contributes to improved metabolic health [8]. To maximize these health benefits, researchers have also emphasized the need for continued investigation into the intake, composition, and biological effects of nuts and peanuts [9].

Alongside nutritional benefits, environmental sustainability has emerged as a key factor influencing crop selection and agricultural planning. Almond cultivation generally requires higher irrigation water, whereas groundnut cultivation offers ecological advantages through biological nitrogen fixation and relatively lower water demand [10]. Additional epidemiological evidence supports the inclusion of nuts in regular diets because of their protective effects against cardiovascular and metabolic disorders [11]. Almonds are particularly recognized for their abundance of polyphenols and antioxidant compounds, which contribute to food quality and health promotion [12]. In contrast, groundnuts are distinguished by their high protein content, favorable fatty acid profile, and diverse nutritional constituents, making them an affordable and accessible food source worldwide.

Moreover, nut phytochemicals and fat-soluble bioactive compounds have attracted considerable attention for their antioxidant and disease-preventive properties. Recent umbrella reviews have further confirmed the positive association between nut and legume consumption and improved human health outcomes, reinforcing their importance in sustainable dietary recommendations. Although almonds and groundnuts are widely consumed across the world, they differ considerably in botanical classification, nutritional composition, cultivation practices, economic significance, and environmental requirements. Therefore, this review presents a comprehensive comparative analysis of almond (Prunus dulcis) and groundnut (Arachis hypogaea) by examining their nutritional characteristics, historical development, economic importance, and environmental sustainability to provide an integrated perspective for researchers, nutritionists, policymakers, and the food industry.

2 Literature Survey

Several studies have highlighted the nutritional significance and health benefits of nuts and legumes, emphasizing their role in promoting healthy dietary patterns. Ros [1] reported that regular nut consumption is associated with reduced risks of cardiovascular diseases, diabetes, and metabolic disorders owing to the presence of unsaturated fatty acids, dietary fiber, antioxidants, and essential micronutrients. Similarly, King et al. [2] identified tree nuts and peanuts as important components of a balanced diet, providing high-quality proteins, healthy lipids, vitamins, and minerals that contribute to overall human health. Environmental sustainability has also become an important aspect of agricultural research. Mekonnen and Hoekstra [3] evaluated the green, blue, and grey water footprints of various crops and reported that tree nuts, particularly almonds, require substantially higher irrigation water than many other food crops.

Their findings highlighted the importance of considering water-use efficiency when evaluating the sustainability of agricultural production systems. Groundnuts have been extensively studied because of their nutritional composition and economic importance. Arya et al. [4] reviewed peanuts as functional foods and demonstrated that they are rich in proteins, monounsaturated fats, vitamins, minerals, and bioactive compounds with significant health-promoting properties. Furthermore, De Souza et al. [5] conducted a systematic review and concluded that regular nut consumption is consistently associated with improved cardiovascular health and reduced risks of chronic diseases. More recently, Maestri [6] presented a comprehensive review comparing groundnuts and tree nuts, emphasizing their lipid composition, phytochemicals, antioxidant compounds, and nutraceutical properties.

The study highlighted that although almonds contain higher concentrations of antioxidant phytochemicals, groundnuts provide an economical and protein-rich alternative suitable for large-scale consumption. The nutritional utilization of nuts has also received considerable attention. Nikodijevic et al. [7] systematically reviewed metabolizable energy and lipid bioaccessibility of tree nuts and peanuts, demonstrating that the physical structure of nuts influences nutrient availability and energy absorption. Likewise, Houston et al. [8] performed a systematic review and meta-analysis, reporting that regular consumption of tree nuts and peanuts significantly lowers the risk of cardiovascular diseases through improvements in blood lipid profiles and vascular health. Recognizing the growing interest in nut-based nutrition, Allen [9] identified priority research areas related to the composition, dietary intake, and long-term health effects of tree nuts and peanuts.

In addition, Mekonnen and Hoekstra [10] further reinforced the importance of evaluating crop water footprints to improve sustainable agricultural planning and resource management. Epidemiological evidence provided by Sabaté and Ang [11] further supported the protective effects of regular nut consumption against cardiovascular diseases and other chronic health conditions. Focusing specifically on almonds, Bolling [12] reviewed almond polyphenols and reported that these compounds contribute significantly to antioxidant activity, food quality, and disease prevention. In contrast, Toomer [13] comprehensively summarized the nutritional chemistry of peanuts, highlighting their rich protein content, favorable fatty acid composition, vitamins, minerals, and phytochemicals.

