Comparative Nutrient Profiles and Functional Activities of Animal- and Plant-Based Milks and Their Roles in the Prevention of Metabolic Syndrome: A Literature Review

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Abstract: Milk contains various bioactive components that required to maintain normal human physiological activities. Both animal and plant-based milks have benefits that can be used to minimize the risk of noncommunicable diseases (NCDs). This review aims to compare the nutritional profiles of animal and plant-based milks and highlight their involvement in reducing the risk of NCDs. A literature review used papers from 2014 to 202, with PubMed and ScienceDirect as key databases. The study found that soy milk includes aglycone isoflavones, which have been demonstrated to inhibit inflammatory pathways in human intestinal cells. On the other hand, animal milk is high in proteins, bioactive peptides, and milk fat globule membrane (MFGM) components, all of which help with brain function, immunological health, and metabolic balance. It is concluded that appropriate animal and plant-based milk consumption may help avoid degenerative diseases and promote overall health by controlling inflammation, increasing antioxidant capacity, and improving energy metabolism. When deciding between animal and plant-based milks, evaluating their nutritional profiles and bioactive components is best to maximise possible health advantages.

1 INTRODUCTION

Noncommunicable diseases (NCDs) have arisen as a major global health issue, gaining global concern. These diseases today account for about 74% of all deaths worldwide, and their prevalence is increasing year after year. Unfortunately, an estimated 17 million people die each year from noncommunicable diseases before they reach the age of 70 (Afianti & Indrawati, 2015). Consumption of functional foods is an important strategy for reducing the rising burden of noncommunicable diseases. Functional foods contain bioactive substances that promote growth and development, improve general health, and lower disease risk. Milk is one of the best-known functional foods (Suciati & Safitri, 2021).

Healthcare professionals in the US commonly refer to milk as a "naturally perfect food" or as a "complementary food" (Khanpit et al., 2024). One special biological fluid that is essential to human growth and health is milk. Magnesium, iron, zinc, calcium, sodium, potassium, phosphorus, and other minerals are among them (Amr & Farid, 2024). Milk is widely split into two kinds considering resource contents. These two types include animal-based and plant-based. Cows and buffaloes along with goats as well as sheep stand as examples for ruminants. Animal milk also mainly comes from those sources (Khanpit et al., 2024). Plant milk however comes from oil-producing plants as well as seeds, pseudocereals, cereals, legumes, even from potatoes (Mondragon Portocarrero et al., 2024).

Protein is the most important component of milk in terms of nutritional value. Certain animal-based milks have significant levels of casein, which aids in mineral binding, particularly calcium and phosphorus. Casein also produces several bioactive peptides, each with unique health benefits. These bioactive peptides have antioxidant, cytomodulatory, immunomodulatory, antihypertensive, and antithrombotic characteristics, which help to maintain cardiovascular, neurological, immunological, and digestive system function (Arrichiello et al., 2022). Soy milk, almond milk, and coconut milk represent some popular milks of plant origin. Since plant-based milks possess fatty acids plus high antioxidant activity, they might aid health. Plant-based milks may lower the risk of cardiovascular disease then cancer, atherosclerosis, and diabetes (Aydar et al., 2020). Animal-based milks tend to have a lower antioxidant content than do plant-based milks. Cholesterol levels can be decreased and also vitamin E levels can be improved by the plant-based milks (Froiio et al., 2020).

This literature study aimed to identify and compare the nutrient composition and functional activities of animal- and plant-based milks and investigate their roles in noncommunicable disease risk. It also intends to investigate the nutrient content and bioactive chemicals in animal and plant milks.

2 METHOD

Research Type

The methodology used in the article writing is a literature review. The article is written to identify and analyze other relevant research articles. The process of writing this article also includes systematic citation of relevant articles.

