

# Plant Based Milk - An Alternative to Nutritional Security

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Back in 1950s it was common to drink entire glass of cow's milk as a beverage. With increasing cost of milk, availability issues, short shelf life making it necessary to have an alternative to animal based milk. Now a day, plant based or non-diary milk is available as a better alternative to address the animal based milk availability issue. As an alternative beverage, plant-based milk prepared from sources like soy, oat, hemp, coconut, rice, and nuts, are available in the market. These non-dairy milk alternatives (or milk analogues) are water extracts of plants and have become increasingly popular for human nutrition. Over the years, the global market for these products has become a multi-billion dollar business and will reach a value of approximately 26 billion USD within the next 5 years. Moreover, many consumers demand plant-based milk alternatives for health-related, lifestyle, sustainability and dietary reasons resulting in an abundance of products based on nuts, seeds or beans.

## Market scenario of plant based milk products

Plant based milk market size was valued at 35.0 billion USD in 2021 and is poised to grow from 40.3 billion USD in 2022 to 123.1 billion USD by 2030. The plant-based milk alternative market was valued at over 17.0 billion USD in 2018 and is projected to grow at a Compound annual growth rate (CAGR) of 11.5% for 2023 (Markets and Markets, 2019). The estimated plant based dairy market size across India in a high growth scenario was likely to be over 106.0 billion INR in 2030. In comparison, for a low growth scenario of plant based dairy, the market size was over 48.0 billion INR. Plant-based milk market exist in different countries viz. U.S.A., Canada, Mexico, Germany, U.K., Italy, France, Spain, Russia, Switzerland, Turkey, Belgium, rest of Europe, China, Japan, South Korea, India, Singapore, Thailand, Indonesia, Malaysia, Philippines, Australia, rest of Asia-Pacific, Brazil,

Argentina, and the Rest of South America, South Africa, Saudi Arabia, United Arab Emirates, Kuwait, and rest of Middle East and Africa. However, Asia-Pacific is dominating the global plant-based milk market due to the increasing consumption of plant-based milk and the market players' promotional activities boosting the demand for plant-based milk products (Data Bridge Market Research, 2023).

## High cost of dairy products

Dairy farming is an integral part of agriculture since ancient times. But now a day rearing livestock has become a costly affair and about 60 per cent cost is involved in animal feeding. In a country like India which is home to 536 million livestock but there is shortage of green fodder and dry fodder to the tune of 11.2 and 23.4 per cent respectively. Market price of milk is increasing continuously due to increasing cost of fodder and feed. The comparative milk price of different animals is given in Table 1.

**Table 1. Milk price and fat content of different animals**

S. No.	Animal	Milk cost (Rs./L)	Fat (per cent)
1	Buffalo	70 to 90	5.2 to 7.2
2	Cow	65 to 75	3.4 to 5.1
3	Goat	80 to 150	2.4 to 5.0
4	Sheep	100 to 140	6.5 to 7.5
5	Camel	120 to 150	1.2 to 6.4
6	Donkey	2000 to 5000	1.2 to 2.0
7	Yolk	1500 -1700	5.5 to 9.0

## Use of plant based milk

Selection and use of plant based milk products depend upon the health-related, lifestyle and dietary reasons. Availability of nutrients and ease of digestion

are the main factors that lead to selection of a particular plant based milk. On the basis of claim, the global plant-based milk market is segmented into regular, gluten free, nut free, soy free, artificial preservatives, color free, and others. On the basis of packaging size, the plant-based milk is available in packing size of less than 100 ml, 110 ml, 250 ml, 500 ml, 1000 ml and more than 1000 ml in different packing like can, bottle and tetra pack. Based on different parameters, a comparison between plant & animal based milk and human milk is given in Table 2. Some of the prominent players operating in the plant-based milk market are Silk, Sanitarium, Alpro, Rude Health, Plenish, Provamel organic-bio, The Hain Celestial Group, Inc., Sunopta Grains and Foods Inc., Califia Farms, LLC, NotCo, Valsoia S.p.A, Yeo Hiap Seng Ltd., Simple Foods, natur-a, Nutrisslim, Australia's Own, Oatly Inc., Elmhurst Milked Direct LLC, Hershey India Private Limited, Life Health Foods, Manitoba Milling Company, and HP Hood LLC. Nutrient related proximate analysis of different of plant based milks is given in Table 3.

