A Review on Fermented Milks and Milk Products as Functional Foods

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ABSTRACT: Milk is thought to be the only food that includes almost all of the components that are known to be necessary for human nutrition. Dairy foods have been found to be both preventive and detrimental in terms of cancer risk. The evidence suggesting dairy foods may either prevent you from cancer or raise your chances of getting cancer is inconclusive. Overall, the health advantages of dairy foods much exceed the risks that have yet to be demonstrated. Dairy foods should be included in a diverse and healthy diet since they are important for bone and dental health, as well as preventing osteoporosis, major cardiovascular disease risk factors, hypertension, type 2 diabetes, metabolic syndromes, and certain malignancies. Milk and milk products should be consumed in three portions per day, according to the Cancer Council and the USDA. This article examines the ability of milk and milk products (both indigenous and foreign components) to reduce the incidence of certain cancers. The studies that have indicated milk and the dairy industry as cancer-causing substances throughout the years are also examined.

KEYWORDS: Fermented Milks, Bifidobacteria, Lactic Acid Bacteria, Probiotics.

1. INTRODUCTION

Cancer is the greatest cause of death and disability worldwide, accounting for 7.6 million deaths per year. Because only 5% to 10% of all cancer cases are caused by genetic defects, and the remaining 90% to 95% are caused by lifestyle factors (such as smoking, diet and nutrition, alcohol, physical inactivity, obesity, and sun exposure), infections, and environmental pollutants, there are significant opportunities for cancer prevention. Within the realm of lifestyle variables, it is well acknowledged that diet and associated factors have a significant influence in the development of cancer. Observational data indicates that 30 to 40 percent of cancer occurrences might be avoided by changing dietary variables and eating habits.

Milk and milk products are classified as functional foods, implying that their intake has a direct and substantial impact on health outcomes, and that their consumption is linked to a lower risk of a variety of malignancies. Stone engravings from the Sahara desert show that milk and other dairy products were recognized as essential diets as early as 4000 BC. It is one of the most essential parts of the human diet, especially in the Western world, but also in Asia. Milk is thought to be the only food that includes almost all of the components that are known to be necessary for human nutrition. Milk is a good source of protein, calcium, and B vitamins (thiamin, riboflavin, niacin, vitamin B6, and folate), as well as vitamin A, C, magnesium, and zinc. Lactose is a kind of carbohydrate that is usually regarded to be low in carcinogenicity. In addition, around a third of the fat in whole milk is monounsaturated, and it contains tiny quantities of important fatty acids. Despite being a small component of milk fat, milk is one of the most important sources of conjugated linoleic acid (CLA) in the diet [1]–[3]**.**

Several milk components, including vitamin D, proteins, calcium, CLA, butyrate, saturated fatty acids, and pollutants including pesticides, estrogen, and insulin-like growth factor I (IGF-I), may be responsible for either a beneficial or detrimental relationship between dairy products and malignancies. The major cancer-causing chemicals found in milk and dairy products may be divided into many categories. The preventive and inductive effects of dairy products on cancer risk are discussed in this article [4], [5].

1.1. Preventive Effects of Milk and Milk Products Consumption on Cancer:

1.1.1. Colorectal cancer:

Colorectal cancer is the third most prevalent cancer in the world, with 1.2 million new cases reported in 2008, accounting for 9.7% of all malignancies (Ferlay and others 2010). Increased intake of milk or dairy products has been linked to a lower risk of colon cancer. A large pooled study of data from ten cohorts (n = 534, 536) from five countries discovered 4992 people who had colorectal cancer at follow-up. Colorectal cancer risk was

decreased by 15% in those who drank more than a glass of milk (250 g) each day (relative risk 0.85, 95 percent CI 0.78 to 0.94).

The findings of a large prospective cohort research revealed an adverse relationship between dairy products and calcium and digestive malignancies in both men and women, particularly colorectal cancer. A number of research (epidemiological, animal, laboratory, and clinical trials) have shown that increasing calcium and/or dairy product consumption lowers the risk of colon cancer. Calcium intakes of 1200 to 1500 mg/d, or 4 servings of dairy products per day, seem to be the most beneficial in preventing colon cancer. Calcium, which has been theorized to prevent colon cancer by binding secondary bile acids and ionized fatty acids and so decreasing their proliferative effects in the colonic epithelium, is found in dairy products. Calcium has also been found to affect various intracellular pathways leading to differentiation in normal cells and death in transformed cells, as well as reducing the frequency of mutations in the K-ras gene in rat colorectal neoplasms.