The bioactive constituents of nuts have also been comprehensively reviewed by Alasalvar and Bolling [14], who discussed the presence of phytochemicals, fat-soluble antioxidants, and other health-promoting compounds responsible for the functional properties of nuts. Finally, Martini et al. [15] synthesized evidence from observational studies and concluded that regular consumption of nuts and legumes is consistently associated with improved health outcomes and supports dietary recommendations for chronic disease prevention.

2.1. Research Gap

- Existing studies have primarily focused on the nutritional composition of almonds or groundnuts individually, with limited direct comparative analyses.
- Most research has emphasized the health benefits and phytochemical properties of these crops rather than providing a holistic comparison.
- Previous studies have investigated the environmental sustainability of individual crops, particularly water footprint and resource utilization, but comprehensive comparisons remain limited.

- The historical development and botanical characteristics of almonds and groundnuts have generally been discussed separately, without integrating them into a unified comparative framework.
- Limited research has simultaneously examined the nutritional, historical, economic, and environmental perspectives of both crops within a single review.
- An integrated comparative assessment is necessary to better understand the complementary roles of almonds and groundnuts in nutrition, agriculture, food security, and sustainable food systems.

3 METHODOLOGY

The present study adopts a structured comparative review methodology to systematically evaluate almond (Prunus dulcis) and groundnut (Arachis hypogaea) from nutritional, historical, economic, and environmental perspectives. Unlike conventional narrative reviews, the proposed methodology integrates evidence from multiple scientific sources through a standardized comparison framework. This approach enables the identification of similarities, differences, advantages, and limitations of both crops while providing a comprehensive understanding of their contribution to global nutrition and sustainable agriculture. The overall methodological framework consists of five interconnected phases: literature acquisition, quality assessment, data extraction, comparative evaluation, and synthesis of findings, as illustrated in Fig. 1.