Keywords for Article Search

The literature search was done using PubMed and ScienceDirect databases. In order to increase the relevant articles, publication dates had to be in the period of 2014 and 2025. These limitations were found within the articles. Keyword combinations using the Boolean operator "AND" were exploited by the search strategy; for example, from "cow milk" AND "bioactive compounds" resulted 758 articles, while from "plant-based milk" AND "bioactive compounds" resulted 294. Following the screening of research publications, 121 studies were retained. An additional selection was made based on journal accessibility (subscription content), yielding 147-270 items. A subsequent title screening generated 52 publications, which were then further reviewed for relevance to the topic and objectives of this literature review, resulting in the ultimate inclusion of eight research articles. Additional journal articles were reviewed to give supporting evidence for the discussion section.

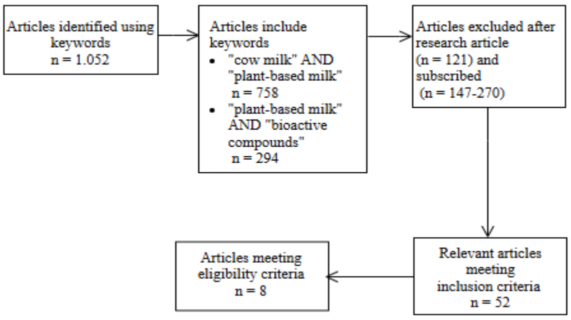

Figure 1: Article Selection Process

3 RESULT

The following section presents the findings from the literature review. This table summarizes the important findings of the chosen research, such as the nutrient makeup, bioactive substances, and functional activities of animal—and plant-based milks and their potential involvement in lowering the risk of noncommunicable illnesses.

Table 1. Summary of Selected Studies on Nutrient Profiles, Bioactive Compounds, and Functional Activities of Animal- and Plant-Based Milks.

No	Judul Artikel	Research Methods	Nutritional Composition/ Bioactive Compounds	Functional Activities
1	Bovine and soybean milk bioactive compounds: Effects on inflamatory response of human intestinal Caco-2 cells (Calvello et al., 2016).	1. A laboratory model employing human intestinal epithelial cells (Caco-2). 2. Cells were activated and inflammation started by lipopolysaccharide (LPS). 3. Before treatment, give isoflavones (genistein, daidzein, and equol), cow's milk, or soy milk. 4. Cell viability was assessed using the MTT assay. 5. Isoflavone concentrations were determined with SPME-HPLC-UV/DAD. Nitric oxide (NO) levels were determined using the Griess reagent. 6. iNOS mRNA expression was examined using RT-PCR, and iNOS and p-IκB-α proteins were assessed using Western blotting.	1. Soy milk has significantly larger quantities of aglycone isoflavones (daidzein 160.7 ± 13.5 µM; genistein 121.8 ± 12.1 µM after deconjugation) than cow's milk (daidzein 0.12 ± 0.05 µM; genistein 0.04 ± 0.01 µM). 2. Equol was not found in either type of milk. 3. Isoflavones in their aglycone form have higher biological activity than their glycoside cousins.	Pre-treatment with isoflavones or milk enhanced Caco-2 cell survival after LPS stimulation while decreasing NO production and lowering both mRNA and protein expression of iNOS in a dose-dependent manner. This pre-treatment also suppressed IκB-α phosphorylation, reducing the activation of NF-κB, a crucial pro-inflammatory transcription factor. These data highlight the potential of isoflavones and milk as anti-inflammatory supplements for treating intestinal inflammatory illnesses.
2	A gas chromatography-mass spectrometry-based metabolomic approach for the	1. Metabolic analysis using gas chromatography-mass spectrometry (GC-MS) was performed	1. Goat milk provides higher levels of lactic acid, valine, glycine, succinate, and ribose compared to cow milk	1. A GC-MS method paired with multivariate analysis may identify goat milk from cow milk based on

