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An Overview on Properties and Constituents of Cow's Milk

Durgesh Nandan[1], and Dr. Prafull Kumar[2]

[1,2]Assistant Professor, Department of Agriculture, Sanskriti University, Mathura, Uttar Pradesh, India

Correspondence should be addressed Durgesh Nandan; durgesh.soa@sanskriti.edu.in

ABSTRACT- Milk is an exceptionally valuable basic material due to its relative ease of conversion into a broad range of goods. In certain instances, milk receives very little processing, Heating processing to lengthen the microbiological shelf life of the product and homogenized to avoid fat segregation to prolong the physiological storage lifetime. 2 extra well ways for coagulating dairy are alkaline thrombosis for yoghurt and enzymes clotting for cheeses. Milk might also be sprayed-dried or utilized as a basis for isolating components such as proteins or lipids. Milk, and products produced from it, have been the focus of scientific research for almost a century as a consequence of its extensive applications and usage in human nutrition. This chapter provides a brief review of the components and characteristics of milk, with a focus on heat-induced changes in milk. This section focusses mostly on cow 's milking; milking from additional significant dairying animals differs in various ways from cow 's milk, but is is within the the purview of this section. To compare the components and characteristics of milk from cows, buffaloes, goats, and sheep.

KEYWORDS- Cow, Lactose, Milk, Protein.

I. INTRODUCTION

Milk provides all of the nutrients that a newborn needs It's long been thought of as evolution's perfect feast; it also contains a wealth of defensive managers, enzymes, and development hormones[1]. Humans have domesticated animals for millennia in order to get milk[2]. Sheep and goats were probably the first animals domesticated for this purpose, Cattle appeared around 8000–10 000 year old following by humans, which are currently the main species for dairying. Since then, total yearly global milk output has increased to 600 million tonnes. Cow's milk accounts for the overwhelming bulk of milk generated globally; buffalo, goat, and sheep milk are the most common other kinds of milk [3]–[5].

Milk is often characterized as a colloidal solution comprising emulsified fat globules, a diverse family of major and minor proteins, the carbohydrate lactose, minerals, vitamins, and enzymes. While the classifications of components in milk from most species are similar, there are significant qualitative and quantitative variations across species (i.e. the amount of each constituent per litre)[6]. This section delves further into the constitution and components of bovine milk [7]–[9].

Fresh cow's bleed has a lot of variation in terms of composition and characteristics[10]. The following are the major causes of such variation:

- Genetic influences (e.g. breed and individual),
- Lactation stage,
- The cow's overall health and
- Factors of environmental.

Various cow breeds have been chosen based on their intended purpose (milk or meat) and environmental factors (such as climate, diet, and topography), resulting in a broad range in milk composition[11]. However, during the past 50 years, vigorous selection of cow breeds has significantly decreased this kind of diversity. The variations in milk composition that occur throughout a cow's lactation cycle are extensively documented[12]. Colostrum, the first breast secretion following parturition, has a higher protein content, especially serum protein. This high protein level is mainly due to high levels of immunoglobulin. Other milk components show seasonal fluctuation as well [13], [14].

The health of the cow has a substantial influence on milk supply and quality. Oestrus and gestation have the greatest impact on milk production, although mastitis, For instance, pathogenic organisms may induce a serious irritation of the mammary glands, has an impact on both milk composition and yield[15]. Mastitis is defined by elevated blood component levels in milk[16]. Finally, severe temperatures, stress, fatigue, housing, milking method, and milking frequency are all variables that affect milk production and composition [17], [18].

A. *Milk constituents*

1) *Lactose*

Glucose is a carbohydrate found in most mammalian milks, with the exclusion of sea lion, seal, and opossum milk, where it is either missing or present in extremely low quantities[19]. Lactose is the primary starch found in most animals' milk, although tiny quantities of other carbohydrates may also be found; cow's milk includes 10 mg L1 monosaccharides (glucose and galactose) and 100 mg L1 oligosaccharides. Lactose in cow 's dairy accounts for 50% of the osmosis tension in milk, with 4.8 g lactose per 100 g1. Lactose percentage declines dramatically as the breastfeeding phase progresses and the milk's somatic cell count rises; this is due to the inflow of NaCl from the blood and the resulting requirement for a reduction in lactose concentration to maintain osmotic equilibrium in both instances[20].

Milk is a glycosidic bonds consisting of d-glucose and d-galactose, with galactose's alkene glycosylated to glycogen. Lactose is made from glucose in the breast secretory cells' Golgi apparatus[21]. Lactalbumin, a whey protein, is essential in lactose production because it causes the Glucose-nonspecific galactosylt ransferase to becomes glucose-specific. As a result, lactalbumin has the capacity to stop lactose production and regulate and manage osmotic pressure if required[22].

