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Review Article

The effects of bovine milk fat on human health

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ABSTRACT

Introduction: Recent years have witnessed a growing interest in the nutritional value and health benefits of food products of animal origin. Numerous research studies have been undertaken to evaluate the effects of bovine milk, a key dietary component, on human health. Fat is one of the most important components in bovine milk, and its content ranges from 2.8% to 8.1%, subject to the breed of cattle, nutritional aspects, individual characteristics, lactation period, milk production hygiene and season.

Aim: The aim of this study was to review the latest literature concerning the health effects of components found in bovine milk fat.

Materials and methods: This paper is a literature review, and it analyzes the composition of bovine milk fat and its effects on human health. The available sources were grouped thematically, and an attempt was made to characterize various milk fat components and their effects on human health.

Discussion: The unique nutritional value of bovine milk can be attributed to the presence of short-chain fatty acids and medium-chain fatty acids which are important sources of energy for the muscles, heart, liver, kidneys, blood platelets and nervous system. They do not pose an obesity risk; they prevent ulcerative colitis, cancer, atherosclerosis and hypertension; they have anti-inflammatory and antibacterial effects, and they boost natural immunity. Milk contains cholesterol, a lipid derivative which stabilizes and stiffens cell membranes, builds the cell cytoskeleton, protects nerve fibers and acts as a precursor of steroid hormones, bile acids and vitamin D_3. Bovine milk lipids do not exert hypercholesterolemic or atherogenic effects in the human body.

Conclusions: A growing tendency to replace animal fats, mainly milk fat, with vegetable fats is a matter of concern.

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1. Introduction

Recent years have witnessed a growing interest in the nutritional value and health benefits of food products of animal origin. Numerous research studies have been undertaken to evaluate the effects of bovine milk, a key dietary component, on human health. Fat is one of the most important components in bovine milk, and its content ranges from 2.8% to 8.1%, subject to the breed of cattle, nutritional aspects, individual characteristics, lactation period, milk production hygiene and season. Milk fats contain simple lipids, compound lipids, free (unesterified) fatty acids, lipid derivatives (sterols and carotenoids) and accompanying substances, including fat-soluble vitamins A, D, E and K (Table 1).[4] Milk fat is synthesized in the form of lipid globules in mammary gland cells when glycerol binds with fatty acids. Raw milk is an emulsion of fat globules with a diameter of 0.1–20.0 μm in the aqueous phase. Lipids can be directly absorbed in the digestive system without hydrolysis, which contributes to the very high digestibility of milk fat (97–99%).

2. Aim

The aim of this study is to analyze the effects of compounds found in bovine milk lipids on the health of consumers of milk and dairy products.

3. Materials and methods

This paper involves a literature review, and it analyzes the composition of bovine milk lipids and their effects on human health. The consequences of excessive consumption or a dietary deficit of milk fat compounds are discussed.

Table 1 – Milk lipid composition.[4,30]

Lipid group	Components	Content	
		Of total fat (%)	Of fat (μg/g)
Simple lipids	Triacylglycerols	95.8–98.3	
	Diacylglycerols	0.28–2.25	
	Monoacyloglycerols	0.003–0.380	
Compound lipids	Phospholipids	0.20–1.11	
	Cerebrosides	0.1	
	Gangliosides	0.01	
Free fatty acids		0.1–44.0	
Derivatives	Sterols	0.30–0.45	
	Carotenoids		6–10
Accompanying substances	Vitamin A		6–20
	Vitamin D		Trace
	Vitamin E		5–100
	Vitamin K		1

4. Discussion

Bovine milk fat contains 400–500 fatty acids, of which 15 have an estimated 95% weight share of the total fatty acid pool in milk.[30] In ruminant milk, fatty acids are synthesized mainly by fermentation of volatile fatty acids in the rumen. The resulting fatty acids contain 4–14 carbon atoms. Long-chain fatty acids (LCFAs) are synthesized in blood plasma.[4,20,31,39,50]

The following fatty acids are found in bovine milk lipids:

(1) *Short-chain saturated fatty acids (SCFAs)* – butyric, propionic, acetic, valeric and isovaleric acid;
(2) *Long-chain saturated fatty acids* – palmitic and stearic acid (which regulate the synthesis of cholesterol and triglycerides);
(3) *Monounsaturated fatty acids (MUFAs)* – mainly oleic acid (n-9) which inhibits the absorption of dietary cholesterol, lowers low-density lipoprotein (LDL) cholesterol levels, decreases blood viscosity, lowers blood pressure, and vaccenic acid which demonstrates anti-atherosclerotic and anticarcinogenic activity;
(4) *Polyunsaturated fatty acids (PUFAs)* – linoleic acid (n-6) (LA) and linolenic acid (n-3) (ALA) which play important biological functions: they lower LDL cholesterol levels, limit triglyceride synthesis, regulate insulin secretion and are a source of tissue hormones, eicosanoids.

The presence of SCFAs and medium-chain fatty acids (MCFAs) (25% of total fatty acids) is a unique attribute of bovine milk. In the human body, these acids are used as sources of energy for the muscles, heart, liver, kidneys, blood platelets and nervous system. They are converted to heat during metabolic processes, and they do not pose the risk of obesity. Butyric acid prevents colorectal cancer by inhibiting DNA synthesis in the nuclei of neoplastic cells and preventing their growth. SCFAs may also play an important role in the prevention of ulcerative colitis.[3,4,40,41]

Fatty acids with long C chains account for 56–65% of total fatty acids. LCFAs have anticarcinogenic, anti-atherosclerotic, antihypertensive, anti-inflammatory, antibacterial and immunity-boosting effects.[4,44]

Bovine milk contains approximately 70% of saturated fatty acids and 30% of unsaturated fatty acids. The latter are composed of 83% of MUFAs and 17% of PUFAs.[7,36] PUFAs from the n-6 and n-3 families are components of cell membrane phospholipids. PUFAs regulate cardiovascular activity, blood pressure, hormonal activity, kidney functions and the immune response.[65] Dietary supplementation with n-3 PUFAs during pregnancy prevents preterm birth, contributes to the healthy body weight of the fetus and the infant, and minimizes the risk of allergic reactions.[4,18,33]

Mammals are incapable of synthesizing PUFAs; consequently, their diets should be supplemented with these crucial fatty acids. Milk, in particular human milk, is a rich source of PUFAs. Bovine milk, which contains lower levels of PUFAs, in particular indispensable n-3 fatty acids, LA ($C_{18:2}$) and ALA ($C_{18:3}$), may be a substitute for human breast milk. LA is an essential component of cell membrane