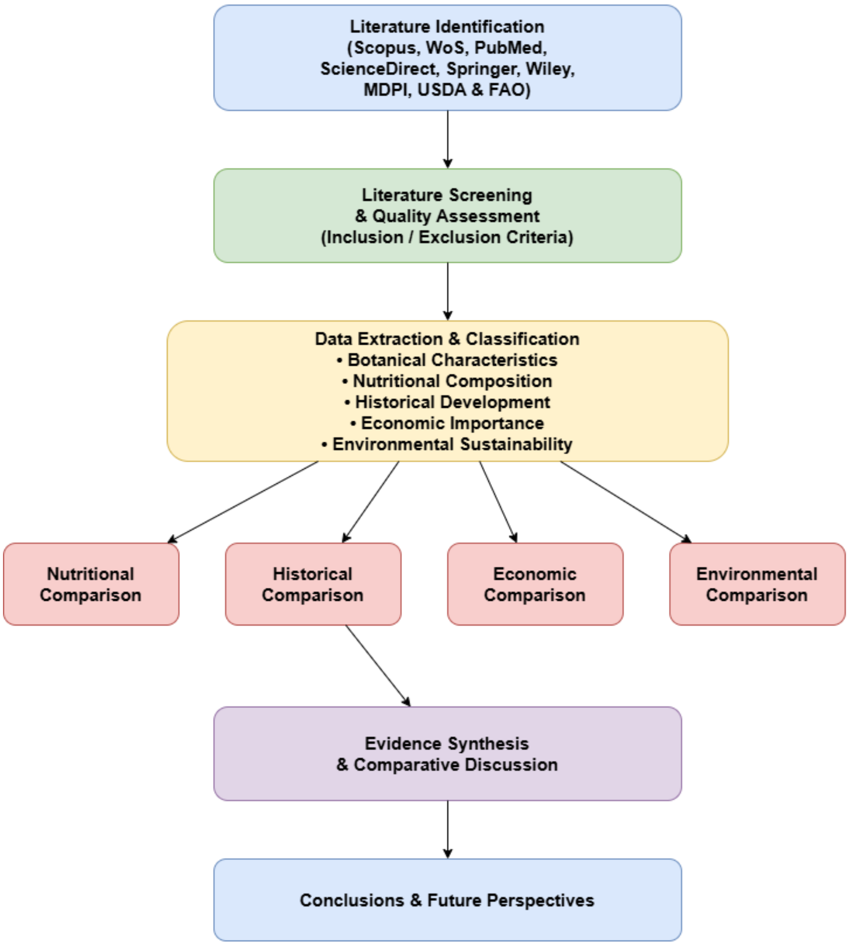

Fig. 1. Proposed methodological framework adopted for the comparative assessment of almond and groundnut.

3.1. Literature Acquisition

The first phase involved a comprehensive literature search using internationally recognized scientific databases, including Scopus, Web of Science, PubMed, ScienceDirect, SpringerLink, Wiley Online Library, MDPI, and Taylor & Francis Online. To ensure the inclusion of reliable statistical information, official databases maintained by the Food and Agriculture Organization (FAO) and the United States Department of Agriculture (USDA) were also consulted. The search was conducted using combinations of keywords such as almond, groundnut, peanut, nutritional composition, functional foods, health benefits, phytochemicals, water footprint, economic importance, and sustainable agriculture. Boolean operators ("AND" and "OR") were employed to refine the search and improve retrieval accuracy. To ensure scientific relevance, only peer-reviewed journal articles published in English were considered.

Studies focusing on nutritional analysis, phytochemical characterization, agricultural production, environmental sustainability, economic importance, and health benefits of almonds and groundnuts were selected. Duplicate records, conference abstracts, editorials, and publications lacking sufficient scientific evidence were excluded from further analysis.

3.2. Data Organization and Classification

After the relevant publications were identified, information from each selected study was systematically extracted and organized into a structured database. Instead of evaluating individual studies independently, all extracted information was classified into common comparison categories to facilitate direct assessment between almond and groundnut. These categories included botanical characteristics, nutritional composition, phytochemical constituents, historical development, global production, economic significance, and environmental sustainability. For each publication, key information including the source, publication year, study objective, nutritional parameters, environmental indicators, and principal findings was documented. Organizing the literature into standardized categories ensured consistency during the subsequent comparative analysis and minimized subjective interpretation of the reported findings.

3.3. Comparative Evaluation Framework

The core of the proposed methodology is a multi-dimensional comparative evaluation framework designed specifically for this review. Each crop was assessed across four major dimensions that collectively represent its scientific and practical significance. The nutritional dimension examined the concentrations of proteins, lipids, dietary fiber, vitamins, minerals, and bioactive compounds reported in previous studies. The historical dimension reviewed the origin, domestication, and geographical expansion of both crops.

The economic dimension evaluated global production patterns, commercial utilization, and market significance, while the environmental dimension focused on irrigation requirements, resource utilization, nitrogen fixation, and sustainability indicators. Rather than ranking one crop as superior, the comparative framework emphasizes the strengths and limitations of each crop within individual evaluation criteria. This balanced assessment enables a more objective interpretation of their complementary roles in food security and agricultural development.

3.4. Evidence Synthesis

Following comparative evaluation, the findings obtained from the selected literature were synthesized using qualitative descriptive analysis. Similar observations reported across multiple studies were consolidated to identify common scientific consensus, whereas differing conclusions were critically examined to explain possible variations arising from geographical conditions, cultivation practices, analytical techniques, or experimental design. The synthesis process integrated nutritional, economic, historical, and environmental evidence into a unified interpretation, allowing meaningful comparisons between almonds and groundnuts.

The final outcome of this methodology is a comprehensive evidence-based comparison that highlights the nutritional benefits, economic importance, environmental implications, and future research opportunities associated with both crops. The proposed methodology therefore provides a systematic framework that enhances the reliability and reproducibility of the review while supporting informed decision-making in nutrition, agriculture, and sustainable food production.

