THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
Popular Article
April, 2025 Vol.5(4), 6707-6710

A1 And A2 Milk and Their Role in Human Health

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DOI:10.5281/ScienceWorld.15266577

Introduction

India is the largest producer of milk in the world. As per the BAHS, 2024, India is producing 239 MT of milk and contributing approx. 25 % in world's production. Dairy is the single largest agricultural commodity which contributes 5% of the national economy and employing more than 8 crore farmers directly. Globally 30% of the world's cattle population of about 1.4 billion exists in India. The per capita availability of milk is 471 grams per day in India during 2023-24. There are 54 recognized breeds of cattle in India including the recently registered synthetic breed 'Frieswal'

Milk is one of the most nutritious foods for human and is consumed right from the birth and almost throughout the life as such or in the form of milk products. Milk is highly nutritious providing an important source of high-quality proteins, carbohydrates and micronutrients and is considered as almost complete food. Milk is considered as a perfect food in all age groups including infants. Cow milk is closest to breast milk. It is one of the inseparable parts of daily diet. Cow milk is a good source of fat, lactose, proteins, vitamins and minerals and also it contains several nutrients needed for growth and development. From health aspects, it contains immunoglobulin, hormones, cytokines, growth factors, nucleotides, peptides, polyamines, enzymes and several others bioactive peptides. Milk also contains lactoferrin which is microbicidal. Cow milk is consisting of Water-87%, carbohydrate (Lactose)-4.8%, Fat-4%, Protein (Casein, Whey, Glycoprotein)-3.5%, Minerals (Ca, K, I)-0.8%, and Vitamins (A, B2, B12) and supplies 66 kcal of energy per 100 grams whereas Human milk contains an average 1.1% protein, 4.2% fat, 7.0% lactose and supplies 72 kcal of energy per 100 grams.

Although, India is highest the world in milk production but quality check for clean milk production is a challenge. Besides clean milk production a new concept is arising yet not new for other countries i.e., A1 and A2 milk. Various non communicable diseases like type 1 diabetes mellitus, schizophrenia, ischemic heart disease, and autism are being associated with a mutant gene that leads to production of A1 milk. New diseases include in this list are milk intolerance, along with lactose intolerance and milk allergy. These associations of diseases with milk are contrasting to earlier views on therapeutic effects of milk against them

Average composition of different milk lactating animals

Animals	Dry matter (%)	Lactose (%)	Protein (%)	Fat (%)	Ash (%)
Cow	13	4.9	3.4	4	0.7
Buffalo	17.2	4.8	4.2	7.6	0.8
Goat	13.2	4.1	3.4	3.5	0.8
Sheep	19.3	4.8	5.5	7.2	0.9
Camel	10.6	4	2.3	3.5	0.7

Source: Galali & Al-Dmoor, (2019)

What is A1 and A2 milk

Milk contains about 87% water. The remaining 13% is the milk sugar lactose, protein, fat and minerals. Beta-casein is about 30% of the total protein content in milk. A2 milk is the milk which contains only the A2 type of beta-casein protein whereas A1 milk contains only A1 beta casein or A1A2 type variant. A1 protein variant is commonly found in milk from crossbred and European cattle breeds. A2 milk is found basically in indigenous/desi cows and buffaloes of India. The A1 and A2 variants differ only at amino acids position 67, which is histidine in A1 and proline in A2 milk. The change occurs due to natural mutation. This difference in amino acids suggests a conformational difference in the secondary structure of the expressed protein.

History of A1 and A2 Milk

Initially all cow milk was of A2 type milk but during evolutionary process, genetic mutation affected some European cattle (Jersey, Guernsey, Holstein Friesian) in β-casein gene, probably 5000-10,000 years ago. This mutation led to genetic variants of β-casein and out of these, A1 and A2 are the most common. The gene at position 67 encoding amino acid proline mutated during evolution and then started encoding histidine. The frequency of A1 allele was increased gradually in the population during selection of animals for higher milk production. While Indian cattle have evolved naturally without any selection pressure and have A2 allele of β-casein. However, with the onset of white revolution in

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Published 23/04/2025

India to increase the milk production, exotic breeds like Jersey, Guernsey, Holstein Friesian etc. were used for cross breeding or their semen was used for the purpose of artificial insemination in India. This ultimately increased the proportion of A1 allele in the population.