	characterization of goat milk compared with cow milk (Scano et al., 2014).	on 31 samples of raw milk and 14 samples of commercial milk. 2. Multivariate analysis (PCA, OPLS-DA, OPLS) improves metabolite profiling and detects changes in urine. The effect of pasteurization (vs. UHT) on metabolite composition is also examined.	and has more variable metabolites. 2. Cow milk has higher glucose, fructose, galactose, malic acid, and other metabolites (U5 and U8). 3. Pasteurized samples contain higher of hydroxyglutarate, while glucose and fructose are more prevalent in UHT samples. 4. Valine (which imparts bitterness) and glycine (which imparts sweetness) contribute to goat milk's flavor profile.	their polar metabolite profiles. 2. An OPLS regression model can detect goat milk adulteration with cow milk with a detection limit of about 5%. 3. According to the metabolite profiles described, goat milk is easier to digest due to its medium-chain fatty acid content, contains the amino acids valine and glycine, which support energy metabolism and tissue repair, and may be more suitable for individuals who are sensitive to cow's milk proteins; in contrast, cow milk contains higher levels of glucose and fructose, serving as a quick energy source.
3	A metabolic profiling approach to characterize and discriminate plant-based beverages and milk (Meoni et al., 2025).	1. A metabolomic study using Proton Nuclear Magnetic Resonance (^{1}H NMR) was conducted on 22 plant-based beverages (soy, almond, coconut, rice, and oat) and eight animal milks (4 UHT cow milks and 4 UHT goat milks). 2. A total of 43 metabolites were detected across all samples; the Mann-Whitney U test, PCA, and PLS-DA were used to distinguish between the groups.	1. Plant-based drinks (PBB) provide important amino acids such as leucine, phenylalanine, tryptophan, 4-aminobutyrate (GABA), asparagine, and aspartate, as well as disaccharide carbohydrates like maltose and sucrose. 2. Cow and goat milk are high in metabolites involved in energy production and membrane formation, such as 2-oxoglutarate, carnitine, glycerophosphocholine, O-acetylcarnitine, succinate, lactose, UDP-galactose, and UDP-glucose. 3. Plant-based beverages rely on choline and guanosine, whereas cow and goat milk rely on adenosine, uridine, valine, and histidine.	1. Using metabolite profiles, plant-based beverages and animal-based milks were identified and verified using proton nuclear magnetic resonance (^{1}H NMR) spectroscopy. 2. Essential amino acids (leucine, phenylalanine, and tryptophan) required for protein synthesis, neurotransmitter function (e.g., GABA), and metabolic health in the human body are found in plant-based beverages. 3. Cows' and goat's milk contain energy-related metabolites (2-oxoglutarate, phosphocreatine + creatine) and lipid metabolism chemicals (carnitine, glycerophosphocholine) that help with cellular energy function, fatty acid transport, and membrane stability. 4. These findings are helpful for quality control and product selection based on nutritional demands, such as for consumers who are lactose intolerant or prefer plant-derived proteins.

