Chapter 12
Health Benefits of Milk and Milk Products

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12.1 Introduction

Besides the supply of basic nutrients for growth and development of the human body, the relevance of nutrition has extended to maintenance of health and combating of diseases (Nicoleta-Maricica 2019). Foods that provide basic nutrition as well as health-promoting benefits are known as functional foods. They contain biologically active compounds or phytochemicals that exert health beneficial effects and help reduce risk of diseases. The introduction of probiotics, prebiotics, or synbiotics into human diet is essential for the intestinal micro flora and the human health. They may be taken in the form of dairy products, raw vegetables and fruit or fermented pickles. A category of functional foods that have proven useful over time by virtue of their health benefits are probiotics (Butnariu and Sarac 2019).

The relevance of functional food has led to the publication of several articles describing studies on the constituents and biological functions of the various type of food, of which milk and milk products hold great uniqueness (Siro et al. 2008).

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C. Egbuna, G. Dable-Tupas (eds.), *Functional Foods and Nutraceuticals*,
https://doi.org/10.1007/978-3-030-42319-3_12

Milk is a probiotic compound because it contains viable bacteria that are beneficial for human health (Roberfroid 2000). Milk is white (yellow-white or bluish-white) liquid secreted by the mammary gland of female mammals. Humans use this as food especially for the nourishment of their offspring. Milk is an important source of energy which contains water, milk sugar (lactose), fat, protein, vitamins and minerals (Soliman 2005). Quantitatively, four components are dominant: water, fat, protein and lactose; while minerals, enzymes, vitamins, and dissolved gases constitute the minor constituents (Mourad et al. 2014). The misconception that milk and milk products contain fatty content that causes obesity and heart diseases could be responsible for the less intake of milk. This chapter succinctly reviews the composition, source and health benefits of milk and milk products in clear perspectives.

12.2 Sources, Composition and Preservation of Milk

All female mammalian species act as sources of milk but cows hold the highest commercial value because 85% of milk is obtained from them (Gerosa and Skoet 2012). Other sources include buffalo milk (11%), goats (3.4%), sheep (1.4%) and camels (0.2%) (Fig. 12.1).

12.2.1 Composition of Milk

The composition of milk varies among species to species or dairy to dairy (Table 12.1).

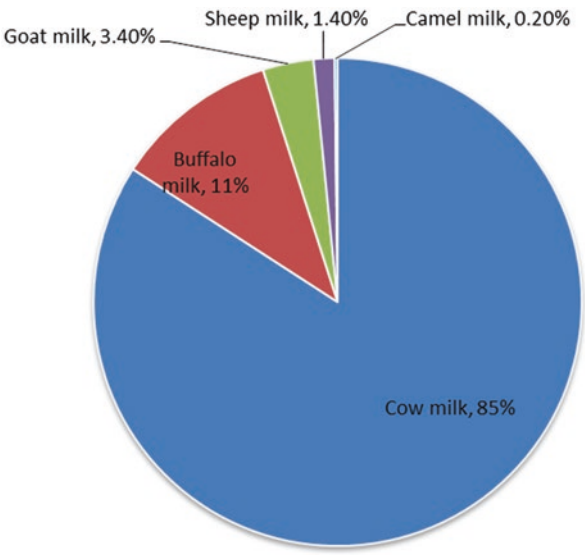

Fig. 12.1 The percentage composition and sources of milk

Table 12.1 Sources and composition of milk

Species	Water	Proteins	Fat	Lactose	Ash
Cow	87.0	3.5	3.9	4.9	0.72
Goat	87.7	3.3	4.1	3.9	0.82
Sheep	82.7	5.5	6.4	4.7	0.92
Camel	86.9	3.4	4.1	3.7	0.71

The composition of milk from different mammals in g/100 g milk (Mourad et al. 2014; Alhadrami 2016).

12.2.2 Milk Preservation

Raw milk contains different type of pathogenic bacteria including*; Listeria monocytogenes, Yersinia enterocolitica, Camphylobacterjejuni and E. coli* (Vasavada 1988). There are two major processes that could lead to contamination of raw milk: preharvest and second one is postharvest process. Several strategies are used to reduce the risk of contamination— enhanced animal health, improved milking hygiene and pasteurization. Pasteurization is a method in which pathogenic bacteria can be killed on fixed time at prearranged temperature.

