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Nutritional Profile and Health Benefits of Plant-Based Milk, A Comprehensive Systematic Review

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Abstract: ***The demand for plant-based milk substitutes as alternatives to traditional dairy milk has grown dramatically as a result of the global trend toward plant-based diets. In order to evaluate the significance of plant-based milk alternatives in human nutrition and health, this systematic review examines the nutritional profile and health advantages of soy, almond, oat, coconut, rice, and other cutting-edge substitutes. The nutritional profiles of various plant-based milk varieties vary significantly, according to a comparative investigation. The most nutritionally similar to cow's milk is soy milk, which has a high protein content and vital amino acids. Unless fortified, almond milk is low in calories and lipids but deficient in calcium and protein. Oat milk has a lot of dietary fiber, especially beta-glucans, which lower cholesterol and promote cardiovascular health. Although coconut milk is lower in protein and other vital nutrients, it does include medium-chain triglycerides (MCTs), which are necessary for energy metabolism. Although it is hypoallergenic and appropriate for sensitive people, rice milk is often high in carbohydrates and low in protein. Plant-based milk has substantial health benefits for certain groups, such as people with lactose intolerance, dairy allergy, and people looking to control their weight or lower their cholesterol. The dietary inadequacies frequently linked to avoiding dairy milk are addressed by fortified plant-based milks, especially for calcium, vitamin D, and vitamin B12. Frequent intake of fortified variations has been demonstrated to benefit weight management, cardiovascular health, and bone health. Additionally, some types, such as oat milk, have prebiotic properties that promote gastrointestinal health. Due to ethical concerns and alleged health benefits, vegan milk has become a well-liked substitute for dairy milk. The nutritional benefits, potential risks, and health implications of consuming vegan milk are examined in this essay. This paper shows the benefits of popular vegan milk substitutes like almond, soy, oat, and coconut milk for cardiovascular health, lowering the risk of allergies, and helping people who are lactose intolerant by reviewing research on these options. There is also discussion on how to incorporate vegan milk into a well-rounded diet. To sum up, plant-based milk is a viable substitute for dairy milk that offers a number of health advantages and supports sustainable food systems. For groups at risk of vitamin shortages in particular, fortification is still essential to improving nutritional value. To satisfy a range of customer demands, further research is required to improve formulations, assess long-term health impacts, and increase the selection of plant-based milk sources.***

Keywords: Plant-Based Milk, Nutritional Composition, Health Benefits, Fortification, Dairy Alternatives, Sustainability

1. Introduction

The consumption of plant-based milk alternatives has gained significant popularity worldwide due to health concerns, environmental sustainability, lactose intolerance, and ethical considerations. With the decline in traditional dairy consumption, plant-based milk—such as soy, almond, oat, coconut, rice, and pea milk—has emerged as an alternative source of nutrition. This systematic review focuses on evaluating the nutritional composition of various plant-based milk types and their associated health benefits.

Non-dairy or plant-based substitutes are made to resemble the texture and characteristics of dairy products, which include cheese, yogurt, ice cream, butter, and most often, milk. Although soymilk and rice milk are examples of liquid dairy substitutes that have historically been referred to as milks, there has been a recent legal dispute over the use of these terms, with some industry participants urging the Food and Drug Administration to limit the use of the term "milk" to liquid secreted from animals (Ramsing et al, 2023).

Dietary habits that enhance a person's health and well-being, are affordable, accessible, equitable, and culturally acceptable, have a little negative impact on the environment, and aid in the preservation of biodiversity and planetary health are known as sustainable healthy diets (WHO 2019).

Furthermore, it is possible to generate plant-based milks with dietary fiber, which adds nutritional advantages not present in dairy milk. However, modern plant-based milks are often lower in protein (with the exception of soy, which is comparable to dairy milk), and they are frequently fortified with minerals like calcium and vitamin B12 to enhance their nutritional value (Makinen et al,.2016).

Plant-based milk substitutes are becoming more and more popular, particularly among vegans. Additionally, economically disadvantaged communities in developing nations and those residing in areas with inadequate cow's milk supplies may find that plant-based milk products offer a cost-effective substitute (Shetty et al, 2011).

In 2020, the volume of sales of plant-based milk rose by 20%, and its yearly revenue growth was double that of dairy milk. An anticipated 40% of households bought plant-based milks in 2020, and they currently account for 15% of retail milk sales (Gaan et al, 2020).

The process of boiling and sifting plant materials yields vegetable milks, which we can categorize into five mains, these include cereal-based lattes (oat, rice, etc.), milks manufactured from pseudo-cereals (quinoa, amaranth, etc.), legumes (soy, nut, etc.), nuts (almond, coco, hazelnut, pistachio, etc.), seeds (sesame, linen, hemp, etc.), and vegetables (almond, coco, hazelnut, etc.). The initial ingredient utilized determines the nutritional composition of each type of milk. Omega 3 and omega 6 polyunsaturated fatty acids and high protein content are two things that quinoa milk is well-known for.

