International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 03 | March - 2024 SJIF Rating: 8.176 ISSN: 2582-3930

Bovine Milk Alternative and its Potential in Indian Market- A Critical Study

Srabanti Chakraborty

Abstarct

Milk has a very important role in human diets: it is used as a source of nourishment for babies and this can go on for different periods, depending on the animal. Today, beverages inclusive of milk are not only treated as thirst quenchers but also in other aspects. The nutritional profile of the beverages became important to the consumer, as well as their environmental and animal welfare impacts deeply.In todays' scenario consumers have turned to plant-based beverages for different reasons.

Bovine milk is under spontaneous and extended scrutiny due to the rising impact on environment and ethical considerations which concerns animal welfare. At present a certain percentage of consumers is opting for plant-based milk substitutes. This study focuses on the alternative of milk obtained from animal sources and the limitations will also be derived and available options to modify the existing product so that it can be utilised for Indian sweet preparations.

Introduction

Recently, consumers have shown an increased interest towards a more plant-based diet which includes cereal, legumes, seeds, nuts, fruits, and vegetables because of varied reasons such as repugnance to cruelty towards animals, more desperate for a healthy lifestyle, and environmental awareness (Janssen, Busch, Rödiger, & Hamm, 2016; Sebastiani et al., 2019). For these reasons, a variety of trends like veganism, vegetarianism, lacto-vegetarianism, and ovo-vegetarianism have arisen. Veganism is defined as non-consumption of meat, fish, chicken, pork, milk or milk products, egg, honey, or any product that contains any amount of these foods. Plant-based milk substitutes belongs to food groups cannot be replaced in the vegan food industry because plant-based milk substitutes are used as an essential ingredient in many vegan food products such as plant-based yogurt, cheese, kefir, butter, ice cream, etc. In addition, plant-based milk substitutes are also consumed and demanded by consumers who are lactose- intolerant and also has allergic reactions to animal milk.

Sweet is a universal language of bonding and happiness in each and every culture, so it is never ever possible to cut down or avoid sweets. With growing demands for Indian sweets there are also many detrimental medical conditions. So, now-a days people are more health conscious and also are looking for alternatives which can satisfy their demands without compromising their health. At present bovine milk is the major ingredient in sweet preparations in the Indian market and also some of the issues are also encountered so in order to overcome the issues and challenges consumers and manufacturers are searching for better alternatives which is more environment friendly and also similar in nutritional aspect, taste, texture, reasonable pricing and also not much labour is needed. Consumers are now more aware of the burden our environment carries, one such example is milk obtained from animals and presently the studies and experiments are going on in this field so as to find better alternative and substitute to provide for dairy based milk from animal source.

Objectives

The objective of this study was:

(1) to analyze the product image of plant milk and cow milk

(2) to analyse the potential of Plant based milk in the production of traditional sweets which can replace bovine milk.

Review of Literature

Using a selective literature survey, research papers published in the research journals that shows that presently there are many other alternatives and substitutes which can be consumed not only as a purpose of drinking or consuming milk but also can be used in the preparation of other milk products or health drinks.

Pistollato et al. (2018) in his research stated that a diet rich in plant-based foods including soybeans and nuts reduces the risk of neurodegenerative disorders such as Alzheimer's disease.Rita and Luciana (2018) state that there is a possibility of getting Parkinson's disease if a person consume daily 2 glasses of cow's milk as there is excessive intake of D galactose above 100 mg/kg. Pistollato et al. (2015) mentioned that, even though large scale clinical and epidemiological studies are needed, consumption of genistein during pregnancy presents a risk of causing one type leukemia in infants, MLL + acute myeloid leukemia.

Methodology

The study reviewed the research papers published in the leading peer-reviewed journals using the selective literature survey. The research papers were selected with the keyword milk substitutes. All the identified research papers with factors influencing the demand for milk substitutes were selected, and content analysis was done. After the content analysis,the major factors, issues and challenges faced for the usage and manufacturing milk from animal sources were critically identified and after proper review of the research papers the advantages and disadvantages were stated. This review explores the datas which are available as literature and after proper comparisons the conclusions are drawn.

