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Takra (Buttermilk) as a functional food: An evaluation of therapeutic potential and evidence

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Abstract
Nutraceuticals are biologically active compounds found in food and dietary supplements that may offer health benefits basic nourishment. In Ayurvedic literature, buttermilk is referred to as “Takra.” Takra is a food item that is made from curd, a fermented milk product, and has been used in Ayurveda for ages. This review covers a wide range of Ayurvedic classics and contemporary textbooks, publications, research articles from PUBMED, MEDLINE database, and research published in scientific journals related to Buttermilk and Takra. The primary objective of this review is to integrate Takra's medicinal and nutraceutical properties. Takra has been shown to have highly nutritious and health-promoting properties, particularly in relation to gastrointestinal disorders, diabetes mellitus, cancer, cardiovascular disease, etc., based on an analysis of ancient sources and multiple trials. Takra uses its several Gunas (Properties) to function as Tridoshshamak. Takra is beneficial for numerous diseases, including Grahani (Sprue), Arsha (Piles), and Udara (Ascites). In addition, Ayurveda highlighted the significance of Takra in the disordered state of Agni (digestive fire). Takra is one of the nutrient-dense drinks that is necessary to maintain a balanced diet and prevent many diseases. It is imperative that the nutritional and physiological benefits of Takra be emphasized once more. The current review presents nutraceutical and therapeutic health benefits of Takra.

Keywords: Takra, buttermilk, nutraceutical, therapeutic, health benefits

Introduction
Nutraceuticals are physiologically active ingredients found in food and dietary supplements that may be more beneficial to health than simple substances. Nutraceuticals come in a variety of forms and can be obtained from a broad range of sources, such as microbes, plants, and animals. Probiotics, phytochemicals, minerals, and vitamins are a few typical categories of nutraceuticals [1]. Traditional Indian beverages like Takra have become powerful players in the field of nutraceuticals, which combines science and nutrition to enhance health and wellness. A liquid known as buttermilk is released when cream is churned to make butter.

Water-soluble ingredients found in buttermilk include minerals, lactose, and milk protein. Furthermore, material derived from milk fat globule membrane (MFGM) that is broken during the churning process and primarily goes into the buttermilk fraction is enclosed by this buttermilk-specific substance. Milk has less phospholipids than buttermilk due to the presence of MFGM material. In buttermilk, phospholipids make up around one-third of the dry matter in MFGM. Phospholipids are found in buttermilk at seven times higher concentrations (0.89 mg/g in buttermilk and 0.12 mg/g in whole milk) than in whole milk, according to numerous prior studies [2].

Within Ayurveda Takra is the popular name for buttermilk. Takra is listed in Agraya Dravyas (the best dravya within its group) in Charak Samhita [3]. After churning the curd (Dadhi) thoroughly with water, takra is obtained. Grahani (irritable bowel syndrome), Panduroga (Anemia), Arsha (piles), Pleehodar (splenomegaly), Jalodara (ascites), Aruchi (anorexia), Vishama jwara (irregular fever), Trishna (thirst), Chardi(vomiting), kapha, and vata disorders are all alleviated by Takra, which is sweet, sour, and has an astringent taste as a subsidiary taste. Ushna virya, light, rough, stimulates Agni, and is sweet in vipaka, agreeable, removes dysuria and oleation therapy complications [4]. Takra can be used as a treatment fora number of ailments and as a pathya Ahara (beneficial diet) to keep the body in a healthy state. Owing to this particular characteristic, it is highly beneficial for patients with Agni vikruti (abnormal conditions of the digestive fire), various dosha dushti (abnormal conditions of the Dosha), and various Prakuti (Constitution). Takra is therefore a crucial part of the treatment of people with Agni-related illnesses. The purpose of this article is to establish Takra's medicinal and nutraceutical value [5].