12.3 Health Benefits of Milk and Milk Products

Cow milk contains high amount of protein, vitamin B, vitamin D, antioxidants, organic compounds and various minerals that affect the body in several ways. According to Karen Giles-Smith, cow milk is a rich source of high-quality protein of which 82% is casein and the remaining 18% consist of whey protein. They are rich source of peptides that helps in lowering blood pressure in hypertensive patients. Whey protein also contains essential amino acid Leucine that provides energy for boosting muscle mass and strengthens during exercise and heavy work (Giles-Smith 2013).

Vitamin B_{12} is an essential vitamin that is necessary for human health because it affects cell division. Its deficiency may lead to anaemia and neuropathy. Matte et al. (2014) described the importance of milk as a source of vitamin B_{12} for human nutrition. They reported three things mainly; ruminant animals have a natural source of vitamin B that is naturally synthesized by ruminant microflora and cobalt is a precursor in this process. Also the concentration of vitamin B12 in milk varies at different levels of heat. The absorption of vitamin B_{12} as a supplement (cyanocobalamin) varies in raw milk, pasteurized milk and micro-filtered milk in the pig's intestine. On analysis, the result shows that absorption efficiency of cyanocobalamin is 0%, raw milk is 9.2%, pasteurized milk is 7.8% and micro-filtered milk is 10.0% (Matte et al. 2014).

Milk contains high amount of calcium (most common mineral) that strengthens bones and teeth. Less intake of calcium source causes rickets in early life (Heaney et al. 2000). Grass-fed cow's milk have a rich source of omega-3 fatty acids that is good cholesterol improves heart health and prevent from different heart problems like heart attacks or strokes (Haug et al. 2007).

It is important to note that cow milk contains low amount of vitamin D. Vitamin D (vitamin D-2, vitamin D-3) is synthesized in the human skin in the presence of sunlight. It acts as a hormone and regulates the calcium and phosphorus concentration in the blood serum. It also helps in muscle development because vitamin D receptors present on muscle. Main source of vitamin D is sun exposure but now a day people do not have enough sun exposure because they live most of the time in shadowed or congested homes, working place also have less sun exposure that's why bones and muscles are weak. Vitamin D deficiency be averted by the use of vitamin D fortified milk (Schmid and Walther 2013).

Khan et al. (2019) reported that milk have antioxidant properties because milk is rich in sulfur-containing amino acids such as carotenoids, cysteine, phosphate, zinc, selenium, vitamin A, E, enzymes, superoxide dismutase, catalase. Milk products such as yoghurt and cheese have oligosaccharides and peptides that also have antioxidant property that can neutralize and act as free radical scavengers. They help protect the human body from harmful effects. These free radicals lead cancer, cardiovascular diseases, and diabetes and increase the ageing process because they cause oxidative stress which disrupts biochemical compounds like DNA, protein and lipids (Khan et al. 2019).

Goat milk is almost similar in nutrient composition as cow milk, but it differs in several characteristics. Goat milk is completely white in colour, as a result of the conversion of the beta-carotene (ingested from feed) to vitamin A. Goat milk has also been shown to have good nutritional value. It contains fat (3.8%), protein (3.5%), lactose (4.1%) unlike in cow which has higher lactose content (4.6%) but less protein (3.3%) and fat (3.6%) contents (Park 2010). Fat globule size is a factor that affects digestion value. Goat milk fat globule diameter is less than cow milk fat globule diameter which implies that its digestion rate is more due to its small size (Gantner et al. 2015).

According to Zenebe et al. (2014), the medicinal and nutritional values of goat milk are quite promising. Goat milk contains medium-chain triglycerides that helps in nutrient absorption and provide energy to the body. Goat milk also have bioactive component like gangliosides, glycolipids, cerebrosides and glycosphingolipids. These bioactive lipids act as antibodies and help detect antigens and bacterial toxins such as cholera toxin and enterotoxins. They also help to maintain cells to cell interaction. Alpha1-casein is a protein that increases the digestion time period of which goat milk has fewer amounts compared to than other sources of milk. Taurine is a free amino acid that is present in goat milk and plays an important role in brain development, growth and bile salt formation. Its deficiency causes epilepsy, retarded growth and cardiomyopathy (Zenebe et al. 2014).