2) Milk Salts

The primary salts in milk include sodium, potash, magnesium, and magnesium phosphorous, ascorbate, chlorine ions, chloride, carbonates, and bicarbonates. Table 2.4 shows the average mineral content of bovine milk[23]. The salt concentration of dairy is not equivalent to the minerals level since it contains both biological and exogenous ions, and the salt content is not equal to the ash content. The salt content of milk is affected by a variety of variables, includes species, lactating phase, and nutrition, as well as the kind of the animal. Jersey cow milk, for illustration, has greater magnesium and phosphorus but lower salt and chlorine than dairy from others strains.

Chloride ions, salt, and potassium are some of the salts found in milk, have a high enough solubility to be found nearly completely in soluble milk serum. Several other salts, notably calcium phosphate, have concentrations that surpass their absorption at milk's normal pH (6.6). As a consequence, these ions coexist in two states: partly solubility and completely colloid, which means they are attached to chitin microspheres. Because calcium and phosphate predominate, Microemulsion calcium (MCP) or cytoplasmic cement phosphatase (CCP) are the most common colloidal salts, however potassium and oxalate are also prevalent[24].

3) Lipid

Ethoxylated of fatty and related constituents that are accessible in nonpolar solutions are known as lipids[25]. Cow's milk has a fat content of 33 to 47 grams per liter. The concentration of lipids in a species changes according on the breed, individual animal, lactation stage, mastitic illness, and feeding plan. Cow's milk lipids are made up of 98 percent lipids and sphingolipids , Diglycerides, monoacylglycerols, chole, cholesteryl ester, and residues of fat-soluble nutrients and various triglycerides are present in small amounts. Cow's milk fat contains about 400 distinct fatty acids, the majority of which are found in trace quantities. In cow's milk fat, the concentration of the main fatty acids. Fatty acid composition has a significant impact on crystallisation characteristics and the melting point of fat ; therefore, fatty acid composition is essential for goods like butter and spreads. Because the fatty acid composition is strongly In places where dairy availability is periodic, significant seasonal fluctuations in butter firmness might be noticed, which are influenced by lactation phase.

4) Proteins

At pH 4.6, cow's milk comprises around 30–35 g L1 peptides, which are split into intractable protein and soluble whey proteins based on mobility. Dairy antibodies have been investigated for almost 200 decades and may be present in a wide range of meals and non-food things.

- Whey proteins: Whey proteins, also known as serum proteins, make up around Cow's milk contains 20% of total milk proteins. In their native condition, whey peptides are accessible at pH 4.6 or in saturating NaCl, remain soluble following rennet-induced casein micelle coagulation, and cannot be sedimented by ultracentrifugation. Amongst protein are lactoglobulin (lg), lactoglobulin (la), plasma blood albumin, lactoferrin, and proteose paragon. of the whey protein class. β-lg is the most abundant individual whey protein in milk from most animals. β-Lg is produced in the mammary gland's epithelial cells. Cow's β-lg is a monomeric protein having 162 residues per monomer, a molecular mass of 18.3 kDa, and an isoelectric point of pH 5.1. Cow's -lg is more often present in genetic variations A or B, although it has also been reported in genetic variations C and D. At regular milk pH, -lg is available in the shape of adduct in cow 's breast, produced via hydrophobic contact. The three-dimensional structure of the natural spherical peptide -lg is well-defined, consisting of a -helix along 1 side of a -barrel. β-Lg has two intramolecular disulphide bridges and one free sulfhydryl group that is unavailable for interaction in the natural form of the protein.
- Caseins are the most common type of milk proteins, accounting for about. In cow's milk, 80 percent of the total protein is found. Caseins are phosphoproteins that are hydrophilic, have a large charged, and include a lot of lysine and relatively few cysteine residues, unlike most other proteins. Caseins have very little secondary architecture, with just a few -helical domains. The bulk of caseins in cow's milk reside as casein micelles rather than in solution. Micelles include inorganic mineral components and are highly hydrated (3gH2O g1 protein). Micelles have a diameter of 50 to 300 nm and a mean chemical weight of 108 Da (average 100 nm). Over the past five decades, much study and debate has focused on the microstructure of casein micelles, yet there is still a lack of broad agreement on the issue. For the cow casein micelle, many models have been suggested; a full study of The subgrade This paragraph's scope is considerably too broad to include casein, but a short summary will follow.

5) Indigenous Milk Enzymes

Approximately 20 enzymes have been identified in cow's milk. The presence of an additional 40 enzymes has also been shown by their activity. Native milk enzyme might be discovered in chitosan spheres, dairy fat viscoelastic substance walls, milk sera, or somatic cells, and they can come from blood, epithelial cells, the MFGM, or the cytoplasm of cells. These milk proteins might cause dairy and cheese foods to lose quality or undergo positive changes, and they can be used as markers of horse welfare or milk's temperature histories, as well as provide protection. The major, technologically significant Lactoperoxidase, alkali naoh, plasmin, lipid protease, and indigenous milking enzymes, are discussed in this section. Plasmin is the most common native proteinase found in milk. It's part of a sophisticated protease system in dairy that also includes dormant ’s fiercely, thrombin boosters that catalyze the conversion of thrombin to fibrin, xarelto inhibitor, and hemostasis sensitizers. Plasmin and laminin are formed from mammalian plasma and are usually present in casein micelles in milk.