4	Differences in proteomic profiles of milk fat globule membrane in yak and cow milk (Ji et al., 2017).	1. This study used a quantitative proteomic technique known as isobaric tags for relative and absolute quantification (iTRAQ) to examine MFGM proteins in yak and cow milk. 2. The MFGM proteins were identified and studied using SDS-PAGE and iTRAQ-LC-MS/MS. 3. Data analysis was carried out with Mascot and Proteome Discoverer 1.3 software.	1. Cow milk has a lower total fat percentage than yak milk, at 3.8%. However, the retrieved MFGM from cow milk was higher, at 2.8%. 2. Cow MFGM contained less protein and sugar than yak MFGM, but more fat. 3. The MFGM of yak and cow milk included over 450 proteins. 4. Cathelicidin-1 belongs to a family of mammalian host defense peptides that perform various host defense functions, including antibacterial activity against pathogens. Although different forms of cathelicidin were detected in both milk types, cathelicidin-1 was more abundant in cow milk. 5. Glycosylation-dependent cell adhesion molecule 1 (GlyCAM1), CD59, and lactadherin were discovered to be much more abundant in yak MFGM (4.6-10.1 times greater).	1. High-abundance proteins in yak MFGM, including GlyCAM1, CD59, and lactadherin, may have biological activities such as antibacterial and anticancer activity. 2. PIGR (Polymeric Immunoglobulin Receptor) mediates the transcellular trafficking of immunoglobulin (Ig) molecules, such as IgA. This protein is essential for immunological protection and has been found in cow milk. 3. Protein S100-A8, abundant in cow MFGM, regulates the innate immune response.
5	In vitro digestion effect on mineral bioaccessibility and antioxidant bioactive compounds of plant-based beverages (Silva et al., 2020)	1. Various plant-based beverages, including rice, cashew, almond, peanut, coconut, oat, and soy (with or without mineral fortification), were tested alongside milk as a comparison. 2. Essential mineral contents (Ca, Mg, Fe, and Zn) were measured by Flame Atomic Absorption Spectrometry (FAAS). 3. Bioactive compounds were assessed using the Folin-Ciocalteu technique for total phenolic content and the DPPH assay for antioxidant activity. 4. HPLC was used to quantify antinutritional substances, including	1. Mineral content varied greatly between products: calcium ranged from 10 to 1697 mg/L (highest in fortified coconut beverage), magnesium from 6.29 to 268 mg/L (highest in cashew beverage), iron from 0.76 to 12.89 mg/L (highest in rice beverage), and zinc from 0.57 to 8.13 mg/L (highest in oat and soy beverages). 2. The total phenolic content ranged from 0.2 to 12.4 mg GAEq/L (lowest in coconut and highest in rice). 3. Antioxidant capacity varied from 3.1 to 306.5 µmol TE/L, with oat and peanut-based products showing the most significant levels. 4. Only a tiny percentage of samples contained myo-	1. Mineral bioaccessibility following in vitro digestion varied significantly: calcium ranged from 8.2 to 306.6 mg/L and magnesium from 1.9 to 107.4 mg/L in the dialysate fraction, whereas iron and zinc were lower (about 1.0 and 0.5 mg/L). 2. Phenolic compounds with antioxidant capability have shown promise as natural antioxidants for the human body. 3. The combined profile of minerals, phenolics, and antioxidant capacity suggests that plant-based beverages may benefit bone health (by calcium and magnesium), immunological function (via zinc), oxygen metabolism (via iron), and oxidative stress resistance.

		myo-inositol phosphate fractions IP5 and IP6. An in vitro digestion test was used to determine mineral bioaccessibility. 5. Multivariate statistical analysis was used to compare the products across all parameters.	inositol phosphate fractions IP5 and IP6, with the highest quantities found in cashew-based beverages.	
6	Lipidomics of coconut, almond, and soybean milks – Detailed analysis of polar lipids and comparison with bovine milk (Blasi et al., 2025).	1. Three organic plant-based beverage samples (almond, coconut, and soy) and semi-skimmed cow's milk were obtained from a local store. 2. Lipids were extracted by the Methanol-MTBE-Chloroform (MMC) technique. 3. Polar lipid analysis was done using Liquid Chromatography Quadrupole Time-of-Flight Mass Spectrometry (LC-MS QTOF). 4. Data were analyzed using MS-DIAL and LipidOne software, and sample discrimination was performed using Principal Component Analysis (PCA) and heatmap visualization.	**Plant-based beverages:** 1. Almond beverage is mainly composed of phosphatidylcholine (PC), phosphatidylethanolamine (PE), phosphatidylinositol (PI), and phosphatidic acid (PA), with trace levels of hexosylceramides. 2. Coconut beverage contains PC and PE with fatty acyl chains C12:0, C14:0, C16:0, C18:0, C18:1, and C18:2, as well as the ether forms of phosphatidylglycerol (PG) and PE. 3. Soy beverages are strong in glycerophospholipids (PC, PE, PG, PA, PI, phosphatidylserine/PS, and lysophospholipids), ceramides, and HexCer. They also include significant levels of α-linolenic acid. **Bovine Milk:** 1. Bovine milk has a complex lipid subclass composition, including glycerophospholipids (PC, PE, PI) and larger quantities of sphingolipids (sphingomyelin/SM) than plant-based beverages. 2. Ceramides and sphingomyelin play important roles in intestinal mucosal defense, neuronal myelination, and cell membrane formation.	Useful Advantages of Plant-Based Drinks: 1. By lowering cholesterol, decreasing inflammation, and improving insulin sensitivity, polyunsaturated fatty acids—particularly linoleic and α-linolenic acids—can improve cardiovascular health. 2. Cell membrane integrity, lipid metabolism, and cognitive function are all enhanced by phospholipids (PC and PE). 3. People who are lactose intolerant, vegetarians, or vegans can enjoy these drinks. The functional characteristics of cow's milk 1. The protection of the gut mucosa, cell membrane integrity, and nervous system health are all supported by higher sphingomyelin levels. 2. Milk proteins and phospholipids enhance gut flora, child development, and immune system performance.
7	Phytochemical profiling of Thai plant-based milk alternatives: insights	1. Oats, yellow corn, tamarind seeds, jackfruit seeds, and germinated red rice	1. Tamarind seed milk had the highest total phenolics and flavonoids (TPC = 2488 µg	Benefits of Plant-Based Drinks for Function: 1. The high levels of TPC, TFC, DPPH, and FRAP in