Materials and Methods
Data Sources and Search Strategy
The data regarding the nutraceutical and health benefits of takra were reviewed from Ayurvedic classical texts, such as Samhita and Nighantu (lexicons), using the MeSH terms "Takra," "Guna," and "Karma." Recent research was searched in electronic databases including PubMed, Web of Science, Scopus, and Google Scholar, employing MeSH terms such as "Buttermilk," "Takra," "OR," "AND," "nutrition," "health benefits," "therapeutic importance," "recipe," "diabetes," "hypertension," "cardiovascular diseases," "obesity," "antioxidant," "immunity," and "nutraceutical."

Inclusion and Exclusion Criteria
Review articles, abstracts only, and papers with weak methodologies were excluded from the analysis.

Data Extraction and Synthesis
Relevant data pertinent to the aim of the present article were compiled, summarized, and discussed.

Result and Discussion

Takra can also be found in the Vedas, which state that humans have takra on earth to be eternal in heaven and that God obtained immortality from a pious drink (Amrit) in heaven [6]. It is also claimed that Shakra, the God-King Indra, had a very difficult time obtaining the Takra [7].

Ayurveda Pharmacodynamics of Takra [8]

Takra primarily has an amla (sour) rasa (taste), with anurasa (secondary tastes) of madhura (sweet) and kashaya (astringent).

The guna (qualities) of takra are laghu (light) and ruksha (dry). Its Veerya (potency) is ushna (hot), and its post-digestive effect (Vipaka) is madhura (sweet). In terms of its effect on the doshas, takra is tridoshahara, meaning it helps balance all three doshas-vata, pitta, and kapha. Additionally, it has several therapeutic actions including srotoshodhana (cleansing of the channels), agnideepana (stimulating digestive fire), vrushya (promoting fertility), balya (strengthening), grahi (absorbing), laghava (lightness), tushtikara (satisfaction), varnya (improving skin complexion), and hrudhya (beneficial for the heart) [9].

Table 1: Classification of Takra (Buttermilk) [10]

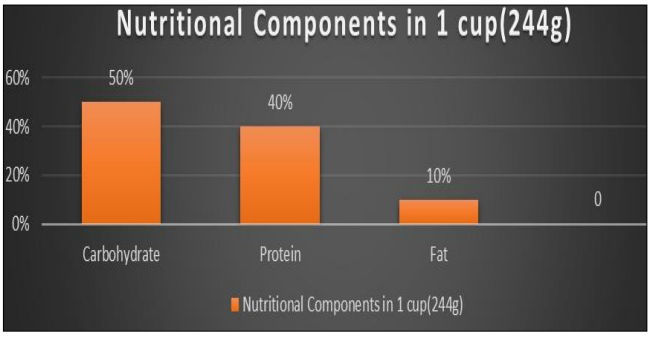
S.N.	Types of buttermilk	Water Ratio	Physical features and methods of preparation	Dosha Karma	Properties
1.	Ghola	Curd: Water 1: 0	A creamy, semi-solid product is produced by churning curd without adding water and without removing butter.	Vatapittahara	It is gratifying and soothes Vata-Pitta Doshas.
2.	Mathita	Curd: Water 1: 0	churning the curd without adding water, but separating the butter component	Kaphapittahara	Alleviates Pitta-Kapha Doshas
3.	Udashwita	Curd: Water 2: 1	Curd is churned well with half the quantity of water.	Kaphavatahara	Gives strength and Amanashak but increases Kapha
4.	Takra	Curd: Water 4: 1	Churning the curd by adding one fourth part of water entirely separates the creamy and solid portion. It is sweet, tangy, and astringent.	Kaphaprakopaka	Improves digestion and keeps the body from losing fluids. The ideal diet for people with stomach issues.
5.	Chachikka	-	The curd is thoroughly mixed with a big amount of water and churned twice to remove the solids (creamy portion).	Pittavatahara	raises the Kapha and calms the Pitta and Vata. Increases digestion, gets rid of fatigue and thirst, and is cold and light.