### Fermentation to improve plant based milk products

Fermentation can help to improve the sensory profiles, nutritional properties, texture and microbial safety of plant-based milk alternatives with the goal of producing more tasty and valuable products. Plant-based milk fermentation mainly uses mono-cultures of microbes, such as lactic acid bacteria, bacilli and yeasts, for this purpose. Mixed-culture fermentations with two or more microbial species can be used to further improve the plant-based products. Due to the rapid progress in this field, we can expect well-balanced and naturally fermented plant-based milk alternatives in the coming years.

### How to choose a healthy plant based milk?

1. **Sugar content:** Choose unflavoured and unsweetened options. Added sugars like fructose and maltodextrine are often added to enhance flavor and texture. Some brand also

adds sugar into unflavored variation, so always check the ingredient list.

2. **Additives:** Plant based milk is often thinner and lighter in texture, additive such as salt, searrageenan and vegetable gums are usually added to achieve a thicker and smother texture while giving the milk a longer shelf life. These thickening agents have known to cause inflammation and gastrointestinal issues for some humans, which negates the benefit of adopting dairy free lifestyle.
3. **Water content:** Water content is important or essential factor for people on low calorie diet. For example commercial almond milk is mostly 98% water, the remaining two per cent constitute only about five almond worth of juice in every cup.
4. **Nutritional profile:** If you are looking for a milk alternative as a source of nutrition, find one that has similar protein and carbohydrates count to cow's milk *i.e.* 8 g and 12 g, respectively.

### Pros and cons of dairy and plant based milk:

#### Dairy based milk

##### Pros:

1. Regular cow milk is an excellent source of good quality protein, which is essential the body for growth and repair.
2. Cow's milk also provides many vitamins and minerals such as calcium, vitamin B12 and zinc.
3. Dairy is more affordable choice per litre which is an important consideration.

##### Cons:

1. Dairy is not suitable for everyone like those who have an allergy to cow's milk or intolerance to lactose (sugar) in milk.
2. The full fat cow's milk is also relatively high in saturated fat.

### Plant based milk

#### Pros:

1. Plant based milk alternative are also important for those who follow a vegan diet, so that meals containing milk can still be enjoyed.
2. Many people prefer the taste of plant based milk instead of dairy milk.

#### Cons:

1. Plant based milk are low in protein content. A 100 ml of cow's milk contain 4 g of protein in comparison the same amount of soy milk provides 3.2 g of protein.
2. They can also lack other essential nutrients such as calcium. Many manufacturers fortify their plant based milk with these nutrients to emulate the nutrition provided by dairy.
3. The sweetened plant-based milk such sweetened almond milk contain added sugar which should be taken in consideration.

### Human based milk

#### Pros:

1. Breast milk provides ideal nutrition for growth and development of infant.
2. It provides specific antibodies viz. IgG, IgA, and IgM plays a key role in defending against pathogens.
3. Breast feeding can reduce the mother's risk of breast and ovarian cancer, type-II diabetes and high blood pressure.

#### Cons:

1. Sometimes it does not suit to babies because of the lactose intolerance due to lack of lactase enzyme which help in digestion of lactose.
2. Even a baby who has never been formula fed and has never had any food besides breast

milk, may so signs of food allergy including diarrhea, bloody stools, vomiting, colic, eczema, constipation and poor growth.

3. The over feeding of breast milk can increase the risk of severe breast infection.

#### Reference

Anonymous (2023a). <https://blog.myfitnesspal.com/a-nutritional-comparison-of-dairy-and-plant-based-milk-varieties/>. Accessed on July 20, 2023.

Anonymous (2023b). <https://ourworldindata.org/environmental-impact>

Anonymous (2023c). [https://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_greenhouse\\_gas\\_emissions\\_per\\_capita](https://en.wikipedia.org/wiki/List_of_countries_by_greenhouse_gas_emissions_per_capita)

Data Bridge Market Research (2023). <https://www.databridgemarketresearch.com/reports/global-plant-based-milk> Accessed on July 31, 2023.