Limitations

On the environmental impact of these products, a lot of data is missing, making it impossible to make a full comparison across environmental categories. Overall, the environmental impact of plant-based milk is lower than milk, with exceptions in some categories. This study has many limitations since the available data for the different products is limited, for both nutritional profile and environmental impact. For example, while mammals' milk is very well characterised, the biggest occurrence of missing data is found in the nutritional profile of plant-based beverages, where some products only have available information on macronutrients.

Discussions and Findings

Some of the major issues and challenges which are recorded as follows:

- Deformities in cows and buffaloes due to high injecting hormones to increase their milk production which are also creating health impacts in humans.
- In Jainism food source from animal or anything which has life cannot be consumed so some percentages of population are not able to consume the traditional sweets made out of dairy milk even though they crave for it.
- Maintenance of cattle and other animals are time consuming and also certain amount of money, land and labor is needed by the farmers hence it creates a pressure on many.
- Buffalo milk has high levels of fat which is 7-8% and due to which it is not suitable for many heart patients and body builders.
- Currently 60% of people are lactose intolerant in India which means they are unable to consume any dairy products.

The above-mentioned reasons can be taken into account and can be stated that there is a huge potential of replacing dairy milk with non-dairy sources in Indian market.

Advantages of plant-based milk

The cereals, legumes, seeds and nuts contain dietary fibre and are also enriched with vitamins, minerals and antioxidant

Polyphenols, tocopherols, and phytosterols are some of the factors that provide a connection between healthy body and consumption of nut, cereal, and oilseed. Nuts, cereals, and oilseed are known as key elements in a daily diet for a healthy life, the well-balanced fat content that has a high amount of MUFA and PUFA and a low amount of saturated fatty acid which includes essential fatty acids such as linoleic and α-linolenic acids that the human body cannot synthesize.

Plant based milk also reduce the risk of cardio-vascular diseases, cancer and diabetes

Due to high antioxidant content it can prevent ovarian, breast, stomach, prostate, and lung cancer .

Health effects of plant-based milk substitutes Nuts, cereals, and oilseeds have countless benefits for human health owing to their rich content of bioactive compounds, macronutrients, micronutrients, and phytochemicals.

Consumption of nuts and seeds have promoted the collagen production in skin

The health benefits of sesame lignan can be listed as enhancing detoxification of the liver, reducing the occurrence of tumors, protecting of neuronal cells from oxidative stress, and possessing anti-hypertensive, anti-inflammatory, and anti-allergic qualities

Apart from health benefits there is also less pressure on the environment.

Environmental effects of the production of plant-based milk substitutes has low affluence and cow's milk Food production has a variety of influences on the environment including accelerating climate change, over water usage, creating eco-toxicity, over land usage, eutrophication, and loss of biodiversity.

Genistein recovers dermal breakdown by binding to the oestrogen receptor β. Moreover, genistein is a chemotherapeutic agent for numerous types of cancer. Also genistein showed a mitigating effect on Alzheimer's disease in mouse models. Also helps in postmenopausal syndrome.

Disadvantages of plant based milk

The price of plant-based milk substitutes is expensive as compared with cow's milk. So, the taste should be improved in a way that responds to the preferences of consumers and at the same time the nutritional aspect is also not compromised.

The main difference between cow's milk and plant-based milk substitutes is protein content. The protein amount in the cow's milk is 3.28% whereas that the highest protein content of the plant based milk substitutes is in soy milk, 8.71%, and the lowest protein content is in the rice milk substitute. Even though soy milk has the highest protein content among the plant-based milk subs titutes, almond milk substitute is preferable to soy milk because of its balanced nutrient content and pleasant flavor when compared to other plant-based milk substitutes.