	into bioactive compounds, antioxidant activities, prebiotics, and amino acid abundance (Taesuk et al., 2025).	were used to make six plant-based beverages using a standard process (soaking, grinding, filtering, and boiling at 80°C for five minutes). 2. Color and pH were examined using a CR-400 Chroma Meter. 3. The antioxidant capacity (DPPH and FRAP assays), total flavonoids ($AlCl_3$ technique), and total phenolic content (Folin-Ciocalteu) of bioactive substances were examined.Amino acid profiles were evaluated using LC-MS/MS. 4. Prebiotic characterisation involved measuring β-glucan concentration with a Megazyme kit and quantifying oligosaccharides (raffinose, stachyose, verbascose) using HPAE-PAD.	GAE/mL, TFC ≈ 8037 µg QE/mL). 2. Tamarind seed milk demonstrated the best antioxidant capability in DPPH (about 9270 µg VCE/mL) and FRAP (approximately 24,954 µg $FeSO_4$/mL) tests. 3. Oat milk exhibited the highest total, essential, and non-essential amino acids. At the same time, jackfruit seed and yellow corn beverages had similar amino acid profiles, with arginine being the major amino acid (168-368 µg/g). 4. Oat milk has the highest prebiotic β-glucan content (180 mg/100 mL), followed by germinated red rice (3 mg/100 mL) and jackfruit seed milk (2 mg/100 mL). 5. Oligosaccharides: The highest amounts of raffinose (0.60%), stachyose (0.98%), and verbascose are found in tamarind seed milk. Compared to ungerminated red rice, germinated red rice contains more raffinose.	tamarind seed milk suggest a potent antioxidant capacity that guards against oxidative stress. 2. Prebiotics, such as oligosaccharides from tamarind, jackfruit, and germinated red rice, and β-glucan from oats, can enhance digestion and gut flora. 3. Protein synthesis, immunological function, cell regeneration, and metabolic health are all supported by the amino acid profile (arginine and BCAAs).Using jackfruit seeds and tamarind enhances sustainability while reducing food waste.
8	Lipid composition and its molecular classes of milk fat globule membranes derived from yak, buffalo, and Holstein cow milk were characterized based on UHPLC-MS/MS and untargeted-lipidomics (Fan et al., 2025).	1. Yak, buffalo, and Holstein cow milk samples were acquired. 2. From every kind of milk, milk fat globule membranes (MFGM) were separated. 3. Untargeted lipidomics and ultra-high-performance liquid chromatography-tandem mass spectrometry (UHPLC-MS/MS) were used to ascertain the composition of polar lipids. 4. To identify lipid compounds and compare their profiles across species,	1. More than 400 polar lipid species have been discovered in the MFGM of all three types of milk. 2. The main subclasses were phosphatidylcholine (PC), phosphatidylethanolamine (PE), phosphatidylinositol (PI), phosphatidylserine (PS), sphingomyelin (SM), ceramides, and glycosphingolipids. 3. PC, PE, and PS are the most prevalent subclasses of polar lipids found in yak milk, which has a higher total polar lipid content than that of buffalo and Holstein cow milk. 4. Sphingomyelin and certain ceramides were	1. MFGM profiles can be used as markers for milk traceability and authentication, and they differ among species. 2. Ceramides and sphingomyelin are crucial for intestinal mucosa protection, nerve myelination, and brain development. 3. Phospholipids, such as phosphatidylcholine (PC), phosphatidylethanolamine (PE), and phosphatidylserine (PS), maintain the integrity of cell membranes, regulate lipid metabolism, and enhance cardiovascular health. 4. Yak milk's high phospholipid content