4 Results And Discussion

4.1. Comparative Nutritional Composition

The comparative nutritional analysis indicates that both almond (Prunus dulcis) and groundnut (Arachis hypogaea) are highly nutritious plant-based foods, although they differ considerably in their nutritional profiles. Groundnuts contain approximately 25 g of protein per 100 g, which is higher than the 21 g per 100 g reported for almonds. This higher protein concentration makes groundnuts an economical source of dietary protein, particularly in developing countries where affordable plant-based nutrition is essential. In contrast, almonds contain higher amounts of dietary fiber, contributing to improved digestive health, glycemic control, and cardiovascular protection.

The micronutrient composition also differs substantially between the two crops. Almonds contain significantly higher concentrations of vitamin E, a powerful antioxidant that protects cellular components against oxidative damage and contributes to skin and cardiovascular health. Groundnuts contain comparatively lower vitamin E levels but remain valuable sources of niacin, folate, and other essential nutrients. These findings indicate that almonds are particularly suitable for micronutrient enrichment, whereas groundnuts are preferable when dietary protein is the primary nutritional objective.

International Journal of Emerging Research in Science, Engineering, and Management
Vol. 2, Issue 7, pp.01-08, July 2026.
www.ijersem.com eISSN- 3107-9075

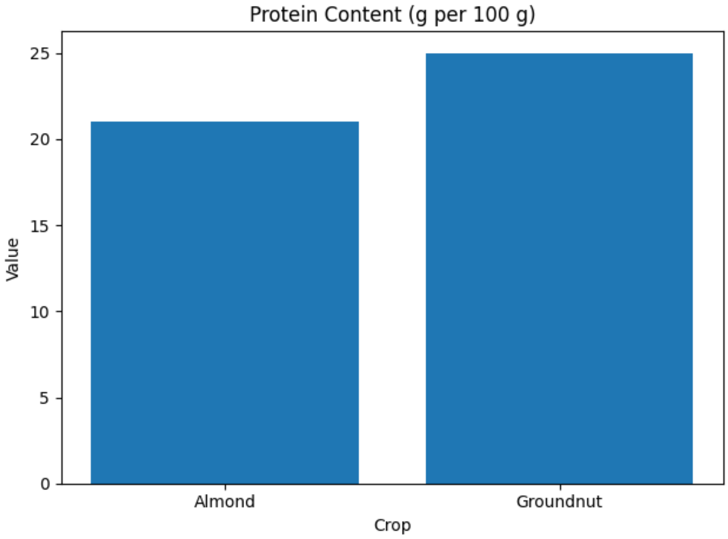

Fig. 2. Protein Content of Almond and Groundnut (g per 100 g)

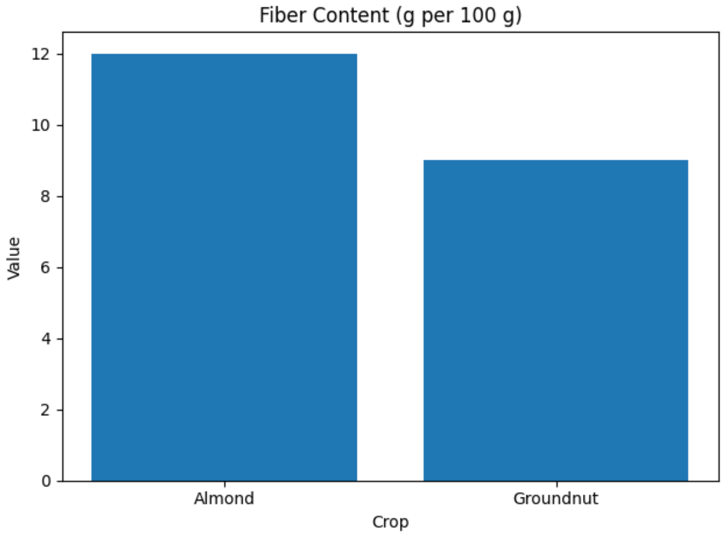

Fig. 3. Dietary Fiber Content of Almond and Groundnut (g per 100 g)