Nutritional Properties of Buttermilk [11, 12]

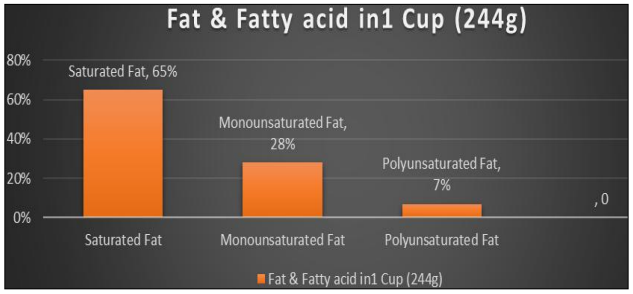
The nutraceutical value of buttermilk (1cup-per 244g) is depicted in Table 1. The results show buttermilk to be highly nutrient-dense. Rich in potassium, calcium, phosphorus, vitamin B12, and riboflavin is buttermilk. 99 calories and 2.2 grams of fat are found in one cup of buttermilk (the amount of fat in buttermilk varies depending on the brand). Whole nutritional values as respective percentage of daily value as depicted in Table 2 and Graph1-4.

Table 2: Nutritional values of Buttermilk [13, 14]

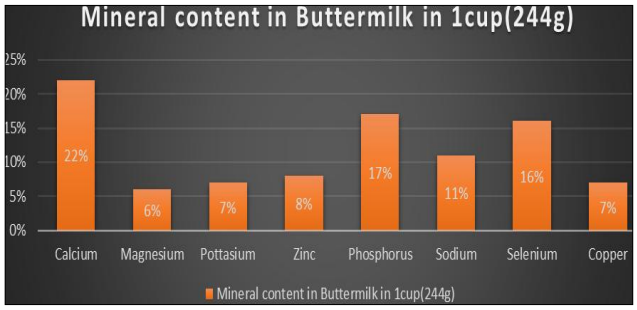
S.N.	Nutrients	Quantity(1cup-244g)
1.	Calories	99kcal
2.	Total Fat	2.2g
3.	Total carbohydrates	10g
4.	Protein	8g
5.	Saturated fat	1 g
6.	Cholesterol	10mg
7.	Sodium	260mg
8.	Vitamin A	130.00IU
9.	Vitamin C	5mg
10.	Potassium	370mg
11.	Calcium	284mg
12.	Iron	0.25mg



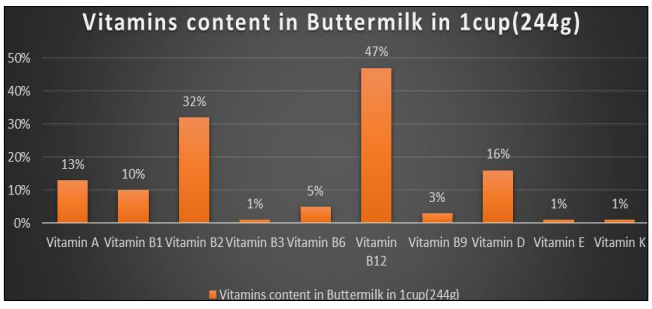
Graph 1: Percentage of Nutritional Components in 1cup(244g) Buttermilk [13, 14]



Graph 2: Percentage of Fat and fatty acid in 1cup(244g) Buttermilk [13, 14]



Graph 3: Percentage of Mineral Content in 1cup(244g) Buttermilk [13, 14]



Graph 4: Percentage of Vitamins Content in 1cup (244g) Buttermilk [13, 14]

Therapeutic Properties of Buttermilk as per Ayurveda

Aacharya Charaka has indicated takra (buttermilk) in disorders such as, Snehavyapad (complication due to overuse of oily substances), Garavisha (low potency poison), shotha (swelling), grahanidosha (sprue), mutragraha (difficulty in micturation), udara (ascites), aruchi (anorexia), in jalodara (ascites) etc. Charak has also mentioned that takra can be used in mandagni (low digestive fire), gaurava (heaviness in the body), arochaka (anorexia), atisaara (diarrhoea) and vatakapha dominant diseases. In arsha (piles) takra (buttermilk) is indicated in Vata-Kapha dominance piles. Agni Vikriti is linked to Grahanidosha, or sprue. In this state, buttermilk, acts as Grahi (absorptive), Laghavatva (lightness), or lightness in the body, and Deepana, or stimulating the force of digestion [16].