		lipidomics software was used to analyze the data.	especially abundant in buffalo milk. 5. Holstein cow milk had a lower level of total polar lipids but a better-balanced composition than yak milk.	supports nervous system development and cell membrane health; buffalo milk's high sphingomyelin content supports brain function and immunity; and Holstein cow milk is a good source of phospholipids and sphingolipids.

4 DISCUSSION

Bovine milk, particularly cow's milk, is abundant in protein and has a well-balanced composition of essential amino acids, calcium, phosphorus, vitamin B12, and bioactive components such as lactoferrin and immunoglobulin. Lactoferrin, for example, is an iron-binding glycoprotein that boosts innate immunity while also having antioxidant and anti-inflammatory characteristics (Chen et al., 2025). Lactoferrin complexation with polyphenols has been demonstrated to enhance the bioavailability of polyphenols and bolster their antioxidant and anti-inflammatory properties, which is a crucial mechanism for reducing the chronic inflammation and oxidative stress that lead to metabolic syndrome (Li et al., 2021, cited in Chen et al., 2025). Therefore, in addition to providing macronutrients and micronutrients, bovine milk also contains useful molecules that may help prevent metabolic diseases through immunomodulatory pathways and the reduction of oxidative stress.

On the other hand, plant-based milks made from rice, almonds, soy, oats, or other legumes and nuts are naturally cholesterol-free and contain less saturated fat. These beverages contain bioactive ingredients such as isoflavones, phytosterols, saponins, β-glucans, polyphenols, and unsaturated fatty acids that have anti-inflammatory, immunomodulatory, and antioxidant properties (Marafon et al., 2025). Genistein and daidzein, two soy isoflavones, improve lipid profiles and lower LDL cholesterol. β-glucans, found in the polysaccharides of rice and oats, help control type 2 diabetes and weight as part of the metabolic syndrome by regulating glycemia and enhancing satiety (Marafon et al., 2025; Sarangapany et al., 2022). Furthermore, unsaturated fatty acids and vitamin E in oilseeds like almonds promote cardiovascular health (Marafon et al., 2025).

Calvello et al (2016) Found that cow's milk and soy milk contain bioactive substances such as isoflavones (genistein, daidzein, and equol), which help to inhibit inflammatory responses in human intestinal cells (Caco-2). The study demonstrated that both types of milk can reduce iNOS expression and NO generation in a dose-dependent manner, while simultaneously suppressing NF-κB activation. This method demonstrates the ability of both animal- and plant-based milks to modify mucosal immune responses in the gut and contribute to the prevention of chronic inflammatory processes, which are major risk factors for noncommunicable illnesses.

Scano et al (2014) Used GC-MS to conduct an in-depth study of the polar metabolite profiles of goat milk versus cow milk. Valine and glycine were determined to be unique to goat milk, whereas talose and malic acid were detected in cow milk. Hydroxyglutaric acid was also found in pasteurized milk samples. This study shows that variations in metabolite profiles are influenced by both milk species and thermal treatment (UHT/pasteurization). These findings are important in understanding the variations in nutraceutical potential between goat and cow milk, especially for those who are allergic to cow milk protein.