Soy milk is less in demand due to its beany flavor and the presence of some anti-nutrients such as trypsin inhibitor, phytic acid, and saponin. Soy beverages which are unflavoured were far less preferred products for children aged 13 to 16 and moderately less children aged eight to 12. (Palacios et al., 2010).

Bioavailability Bioavailability is the ratio of a compound in an active form at the targeted site of action (McClements & Peng, 2019).

Plant-based milk alternatives are richer in terms of fibre and unsaturated fatty acid content.

Cow milk has more pleasant taste

Although nuts and seeds are rich in terms of mineral and vitamin, antinutrients cause a decrease in bioavailability.

The types of plant-based milk substitutes have both similar and distinctive processing steps. Wet milling, filtration, the addition of ingredients, sterilization, homogenization, aseptic packaging, and cold storage are applied to all plant-based milk substitute; dehulling, roasting, dry grinding, steeping in diluted acid, the addition of some enzymes, and soaking in deionized water are specific for different plant-based milk substitutes production so it really becomes challenging as not every person has the knowledge about different plant based milk extraction methods and processes.

Recent studies have drawn attention to the adverse effects of added sugar found in plant-based milk substitutes on oral health.

However, while experimentation done by other resaerchers the two major problems were found, a final product having “beany” or “painty” off-flavor due to lipoxygenase activity, and a chalky mouthfeel caused by insoluble large particles (Kwok & Niranjan, 1995; Durand, Franks, & Hosken, 2003.

Also a survey was done of where children of age group 8-16 were given to taste chocolate lactose free cow’s milk and soy beverages were compared for their sensory intensity, without revealing the product type; chocolate lactose-free cow’s milk was preferred in the flavour category.

However, when plant-based milk is considered, it is significant to realize that, even though nuts and cereals are rich in terms of protein, dietary fibre, fatty acids, vitamins, and phytochemicals, plant-based milk substitutes include smaller amounts of these beneficial bioactive compounds which are lost during processing.

The antioxidants found in nuts are located in the skin, and, when the nut is peeled, less than 10% of the antioxidants remain. For hazelnut phenolic compounds decrease by about 42% when the hazelnut milk substitute is produced and the total phenolic compounds of the sesame decrease about 84% when the sesame milk is produced.

The acidification risk for oat milk substitute production was 21–37% higher than for cow's milk because more digestate was generated, causing ammonia emissions during storage and distribution.

Also the phytic acid found in certain nuts and soya milk substitutes decreases thiamine absorption and decrease digestibility of protein.

Recently, novel technologies that include ultrasound, pulsed electric field, ohmic heating, high- and ultra-highpressure homogenization have been applied to increase the stability of the plant-based milk substitutes, and these novel applications could be improved for large scale production which requires huge investment and also trained and skilled manpower.

Conclusions

So, it can be concluded that due to numerous advantages of non-dairy milk sources there is a huge potential to utilize the milk in sweet preparation and other functional drinks which still needs more experiments as far as the taste texture and nutients are concerned and how the general mass reacts to it.

However, plant-based milk substitute products also have various negative health effects including lack of protein content, low bioavailability of minerals and vitamins, and oral health problems. Probiotic

bacteria and yeasts can be added and mixed in required amount to enhance the bioavailability of isoflavones, support the digestion of protein, and increase calcium solubility in fermented soymilk but It can be also stated that people who are allergic to nuts or soya products may not be able to consume the milk or milk products or sweets prepared from it but also the experiment is needed to check the permitted level of endurance if it is being prepared with a blend with other milk.