Three forms of buttermilk i.e. fat-free, half-fat, and full fat and their qualities based on fat content are explained by Ayurveda. These types of buttermilk are to be ingested based on an individual's Agni or digestive capacity. Probiotics have been thoroughly researched in relation to gastrointestinal disorders such as IBD, IBS, antibiotic-associated diarrhoea, and infectious gastroenteritis [17,18]. It eases the sensation of puffiness and aids in better digestion. It is a natural remedy for gastrointestinal issues, spleen diseases, oedema, irritability, anaemia, and lack of appetite. It also contains all the important macronutrients [19].

Indications of Takra according to Dosha

In Ayurveda, Takra is used with various drugs to manage different dosha disorders. For Vataja disorders, Amla Takra (sour buttermilk) is recommended with Saindhavalavana (rock salt). In the case of Pittaja disorders, Swadu Takra (sweet buttermilk) is advised, which can be taken with Sharkara (sugar). For Kaphaja conditions, Kasaya Takra (astringent buttermilk) with Kshara (alkali) and Trikatu (a blend of Pippali, Shunti, and Maricha) is advised. In Grahani (sprue), Arshas (hemorrhoids), Atisara (diarrhea) takra is taken with Hingu (asafoetida), Jeeraka (cumin seeds), and Saindhava lavana (rock salt) to enhance its therapeutic benefits. In mutrakrichha (Painful micturartion) takra is used with Gud (jaggery) [20].

Clinical Evidence

Benefits

Act as a Natural Probiotic

Current scientific research indicates that intestinal diseases are frequently caused by toxic or nasty bacteria that are present in the gut flora of the intestines [21]. Consistent consumption of probiotics, such as buttermilk, is crucial for maintaining healthy gut flora and promoting excellent digestion and general well-being [22]. Because buttermilk contains friendly bacteria that are beneficial to the intestines, it naturally contains probiotic lactic acid bacteria. Probiotics appear to have three main modes of action, with notable variations between probiotic species and strains: anti-microbial actions, mucosal barrier integrity enhancement, and immuno-modulation [23]. Probiotics raise the quantity of killer cells, boost macrophage systemic activity, and promote the synthesis of antibodies. Thus, probiotics enhance the immune system by acting as an immunomodulator in the human body [24].

Probiotics also increase energy levels by boosting B-complex synthesis, relieve constipation by controlling bowel movements, safeguard important organs like the heart, kidney, lungs, and liver with their antioxidant qualities, and speed up clinical response by improving drug absorption [25, 26].

Prevent Dehydration

One of the greatest beverages to combat the heat and the body's loss of water is buttermilk mixed with salt and spices. It also acts as an efficient medication to prevent dehydration because it is high in electrolytes. It is used as a refreshing and nourishing beverage during the summer months since it gives the body the necessary nutrients and moisture. Buttermilk thereby lessens summertime complaints, general apprehension, etc [27].

Source of Micro-Nutrients

As one ages, buttermilk's calcium content and nutritional additives aid to prevent or delay bone loss. Vitamin D and the B complex are two of the many vitamins found in buttermilk. Buttermilk's vitamin D boosts immunity and fortifies the body, reducing the body's vulnerability to illnesses. One serving of buttermilk gives us the required 21 percent of the water content with nutrients, per a study [28].

Improves Digestion and Treatment of Stomach Ailments

Because buttermilk contains acid, it helps with digestion by acting against the germs in the stomach. Buttermilk is an excellent digestive aid due to the various additions added to it, including cumin, ginger, and pepper. Because they have the carminative quality, they aid in the expulsion of gas from the stomach, and when consumed combined, they have a cooling and digesting effect on the gastrointestinal tract. The majority of gastrointestinal disorders, including irritable bowel syndrome, stomach infections, irregular bowel movements, and colon cancer, can be prevented and treated by regular buttermilk drinking [30].

Anticancer Effects

An *in vitro* study found that some breast cancer cell lines' proliferation is regulated by the selenium transporter protein found in milk fat globule membranes (MFGM). The MFGM contains intestine bacterial beta-glucuronidase inhibitors, which may protect against colon cancer [31]. Metabolites of sphingolipids are involved in differentiation and apoptosis of cells [32].