Lipoprotein lipase is a milk lipase produced by the secretory cells of the mammary gland. In tri-, di-, and monoglycerides, LPL frees fatty acids from locations 1 and

3 in two steps: first, it collects at the solvent contact, then it coordinates its surface with the substrate monomer and dissolves in moisture it. Free fatty acids are produced during lipoprotein lipase, which might cause milk to turn hydrogel sour.

The mammary gland produces alkaline phosphatase, a phosphomonoesterase having a pH range of 9.0–10.5 and a temperature range of 37°C. ALP is made up of 2 similar 85 kDa monomers that form a heterodimer that each contain four zinc atoms that are needed for action. In the MFGM, ALP is mostly linked with phospholipid particles. This enzyme can dephosphorylate caseins under certain circumstances and is active against a broad variety of substrates. It hydrolyzes most phosphate ester linkages and can hydrolyze most phosphate ester bonds.

However, ALP's technical relevance heat irradiation and apparent simplicity of detecting are associated for many dairy solids. ALP is heat sensitive, having only somewhat greater heat stability as non-spore generating harmful microorganisms present in milk. As a consequence, heat inactivation of ALP has been successfully employed as a sensitive indication for appropriate pasteurisation of milk; however, caution should be used since reactivation may occur during later storage, resulting in misleading ALP-positive test findings.

B. *Variations in the Physical Qualities of Milk Caused by Heat*

1) *pH*

The pH of typical milk from a healthy cow is between 6.6 and 6.7; lower pH readings indicate the development of lactose-fermenting bacteria or severe lipolysis. Higher pH levels in milk may occur when the producing animal is under physiological stress and the Variations in the porosity of the body barrier disturb the minerals equilibrium of milk. Temperature affects milk pH, which decreases with rising temperature owing to changes in ionisable group dissociation. Due to the hydrolysis of esters, particularly phosphoric esters, lipolysis may lower the pH of milk.

2) *Capacity of Buffering*

Milk's buffering capacity refers to its ability to withstand changes in pH in either an alkaline or acidic direction. Small molecules (such as salts and organic acids) and proteins, among others, contribute to milk's buffering ability. The maximum buffering capacity of caseins is around pH 5–5.5, whereas that of whey proteins is around pH 3–4; the precise maximum varies depending on the amount of acidic amino acids as well as phosphoserine and histidine residues in specific proteins.

3) *Creaming*

The density differential between milk fat globules and milk serum causes Splitting of dairy into creamy and skimmed milk stages by creaming or gravity. However, given the relatively tiny size of milk fat globules, the rate of creaming of raw milk is considerably quicker than would be expected just on the basis of density differential. Because fat globules form clusters through a complicated mechanism including immunoglobulins (or cryoglobulins) and lipoproteins, fast creaming ensues; these clusters rise quickly owing to a significantly increased effective width.

II. DISCUSSION

Due to variables such as lactation stage, seasonality, breed, nutrition, milking technique, and health, Dairy foods are made from milk, which is a remarkably malleable basic ingredient; its composition and processing properties may vary in a complicated way. The levels of several milk components and enzymes vary in later phases of the lactation cycle, including changes in the mineral balance, decreased casein, increased whey protein content, and enhanced plasmin activity. Mastitis causes comparable changes in milk composition and processing abilities, and these changes are usually linked with milk somatic cell count (SCC). On the quality of milk and dairy products, there are also interaction impacts of variables like SCC and lactation stage, as well as nutrition and lactation stage.

These modifications have the potential to have a major impact on the quality of dairy products. Changes in milk quality, for example, have a detrimental impact on rennet coagulation characteristics, cheese production, composition (e.g. moisture content), texture, and flavor, all of which are influenced by milk quality, such as lactation stage and SCC. In a recent study, it was discovered that Cheddar cheese made from late-lactation milk had a higher rate of proteolysis than Cheddar cheese created from milking from an april herd in early or mid-lactation, and that the volatility spectra of dairies prepared from milk at various phases of breastfeeding vary.

III. CONCLUSION

Milk is a highly complex biological substance that contains a multi-phase system comprising various groups of nutritional and technologically important components, the quantities of which vary according to a variety of circumstances. It's also a dynamic system that's very sensitive to changes in the environment, such as temperature and pH. Changes in such characteristics have been used for millennia to create a variety of dairy products and guarantee their safety for customers. The composition and quality of milk are also affected by the frequency of milking; for example, compared to twice-daily milking, once-daily milking lowers milk production, increases fat and protein content, decreases lactose content, and changes the mineral balance. The cheese-making properties of milk from Friesian and Jersey cows, as well as animals of various genetic variations, were compared. It has been suggested that genotypic selection may be used to identify cows that fit particular milking frequency or lactation lengths, and that such cows within herds can then be grouped to provide milk for specified uses. Furthermore, the microbial condition of milk influences the taste of milk items directly. Milk is the source of many of the spoilage or pathogenic microorganisms that cause problems in dairy products.

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