So, the option left with them will be either to consume the products prepared from plant based milk or sweet corn milk can also be experimented for sweets preparation in Indain context. Bioavailability of plant-based milk substitutes must be investigated in a detailed way. Also there is a huge potential to blend the different plant based milk substitute and further research and experiments should be conducted to check the required amount of different ingredients added to make various sweet preparation so that the the taste, texture and shelf life is retained. The plant-based diet has become widespread as a result of popular trends, social media, food blogs, and a trend toward a healthy lifestyle; therefore, the plant-based milk substitute industry has soared. To supply the rising demand for plant-based milk substitutes, the shelf-life of these products must be increased by improving emulsion stability. While one of the solutions to this problem is using additives which are not readily accepted by the consumer, the other solution is to apply novel technologies. The impact of manufacturing plant-based milk substitutes should be studied closely, and solutions to decrease acidification and eutrophication should be developed. Different novel technologies must be applied to investigate the effects of processing on bioactive compounds in plant-based milk substitutes.

Insufficient protein content can be eliminated by mixing different types of plant based milk substitutes, and, in this way, a pleasant taste can also be achieved without the need for added sugar. The lower bioavailability of calcium and various vitamins can be overcome by fermentation of plant-based milk substitutes via the use of lactic acid bacteria and yeast.

Another issue is that, although nuts and cereals have a high antioxidant capacity, the final product of plant-based milk substitutes have less than the raw materials because of the processing steps and low amounts of hydrophilic phenolics. Most of the bioactive compounds remain in the waste products. Therefore, plant-based milk substitute waste must be recovered, and the antioxidant capacity of plant-based milk substitute must be analyzed. To respond to consumer preferences, plant-based milk substitutes must be forti fied with protein while achieving a pleasant taste without the use of added sugar. This can be achieved by practicing sensory analysis for mixed types of plant-based substitutes.

References

- Abdo, K. M. and King, K. W. (1967). Enzymic modification of the extractability of protein from soybeans, Glycine max. *J. Agric. Food Chem.* 15:83–87.
- Ahrens, S., Venkatachalam, M., Mistry, A. M., Lapsley, K. and Sathe, S. K. (2005). Almond (Prunus dulcis L.) protein quality. *Plant Food Hum. Nutr.* 60:123–128.
- Aidoo, H., Sakyi-Dawson, E., Abbey, L., Tano-Debrah, K. and Saalia, F. K. (2012). Optimisation of chocolate formulation using dehydrated peanut–cowpea milk to replace dairy milk. *J. Sci. Food Agric.* 92:224–231.
- Akinyele, I. (1991). Effect of process method on the energy and protein content, antinutritional factors and in-vitro protein digestibility of cowpea milk (Vigna unguiculata). *Food Chem.* 42:129–134.
- Andres, S., Abraham, K., Appel, K. E. and Lampen, A. (2011). Risks and benefits of dietary isoflavones for cancer. *Crit. Rev. Toxicol.* 41:1–30.
- Bandla, S., Choudhary, R., Watson, D. G. and Haddock, J. (2011). UV-C treatment of soymilk in coiled tube UV reactors for inactivation of Escherichia coli W1485 and Bacillus cereus endospores. *LWT – Food Sci. Technol.* 46:71–76.
- Black, R. E., Williams, S. M., Jones, I. E. and Goulding, A. (2002). Children who avoid drinking cow milk have low dietary calcium intakes and poor bone health. *Am. J. Clin. Nutr.* 76:675–680.
- Bode, S. and Gudmand-Høyer, E. (1988). Incidence and clinical significance of lactose malabsorption in adult coeliac disease. *Scand. J. Gastroenterol.* 23:484–488.
- Bus, A. and Worsley, A. (2003). Consumers' health perceptions of three types of milk: A survey in Australia. *Appetite.* 40:93–100.
- Carvalho, N. F., Kenney, R. D., Carrington, P. H. and Hall, D. E. (2001). Severe nutritional deficiencies in toddlers resulting from health food milk alternatives. *Pediatrics.* 107:46.
- Chambers, E., Jenkins, A. and McGuire, B. H. (2006). Flavor properties of plain soymilk. *J. Sens. Stud.* 21:165–179.
- Charalampopoulos, D. Pandiella, S. S. and Webb, C. (2002). Growth studies of potentially probiotic lactic acid bacteria in cereal-based substrates. *J Appl. Microbiol.* 92:851–859.
- Chen, S. (1989). Preparation of fluid soymilk. In: Proceedings of the World Congress on Vegetable Protein Utilization in Human Foods and Animal Feedstuffs, pp. 341–351. Applewhite, T. N., Ed., American Oil Chemists Society, Champaign, IL.