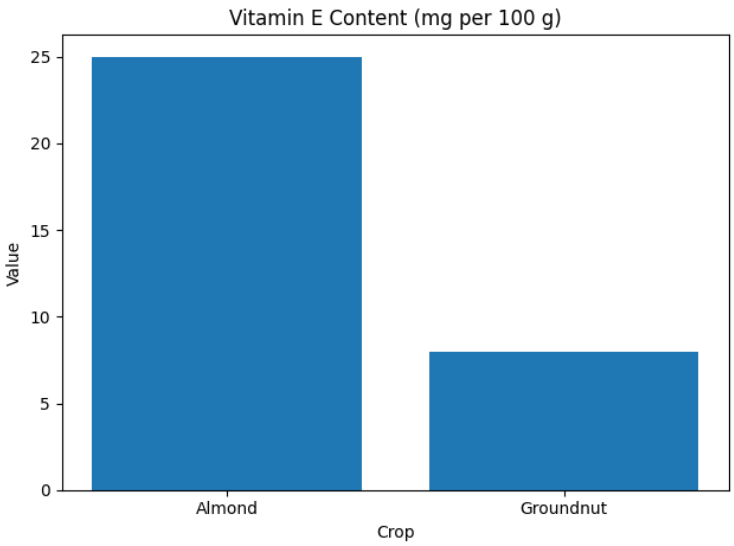

Fig. 4. Vitamin E Content of Almond and Groundnut (mg per 100 g)

Fig. 2 illustrates the comparison of protein content between almonds and groundnuts. The graph clearly demonstrates the superior protein concentration of groundnuts. The difference in dietary fiber between both crops is presented in Fig. 3. Almonds contain considerably higher fiber content than groundnuts, which enhances satiety and supports gastrointestinal health. Similarly, Fig. 4 presents the vitamin E concentration of both crops. Almonds exhibit substantially higher vitamin E levels than groundnuts, confirming their superior antioxidant potential.

4.2. Global Production and Economic Importance

Global production statistics demonstrate a remarkable difference between almond and groundnut cultivation. As illustrated in Fig. 5, annual groundnut production exceeds 45 million tonnes, whereas global almond production remains below 5 million tonnes. This disparity reflects the adaptability of groundnuts to diverse climatic conditions, shorter cultivation periods, and lower production costs.

In contrast, almond cultivation is geographically concentrated, with California accounting for the majority of global production. Although total production is comparatively lower, almonds possess significantly higher commercial value because of their premium market demand, export potential, and utilization in confectionery products, bakery industries, dairy alternatives, and functional foods.

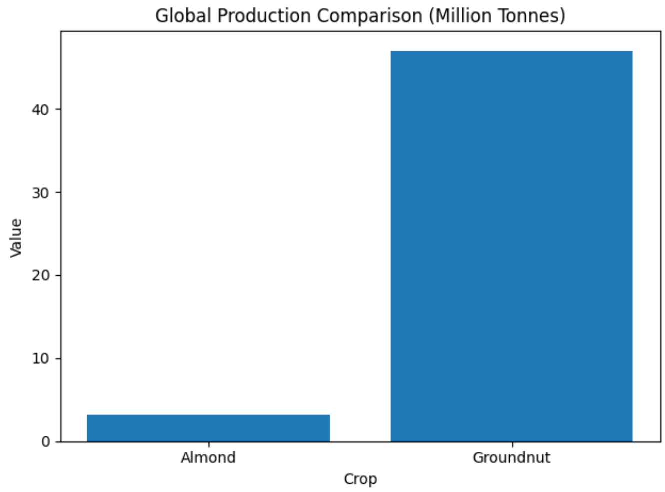

Fig. 5. Global Production Comparison of Almond and Groundnut (Million Tonnes)

4.3. Environmental Sustainability

Environmental sustainability has emerged as a major consideration in modern agricultural systems. Water availability is one of the primary factors influencing crop selection and long-term agricultural productivity.

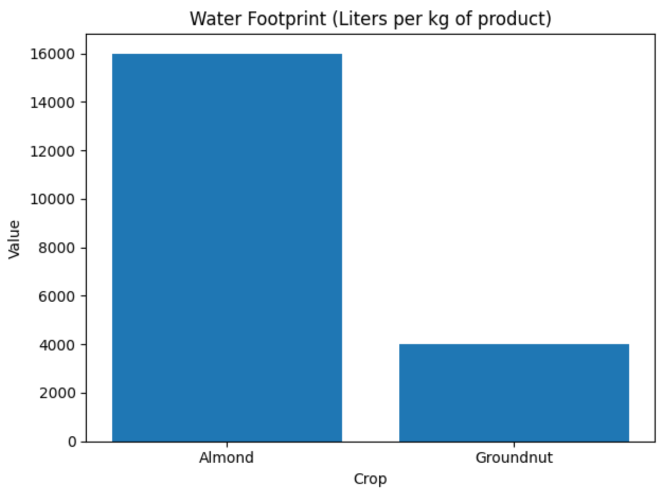

Fig. 6. Water Footprint Comparison of Almond and Groundnut (L kg^{-1})