Markets and Markets, 2019: Dairy Alternatives Market - Market Research Report (2019) Retrieved from <https://www.marketsandmarkets.com/Market-Reports/dairy-alternative-plant-milk-beverages-market-677.html>. Accessed June 1, 2022.

Poore, J., and Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, 360(6392), 987-992.

Sandström, V., Valin, H., Krisztin, T., Havlík, P., Herrero, M., & Kastner, T. (2018). The role of trade in the greenhouse gas footprints of EU diets. *Global Food Security*, 19, 48-55.

Table 2. Comparison of plant and animal based milk based on different parameters

S. No.	Parameter	Plant based milk	Animal based milk	Human milk
1	<b>Nutrient value</b>	<p>100 ml of almond's milk contain 1.0-1.5 g of protein.</p> <p>100 ml of soy milk contain 3.0-4.0 g of protein.</p> <p>100 ml of oat milk contain 1.0-1.2 g of protein.</p> <p>100 ml of rice milk contain 0.2-0.4 g of protein.</p>	<p>100 ml of cow's milk contain 3.0 to 4.0 g of protein.</p> <p>One cup of low-fat milk has 100 calories and 8.0 g of protein, as well as 30% of the daily recommended value of calcium, 25% of vitamin D and 8% of potassium. While it contains 13.0 g of sugar, it's in the form of lactose, which is a natural part of cow's milk. The fat content varies depending on the type chosen (skim vs. low-fat vs. whole milk).</p>	<p>Mature human milk contains 0.8 to 0.9 per cent proteins, 3 to 5 per cent fat, 6.9 to 7.2 per cent carbohydrate calculated as lactose besides 0.2 per cent mineral constituents expressed as ash. Its energy content is 60-75 kcal/100 ml.</p> <p>Fortified Unsweetened soy milk can be used as an alternative for human milk.</p> <p>Colostrum contains IgG, IgA, and IgM antibodies. Special immuno-globulin (IgA) antibody is found in mature breast milk plays a key role in defending against pathogens. IgG strengthen immune system.</p>
2	<b>Green house gas emission (kg/L of milk)</b>	<p>Rice milk – 1.18 kg</p> <p>Soy – 0.98 kg</p> <p>Oat milk – 0.90 kg</p> <p>Almond – 0.70 kg</p>	Dairy milk – 3.15 kg	<p>Total per capita greenhouse gas (GHG) emissions vary from country to country.</p> <p>GHG emission in India is 2.5 metric tonne CO<sub>2</sub>e per capita per year (2018).</p>
3	<b>Eutrophication</b>	<p>Rice milk – 4.69 g</p> <p>Soy – 1.62 g</p> <p>Oat milk – 1.5 g</p> <p>Almond – 1.06 g</p>	Dairy milk – 10.65 kg	-
4	<b>Freshwater use</b>	<p>Rice milk – 371.46 g</p> <p>Soy – 269.81 g</p> <p>Oat milk – 48.24 g</p> <p>Almond – 27.8 g</p>	Dairy milk – 6.28 kg	Freshwater uses in India 49275 litre per capita per year.
5	<b>Land use</b>	<p>Rice milk – 0.76 m<sup>2</sup></p> <p>Soy – 0.66 m<sup>2</sup></p> <p>Oat milk – 0.50 m<sup>2</sup></p> <p>Almond – 27.8 m<sup>2</sup></p>	Dairy milk – 8.95 m <sup>2</sup>	Human being – 10 m <sup>2</sup>

Source: Joseph Poore and Thomas Nemecek (2018)

Table 3. Comparison of plant based milk

	Soy milk	Oat milk	Rice milk	Pea milk	Almond milk	Cashew milk	Coconut milk
Calorie	80	130	120	70	30	25	45
Carbs (g)	4	24	23	0	1	1	1
Sugar	1	5	10	0	0	3	7
Protein	7	4	1	8	1	<1	0
Fat/unsaturated fat	4/0.5	2.5/0	2.5/0	4.5/0.5	2.5	2.0	4/3.5
Vitamin D (MCG)	30	25	0	30%	25%	25%	25%
Calcium (mg)	45	35	2	45%	45%	45%	45%
Potassium (mg)	287	95	35	450	160	1	40

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