- Cheng, Y., Thompson, L. and Brittin, H. (2006). Sogurt, a yogurt-like soybean product: Development and properties. *J. Food Sci.* 55:1178–1179.
- Chronakis, I. S., Fredholm, A., Triantafyllou, A. Ö. and Öste, R. (2004). Complex formation in aqueous medium of partially hydrolysed oat cereal proteins with sodium stearoyl-2 lactylate (SSL) lipid surfactant and implications for bile acids activity. *Colloids Surf. B.* 35:175–184.
- Cortés, C., Esteve, M., Frıgola, A. and Torregrosa, F. (2005). Quality characteristics of horchata (a Spanish vegetable beverage) treated with pulsed electric fields during shelf life. *Food Chem.* 91:319–325.
- Crittenden, R. G. and Bennett, L. E. (2005). Cow's milk allergy: A complex disorder. *J. Am. Coll. Nutr.* 24:582–591.
- Cruz, N., Capellas, M., Hernandez, M., Trujillo, A., Guamis, B. and Ferragut, V. (2007). Ultra high pressure homogenization of soymilk: Microbiological, physicochemical and microstructural characteristics. *Food Res. Int.* 40:725–732.
- Dahllöv, O. and Gustafsson, M. (2008). Livscykelanalys av Oatly havredryck. M.Sc. Thesis, Lund University, Lund, Sweden.
- De Vries, M. and De Boer, I. (2010). Comparing environmental impacts for livestock products: A review of life cycle assessments. *Livest. Sci.* 128:1–11.
- Debruyne, I. (2006). Soy base extract: Soymilk and dairy alternatives. In: Soy applications in foods, pp. 111–134. Riaz, M. N., Ed., Taylor & Francis, Boca Raton, FL.
- Diarra, K., Nong, Z. G. and Jie, C. (2005). Peanut milk and peanut milk-based products production: A review. *Crit. Rev. Food. Sci. Nutr.* 45:405–423.
- Alasalvar and Bolling, 2015
- C. Alasalvar, B.W. Bolling

  Review of nut phytochemicals, fat-soluble bioactives, antioxidant components and health effects

  The British Journal of Nutrition, 113 (Suppl 2) (2015), pp. S68-S78

- E. Alozie Yetunde, U.S. Udofia

  Nutritional and sensory properties of almond (Prunus amygdalu Var Dulcis) seed milk

  World Journal of Dairy & Food Sciences, 10 (2) (2015), pp. 117-121
- M.H. Alu'datt, T. Rababah, K. Ereifej, I. Alli

  Distribution, antioxidant and characterization of phenolic compounds in soybeans, flaxseed and olives

Food Chemistry, 139 (1–4) (2013), pp. 93-99

- Donkor, O., Henriksson, A., Vasiljevic, T. and Shah, N. P. (2007). α-Galactosidase and proteolytic activities of selected probiotic and dairy cultures in fermented soymilk. *Food Chem.* 104:10–20.
- Durand, A., Franks, G. and Hosken, R. (2003). Particle sizes and stability of UHT bovine, cereal and grain milks. *Food Hydrocoll.* 17:671–678.
- N. Bernat, M. Chafer, A. Chiralt, C. Gonzalez-Martınez
  Hazelnut milk fermentation using probiotic Lactobacillus rhamnosus GG and inulin
  International Journal of Food Science and Technology, 49 (2014), pp. 2553-2562
- Bernat et al., 2015
  N. Bernat, M. Chafer, A. Chiralt, J.M. Laparra, C. Gonzalez-Martinez
  Almond milk fermented with different potentially probiotic bacteria improves iron uptake by intestinal epithelial (Caco-2) cells