As shown in Fig. 6, almond cultivation requires approximately 16,000 L of water per kilogram of product, whereas groundnut production requires nearly 4,000 L kg^{-1}, indicating substantially lower irrigation demand. Despite their higher commercial value, almond orchards require intensive irrigation, particularly in semi-arid regions, raising concerns regarding long-term water resource management. Conversely, groundnuts exhibit better environmental adaptability and improve soil fertility through biological nitrogen fixation, thereby reducing dependence on synthetic fertilizers.

4.4. Overall Comparative Assessment

The overall comparison demonstrates that neither almond nor groundnut can be regarded as universally superior because each possesses unique nutritional and agricultural advantages. Almonds exhibit higher concentrations of dietary fiber, vitamin E, calcium, magnesium, and antioxidant phytochemicals, making them particularly suitable for functional foods and preventive nutrition. Groundnuts, however, provide higher protein content, lower production costs, greater cultivation adaptability, and improved environmental sustainability.

Table 1. Comparative Assessment of Almond and Groundnut

Parameter	**Almond *(Prunus dulcis)***	**Groundnut *(Arachis hypogaea)***
Botanical classification	Tree nut	Legume
Protein (g/100 g)	21	25
Dietary fiber (g/100 g)	12	9
Vitamin E (mg/100 g)	25	8
Water footprint (L kg^{-1})	16,000	4,000
Major producing regions	USA, Spain, Australia	China, India, Nigeria, USA
Production volume	Low–Moderate	Very High
Market value	Premium	Moderate
Nitrogen fixation	No	Yes
Environmental sustainability	Moderate	High
Major strength	Micronutrient richness and antioxidant activity	High protein content and sustainable cultivation

Table 1 summarizes the principal differences identified in this review. Almonds provide superior micronutrient density and antioxidant capacity, whereas groundnuts offer higher protein content, broader cultivation potential, and lower environmental impact. Therefore, the selection of either crop should be based on specific nutritional requirements, economic considerations, and regional agricultural conditions. Rather than competing directly, almonds and groundnuts complement one another in supporting global food security, sustainable agriculture, and healthy dietary practices.

5 CONCLUSION

This review presents a comprehensive comparative analysis of almond (*Prunus dulcis*) and groundnut (*Arachis hypogaea*) by examining their nutritional composition, historical development, economic significance, and environmental sustainability. The findings indicate that both crops are valuable sources of plant-based nutrition, although they differ considerably in their functional attributes. Almonds are characterized by higher concentrations of dietary fiber, vitamin E, healthy monounsaturated fats, and antioxidant compounds, making them particularly beneficial for cardiovascular health and functional food applications. In contrast, groundnuts provide higher protein content, lower production costs, and greater adaptability to diverse agro-climatic conditions, making them an affordable and accessible food source for large populations. Furthermore, the environmental assessment revealed that groundnuts require substantially less irrigation water and contribute to soil fertility through biological nitrogen fixation, whereas almond cultivation demands higher water resources despite its greater commercial value. Future research should focus on improving sustainable cultivation practices, enhancing resource-use efficiency, and developing value-added food products that integrate the nutritional strengths of both almonds and groundnuts to support global food security and sustainable agricultural development.

FUNDING INFORMATION
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ETHICS STATEMENT
This study did not involve human or animal subjects and, therefore, did not require ethical approval.

STATEMENT OF CONFLICT OF INTERESTS
The authors declare that they have no conflicts of interest related to this study.

LICENSING

REFERENCES

[1] E. Ros, "Health benefits of nut consumption," *Nutrients*, vol. 2, no. 7, pp. 652–682, Jun. 2010, doi: 10.3390/nu2070652.