Research shows that changing from low-fat cow's milk to plant-based alternatives, such as oat or soy milk, for four weeks can lower plasma cholesterol and LDL levels ((Sarangapany et al., 2022). Phytosterols and saponins lower cholesterol, whilst polyphenols and isoflavones reduce systemic inflammation and oxidative stress, both of which play essential roles in the development of metabolic syndrome (Aydar et al., 2020). This strategy is consistent with data indicating that a plant-based diet lowers the risk of cardiovascular disease, type 2 diabetes, and obesity, all of which are important components of metabolic syndrome. Furthermore, β-glucans and other soluble fibers form gels in the colon that delay glucose absorption and improve glycemic profiles. (Marafon et al., 2025).

Meoni et al (2025) NMR spectroscopy was used to identify essential molecules that separate animal milks (cow and goat) from plant-based beverages made from soy, almond, coconut, rice, and oat. UDP-glucose and adenosine were used to identify cow and goat milk, whereas choline and guanosine distinguished the plant-based group. These findings lay the groundwork for the authenticity and nutritional assessment of plant-based products, which are gaining popularity as alternatives to animal milk. Despite this, plant-based milk has more protein and calcium than animal-based milk, and antinutrients such as fitat can limit mineral bioavailability. As a result, processes such as extraction, fermentation, and enzyme or vitamin-mineral fortification are frequently used to improve the quality of nutrition and plant-based milk (Aydar et al., 2020; Sarangapany et al., 2022)Technological innovations such as ultrasonography have also been shown to improve the physical and microbial stability and functional capacity of plant-based milk without increasing additives.

Silva et al (2020) Evaluated the effects of in vitro digestion on the bioavailability of minerals (Ca, Mg, Fe, Zn) and antioxidant bioactive compounds in various plant-based beverages, including rice, cashew, almond, peanut, coconut, oat, and soy. While the antioxidant capacity varied greatly (3.1-306.5 μmol TE/L), the total phenolic content varied from 0.2 mg GAEq/L (coconut) to 12.4 mg GAEq/L (rice). Furthermore, myo-inositol phosphate fractions (IP5, IP6), which functioned as antinutritional agents, were present in a number of samples. The need for proper formulation or fortification of plant-based beverages to more closely resemble the mineral profile of animal milk is highlighted by the notable heterogeneity in mineral content and bioaccessibility

5 CONCLUSIONS

Both plant-based beverages (soy, almond, coconut, oat, rice, and others) and animal milks (cow, goat, buffalo, yak, and Holstein cow) have unique nutrient profiles and bioactive components, and each one displays a unique mechanism of functional activity, according to an analysis of eight studies.

Aglycone isoflavones, like genistein and daidzein, found in soy milk, for instance, have been demonstrated to inhibit inflammatory pathways in human intestinal cells (Calvello et al., 2016). Animal milks, on the other hand, are higher in polar lipids, milk proteins, bioactive peptides, and components of the milk fat globule membrane (MFGM), all of which support metabolism, immunological response, and brain function (Scano et al., 2014; Meoni et al., 2025). The differences in metabolite profiles between goat and cow milk and organic and conventional milk demonstrate the impact of source and production system on bioactive content and nutritional quality. Other plant-based beverages contain high levels of phenolics, flavonoids, prebiotics, and polar lipids, indicating strong antioxidant potential and the ability to regulate gut microbiota, both of which are important for noncommunicable disease prevention (Silva et al., 2020; Phytochemical Profiling, 2025). Through complementary processes like inflammation control, antioxidant capacity enhancement, bone and nervous system health support, and energy metabolism, appropriately and scientifically supported consumption of animal and plant-based milks can help preserve health and prevent degenerative diseases. To maximize long-term health benefits and lower the risk of noncommunicable diseases, pick a particular kind of milk or plant-based beverage based on its nutritional profile and bioactive ingredients.

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