Cow breeds concerned with A1 and A2 milk

Researches conducted on indigenous/Zebu cows, buffaloes and exotic cows have revealed that A1 allele is more frequent in exotic cattle (A1 milk) while Indian native dairy cows and buffaloes have only A2 allele and hence are a source for safe milk i.e A2 milk. The A2 allele gene in Indian milk breeds of cows and buffaloes are 100% (Sahiwal, Red Sindhi, Gir, Tharparkar and Rathi), other Indian breeds used for farming is around 94 % and while in foreign breeds (HF and Jersey), it is around 60 per cent. A1 β-casein is absent in milk of pure Asian and African Cow. So, our indigenous/desi cows and buffaloes produce A2 milk.

Role of A1 and A2 milk on human Health:

In A1 milk Due to the presence of a Beta-casomorphin-7(BCM-7), digestive enzymes acted in a different way than the A2 milk during the process of digestion. BCM-7 is released by digestive enzymes from the A1 beta-casein protein but the enzymes cannot split the A2 protein due to the presence of proline at that place. Hence, BCM-7 is not released from A2 beta-casein protein digestion. Since, BCM-7 easily interacts with the human gastrointestinal tract and brainstem so that it is known as a “devil” in A1 milk.

A2 milk usually comes from Southern French breeds of cow i.e., Jersey, Channel Island cows, Guernsey, Charolais, Limousin, and in the Zebu cattle of Africa and Asia, which does not release BCM-7. Research from different countries proved that A1 milk carries potential health risks as compared to the consumption of A2 milk. The calcium to magnesium ratio of cow milk does alter its beneficial effects. A high Ca to Mg ratio increases the chances of colorectal cancer along with multiple chronic conditions such as cardiovascular disease, calcification, osteoporosis, and bone fractures. The ideal calcium to magnesium ratio suggested will range from 1.70 to 2.60. The same for A1 cow’s milk is 10:1, which is far higher than that of A2 milk i.e., 2:1. Thus indirectly indicating the health benefits of A2 milk. In the light of Vedic literature, desi/Indian cow milk has got huge importance in terms of its huge beneficial effects. Cow’s milk is believed to possess anti-aging properties, anti-cancer properties, antifungal properties with a tonic effect on the heart and brain. Such effects are more pronounced in value-added products such as ghee, curd, buttermilk, etc. That is the reason why milk and other milk products have always been part of a conventional traditional Indian family. Though huge oral evidence is present on the exceptional benefits of A2 milk, scientific evidence has to be supplemented to make it established globally.

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Published 23/04/2025

Cow milk provides a high-quality source of protein and essential micronutrients like calcium, magnesium, and phosphorus to human beings. Various medical research findings revealed a positive correlation between the development of cardiovascular disease (CVD) after consumption of A1 milk protein. Tailford *et al.* (2003) found that beta-casein A1 is more atherogenic than beta casein A2. Laugesen and Elliot (2003) found higher incidence of ischemic heart disease (IHD) and Type 1 Diabetes Mellitus after consumption of A1 cattle milk. In western countries mostly milk came from jersey. HF and other breeds that carry the A1 allele had a greater incidence of CVD than other nations having A2 milk intake in the populations. Elliot (1992) observed that children in Polynesian islands consuming only A2 type cow milk were at lesser risk to type 1 diabetes than Polynesian children in Auckland who were consuming A1 type of cow milk. Kaminski *et al.* (2005) found a probable linkage between consumption of A1 milk and the occurrence of ischemic heart disease, sudden infant death syndrome, neurological disorders like autism and schizophrenia in New Zealand' Swinburn, (2004) revealed that a high intake of milk with A1 increases the chance of diseases. McLachlan, (2001) also stated that certain communities viz. Masai (East African) and Samburu (Northern Keyan) had virtually no CVD because of consuming milk that carries the A2 allele.

Conclusion:

Many scientists reported that consumption of A1 milk causes negative health impacts i.e., diabetes, coronary heart disease, etc. On the other hand, several studies revealed that A2 milk is natural, better, and free from negative effects. However, few studies by the European food safety authority (EFSA) could not find any relationship between intake of BCM-7 and the etiology of such diseases. The Australian and New Zealand food safety Authorities have also reported no correlation between consumption of A1 or A2 milk with diabetes and coronary heart disease incidence. The controversy between the health benefits of A1 and A2 cow milk cannot be solved until we have comprehensive research on this matter.

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Published 23/04/2025