Pre- clinical Studies

Influence on gut health

Sprong *et al*. conducted studies on rats and found that feeding the experimental animals powdered sweet butter milk treated with lactase prevented L. monocytogenes from colonizing that reduced gastrointestinal illnesses [33]. Furthermore, MFGM and peptide hydrolysates produced through proteolysis using immobilized digestive enzymes exhibited antibacterial efficacy against Pseudomonas fluorescens and Salmonella enterica [34].

According to Wang *et al*. (2001), oral MFGM administration decreased H. pylori-induced gastric mucosa infection in mice. This was due to the protein component of MFGM [35]. Periodic acid–Schiff VI/VII, one of the proteins presents in MFGM promoted mucosal healing [36]. Some study also found that MFGM-enriched milk protected young children against gastrointestinal illness [37].

Anti-inflammatory Effect

With the assistance of neutrophils, XDH (Xanthine Dehydrogenase) /XO (Xanthine Oxidase) performs antibacterial and protective roles in the gastrointestinal tract and reduces inflammation in humans [38]. According to Sonali *et al*., cultured buttermilk made by combining fermented whey and dahi in a 60:40 ratio and using L. helveticus MTCC 5463 exhibited antibacterial action against E. coli, S. aureus, and S. typhi [39].

Effect on Cholesterol Management

As part of a balanced diet, Conway *et al*. (2014) proposed that buttermilk may offer a novel safe food modality to control blood pressure and cholesterol [40]. Rats' total and LDL cholesterol concentrations were dramatically reduced when they were fed processed cheese spread with 30% buttermilk concentrate (El Sayed *et al*. 2006). *In vitro* tests of cultured buttermilk made by incorporating fermented whey with dadhi revealed ACE-inhibitory action, according to Sonali *et al*. (2017) [41].

An additional investigation on the impact of buttermilk consumption on human blood pressure and renin-angiotensin-aldosterone (RAS) system indicators was conducted. Consuming buttermilk, as opposed to a placebo, dramatically lowered plasma levels of the angiotensin I-converting enzyme (10.9%), mean arterial blood pressure (1.7 mm Hg), and systolic blood pressure (2.6 mm Hg). However, it had no effect on the concentrations of angiotensin II and aldosterone in the plasma [42]. It also functions as a homeopathic treatment for reducing and managing blood cholesterol [43].

Neurological Development

Milk phospholipids and milk products provide a protective effect against stress-induced neuronal cell death, which may lower the chance of developing certain neurodegenerative illnesses. Another excellent source of phospholipids is cultured buttermilk [44].

Antioxidant activity

According to Conway *et al*. (2012), when compared to skim milk proteins, buttermilk protein concentrates and their enzymatic hydrolysates shown higher antioxidant activity (particularly because MFGM contains butyrophilin) [44]. According to Sonali *et al*. (2017), ABTS testing revealed antioxidant activity *in vitro* experiments of cultured buttermilk made by incorporating fermented whey into curd made with the L. helveticus MTCC 5463 strain [45]. Buttermilk powder is effective at scavenging peroxide and hydroxyl radicals by acting as a reducing agent and sequestering both Fe2+ and Fe3. This was found by Wong and Kitts (2003) [46].

Conclusion

Takra is proof of the harmony between conventional knowledge and cutting-edge research. Accept Takra as more than just a drink; it's a nutritional powerhouse that can improve overall state of health. Untapped nutritional properties of buttermilk, a genuinely nutritious beverage that can be found in every home's kitchen, are readily apparent. It is a promising component for the creation of functional foods, and further study is needed to fully understand buttermilk's medicinal qualities. As we learn more about nutraceuticals, uncovering ancient drinks like Takra again offers insights into their enormous health advantages. Thus, buttermilk is another nutritionally rich coproduct with many potential positive impacts on human well-being, ranging from supporting bone health to boosting immunity and encouraging digestive wellbeing. Therefore, when thinking about the future of milk-based beverages, one of the most important things to keep in mind is the development of buttermilk beverages.

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