[2] J. C. King, J. Blumberg, L. Ingwersen, M. Jenab, and K. L. Tucker, "Tree nuts and peanuts as components of a healthy diet," *Journal of Nutrition*, vol. 138, no. 9, pp. 1736S-1740S, Sep. 2008, doi: 10.1093/jn/138.9.1736s.

[3] M. M. Mekonnen and A. Y. Hoekstra, "The green, blue and grey water footprint of crops and derived crop products," *Hydrology and Earth System Sciences*, vol. 15, no. 5, pp. 1577–1600, May 2011, doi: 10.5194/hess-15-1577-2011.

[4] S. S. Arya, A. R. Salve, and S. Chauhan, "Peanuts as functional food: a review," *Journal of Food Science and Technology*, vol. 53, no. 1, pp. 31–41, Sep. 2015, doi: 10.1007/s13197-015-2007-9.

[5] R. De Souza, R. Schincaglia, G. Pimentel, and J. Mota, "Nuts and Human Health Outcomes: A Systematic review," *Nutrients*, vol. 9, no. 12, p. 1311, Dec. 2017, doi: 10.3390/nu9121311.

[6] D. Maestri, "Groundnut and tree nuts: a comprehensive review on their lipid components, phytochemicals, and nutraceutical properties," *Critical Reviews in Food Science and Nutrition*, vol. 64, no. 21, pp. 7426–7450, Mar. 2023, doi: 10.1080/10408398.2023.2185202.

[7] C. J. Nikodijevic, Y. C. Probst, S.-Y. Tan, and E. P. Neale, "The Metabolizable Energy and Lipid Bioaccessibility of Tree Nuts and Peanuts: A Systematic Review with Narrative Synthesis of Human and In Vitro Studies," *Advances in Nutrition*, vol. 14, no. 4, pp. 796–818, Mar. 2023, doi: 10.1016/j.advnut.2023.03.006.

[8] L. Houston, Y. C. Probst, M. C. Singh, and E. P. Neale, "Tree nut and Peanut Consumption and Risk of Cardiovascular Disease: A Systematic Review and Meta-Analysis of Randomized Controlled Trials," *Advances in Nutrition*, vol. 14, no. 5, pp. 1029–1049, May 2023, doi: 10.1016/j.advnut.2023.05.004.

[9] L. H. Allen, "Priority areas for research on the intake, composition, and health effects of tree nuts and peanuts1," *Journal of Nutrition*, vol. 138, no. 9, pp. 1763S-1765S, Sep. 2008, doi: 10.1093/jn/138.9.1763s.

[10] M. M. Mekonnen and A. Y. Hoekstra, "The green, blue and grey water footprint of crops and derived crop products," *Hydrology and Earth System Sciences*, vol. 15, no. 5, pp. 1577–1600, May 2011, doi: 10.5194/hess-15-1577-2011.

[11] J. Sabaté and Y. Ang, "Nuts and health outcomes: new epidemiologic evidence," *American Journal of Clinical Nutrition*, vol. 89, no. 5, pp. 1643S-1648S, Mar. 2009, doi: 10.3945/ajcn.2009.26736q.

[12] B. W. Bolling, "Almond polyphenols: Methods of analysis, contribution to food quality, and health promotion," *Comprehensive Reviews in Food Science and Food Safety*, vol. 16, no. 3, pp. 346–368, Mar. 2017, doi: 10.1111/1541-4337.12260.

[13] O. T. Toomer, "Nutritional chemistry of the peanut (Arachis hypogaea)," *Critical Reviews in Food Science and Nutrition*, vol. 58, no. 17, pp. 3042–3053, Jun. 2017, doi: 10.1080/10408398.2017.1339015.

[14] C. Alasalvar and B. W. Bolling, "Review of nut phytochemicals, fat-soluble bioactives, antioxidant components and health effects," *British Journal of Nutrition*, vol. 113, no. S2, pp. S68–S78, Apr. 2015, doi: 10.1017/s0007114514003729.

[15] D. Martini *et al.*, "Nut and legume consumption and human health: an umbrella review of observational studies," *International Journal of Food Sciences and Nutrition*, vol. 72, no. 7, pp. 871–878, Feb. 2021, doi: 10.1080/09637486.2021.1880554.