Goat milk induces less allergic reaction in infants than cow milk because it is easily digestible due to its less percentage of lactose (lactose is a major carbohydrate). Several studies report that the use of goat milk resolves 30% and 40% of the

cases (Haenlein 2004). Oligosaccharide is also a carbohydrate that is present in goat milk. It is beneficial to human nutrition because of their prebiotic and anti-infective properties. In animal models, goat milk oligosaccharides have been shown to have anti-inflammatory effects in induced colitis (LaraVilloslada et al. 2006).

CLA (Conjugated linoleic acid) is a bioactive lipid present in goat milk. It has anti-allergic and anti-inflammatory properties because it decreases the production of cytokines, prostaglandins and immunoglobulins that are associated with atherosclerosis, cancer and irritable bowel disease (Park 2009).

On the other hand, Sheep milk contains high amount of fat in milk than other dairy mammals (Mourad et al. 2014). Sheep milk has a high level of solids, fats and conjugated linoleic acid that makes it more suitable than other milk for producing high amount of cheese (Sinanoglou 2015).

Camel is a draught animal that has significance due to its nutritional and medicinal benefits. Its milk is called white gold of the desert (Wernery 2006). According to a prospective study conducted by Saltanat et al. (2009) aimed at assessing the influences of camel milk on the immune response of chronic hepatitis B patient, they found out that camel milk corrects the imbalance of Th1/Th2 cytokines network and inhibit the replication process of DNA by strengthening the cellular immune response, thereby improving the recovery chances of chronic hepatitis B patients (Saltanat et al. 2009).

Camel milk contains lactoferrin protein. Lactoferrin is an iron-binding glycoprotein, which plays an important role in host defense system against pathogenic organisms. In Egypt, a clinical study was performed for the role of camel milk in hepatitis C patients. The study shows that camel milk contains constituents that have the ability to decrease the level of alanine aminotransferase and aspartate aminotransferase (Redwan and Tabll 2007). Another study was performed by EL-Fakharany et al. (2012) on anti-infectivity of camel polyclonal antibodies against hepatitis C virus in Huh7.5 hepatoma. They perform three experiments on PBMCs and HuH7.5 cell. They found that camel milk-lactoferrin inhibits the HCV infectivity on direct interaction with HCV but human IgGs and casein failed to inhibit the HCV entry at any tested concentration. The concentration at which camel lactoferrin inhibits HCV replication was recorded to be at 0.25–1.25 mg/ml (EL-Fakharany et al. 2012).

12.4 Milk Products and Their Benefits

For over many centuries, Milk has been an invaluable dietary source of nutrition to humans in the production of both fresh and storable nutritious foods. In some parts of the globe more than a quarter of the milk produced is consumed as fresh pasteurized whole, low-fat, or skim milk. However, most milk is manufactured into more standardized dairy products of global economic importance, such as butter, cheese, dried milks, ice cream, and condensed milk. Milk or dairy products are the kinds of foods that are obtained primarily from or contain milk of mammals such as cattle, goats, sheep, etc. Milk can be used in different forms such as yoghurt, cheese, butter and ice cream.

Yoghurt is a fermented form of milk it contains probiotics that act as an immunomodulator and prevent inflammatory conditions such as inflammatory bowel disease (Lorea Baroja et al. 2007). Yoghurt used for hepatitis and HIV patients (Deems et al. 1993).Yoghurt is beneficial for lactose intolerance patients (He et al. 2008).

Butter is a pale yellow substance has solid texture at room temperature.it is also a milk product contains nutrients that present in milk but the fat value is high in them. It is a rich source of energy due to high-fat content, also prevent from night blindness because it contains vitamin A. great source of short-chain fatty acid (CLA) which reduce the inflammation and cancer risk (Ip et al. 1999).

Cheese is a milk product which contains almost the same nutrients present in milk such as protein, fat and minerals. It is the best source of energy for underweight people to gain healthy weight. Settanni and Moschetti studied the cheese quality improvement technique by using the non-starter lactic acid bacteria (NSLAB) to improve the quality of cheese. This bacterium (NSLAB) has the potency to produce bioactive peptides and improved probiotic quality (Settanni and Moschetti 2010).

12.5 Conclusions

Milk and milk products exert biological and nutritional effects that are beneficial to health. Use of milk and milk products according to our body requirement improves the health and nutritional status. Milk has natural ingredients such as bioactive peptides, casein or whey proteins and other ingredients that confer functional food properties to it. Further research that will harness the intrinsic nutrients in milk via quality processing techniques would help to produce viable milk products that would be beneficial to both healthy and immune-compromised patients.

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