Hemp grain milk has a lot of monounsaturated fatty acids, whereas almond milk has more fiber, vitamins, minerals, antioxidants, and phytoestrogens (Silva et al., 2020).

Plant milk is prized for its functionally active ingredients, which are often associated with traits that promote health and prevent disease. When compared to animal milk, plant-based milk uses less energy per unit of production. However, the difficult production technology and poor sensory profile of plant-based milk—which are crucial for beverages made from legumes—are the main factors restricting their acceptability (Paul et al., 2020).

Similar to legume-based milk substitutes, their sensory acceptability may be a key barrier to their broad appeal. Ultra-high temperature treatment, ultra-high pressure homogenization, and pulsed electric field processing are examples of new and sophisticated non-thermal processing technologies being used to address problems with the final product's increased shelf life, emulsion stability, nutritional completeness, and sensory acceptability. More work is needed in the functional beverage market to create more pleasant and nutritionally sound customized new products These days, technical advancements are being made to improve the acceptability and quality of plant-based milk. To achieve widespread customer acceptance, a few bottlenecks must be addressed, including enhancing product stability, eliminating off flavors, inactivating or removing inhibitors, and extending shelf life (Sethi et al., 2016).

Particularly for people with dietary limitations, lactose intolerance, and ethical preferences, plant-based milk substitutes offer significant nutritional and health advantages. To make up for nutritional deficiencies, fortification is essential, especially in protein, calcium, and vitamin B12.

Nutrition Composition

Table 1: Overview of nutritional composition of plant- based milk alternatives (per 100ml)

Nutrition	Soya milk	Almond milk	Coconut milk	Oat milk	Rice milk
Energy (kcals)	42	60	25	54	54
CHO (g)	3.29	2.5	5.3	10	11.25
Sugar (g)	2.5	2	-	7.9	5.8
Fiber (g)	1	0.9	-	1.9	0
Protein (g)	3.3	0.41	3.2	1.6	0.42
Fat (g)	1.66	1.66	3.3	1	0.82
Vitamins and Minerals	Calcium - 124.5 mg, Vitamin A - 208.7 IU, Vitamin D2 - 49.5 IU	Calcium-188 mg, Vit D2 - 41.6 IU, Vitamin E -	Calcium - 133 mg, Vitamin E	Calcium- 145.8mg Vitamin A -207.9 IU	Calcium 125 mg, high in selenium and magnesium

(Bridges et al,.2018)
(Tulashi et al,.2022)

Health benefits –
The nutritional makeup of vegan milk choices varies greatly, providing versatility to accommodate various dietary requirements. For example, soy milk has the same amount of essential amino acids as dairy milk and is high in protein (Wang & Murphy, 1994). Vitamin E, an antioxidant that promotes skin health and immunological function, is abundant in almond milk and low in calories (Redan et al.,2023). While coconut milk offers medium-chain triglycerides (MCTs) that may improve energy metabolism (Dayrit, 2014), oat milk is a good source of beta-glucans, soluble fibers that are known to lower cholesterol levels (Wolever et al., 2010).

Cardiovascular Health
Health of the Heart According to studies, plant-based milks help strengthen the heart, especially if they are fortified with calcium and vitamin D. Almond and soy milk's lack of cholesterol and unsaturated fats can lower LDL cholesterol levels and enhance cardiovascular health (Singhal et al., 2017).

Lactose Intolerance and Dairy Allergies
Dairy allergies and lactose intolerance for those who are allergic to cow's milk proteins or lactose intolerance, vegan milk is a good substitute. Because of their high nutritional density and hypoallergenic qualities, soy and oat milk are particularly advised (Vanga & Raghavan, 2018)

Weight Control
Controlling Weight Almond milk is a low-calorie choice that offers vital nutrients and can help with weight management. The MCTs in coconut milk are quickly digested and may help people feel fuller, which lowers their total caloric intake (Dayrit, 2014).

Bone Health
Bone Well-Being in order to preserve bone density, fortified vegan milks offer vital minerals including calcium, vitamin D, and phosphorus. Those with dietary limitations or dairy product sensitivities can especially benefit from this (Jacobs et al., 2009)

2. Conclusion

Vegan milk provides a wholesome and adaptable substitute for dairy milk, meeting a range of dietary requirements and health requirements. Although there are advantages to each variety of vegan milk, consumers should select products that suit their environmental ideals and dietary needs. Their contribution to a healthy diet will be further enhanced by ongoing research and innovation in the creation of fortified and environmentally friendly vegan milks.

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