Calcium and dairy products have been shown to decrease cell growth in the colon and rectum in many clinical studies. Each 500 mL increase in milk consumption resulted with a 12% decrease in colon cancer risk, according to data compiled from ten cohort studies. When Ricotta cheese was consumed at a rate of more than 25 mg per day, the risk of colorectal cancer was reduced by 17%. Calcium administration reduces colon adenomatous polyps and cancer rates, according to epidemiologic intake and intervention studies, and this impact may last for a long time. Furthermore, the findings of a case-control research conducted in New Zealand showed that daily milk intake in infancy may decrease the risk of colorectal cancer, perhaps due to calcium's effect on the formation of adenoma. For every 100 half-pint bottles consumed (1 half-pint bottle = 284 mL), participation in school milk programs was linked to a 2.1 percent decrease in the odds ratio for colorectal cancer [6]–[8].

The majority of data indicates that calcium's impact is reliant on or partly linked to concurrent vitamin D consumption. Vitamin D may also lower the incidence of colon cancer in the absence of increased calcium or dairy items in the diet. Calcium's effects on colorectal carcinogenesis are modulated by vitamin D. A large case-control study in a Japanese population found inverse associations between dietary calcium and vitamin D and colorectal cancer risk, indicating that dietary changes to increase calcium intake while maintaining adequate vitamin D status through diet and moderate sun exposure had significant potential in the prevention of colorectal cancer in Japanese adults.

1.1.2. Breast cancer:

Breast cancer is the most prevalent disease in women, with an estimated 1.4 million women diagnosed in 2010. CLA has been shown to protect the mammary gland from carcinogenesis in animal and in vitro studies, possibly by inhibiting the cyclooxygenase-2 or lipooxygenase pathways or inducing the expression of apoptotic genes. Women who consumed a lot of low-fat dairy products throughout their premenopausal years showed a nonsignificant negative relationship with breast cancer risk in the Nurses' Health Study II. A meta-analysis of prospective cohort studies found that low-fat dairy intake, but not high-fat dairy consumption, is linked to a lower risk of breast cancer, which is consistent with existing data [8], [9].

In several prospective studies, calcium consumption was shown to be inversely linked to lowering the risk of breast cancer. A population-based prospective cohort research discovered a negative relationship between calcium consumption and pre- and postmenopausal breast cancer risk. Women who ate 25 grams of white cheese per day had a 50% lower risk of premenopausal breast cancer than women who ate less than 6 grams per day, according to the findings. Calcium's anticarcinogenic properties may be mediated by a number of mechanisms:

a) reducing cell proliferation and inducing mammary cell differentiation
b) fatty acids and mutagenic bile acids are likely to be bound and neutralized,
c) reducing fat-induced epithelial hyperproliferation in mammary glands of rodents.

Calcium is metabolically linked to vitamin D, which has also been linked to breast carcinogenesis, and it has been proposed that part of calcium's anticarcinogenic effects may be mediated via vitamin D. Calcium, for example, may have a role in apoptosis caused by 1, 25(OH)2D (the active form of vitamin D). Vitamin D and calcium intakes protect against breast cancer, according to a new meta-analysis, especially in premenopausal women. A large cohort research found that women who consumed the most dietary calcium (>1250 mg/d) had a reduced risk of breast cancer than those who consumed less than 500 mg/d [RR, 0.80; 95 percent confidence range (95 percent CI), 0.67 to 0.95; P = 0.02]. The findings of the latter research back up the hypothesis that

dietary calcium and/or other components found in dairy products may help women avoid breast cancer after menopause.

1.1.3. Ovarian cancer:

Ovarian cancer has the greatest fatality rate among all gynecological malignancies, and it is the fourth largest cause of cancer death in women. The idea that vitamin D might be a broad-spectrum anticancer agent has piqued people's attention. Ovarian cancer is one of the cancers that has been related to vitamin D deficiency. There is evidence that the ovarian epithelium includes receptors for the active form of vitamin D, and in vitro experiments have demonstrated that vitamin D and its analogues suppress the development of ovarian cancer cells. Vitamin D and calcium may have a role in the prevention of ovarian cancer, according to dietary research. There are scientific grounds to believe that 1,25-$(OH)_2$ D, the active form of vitamin D, is linked to ovarian cancer incidence and death. Human ovarian tumor tissues and cell lines, for example, have the vitamin D nuclear receptor, which mediates the action of 1,25-$(OH)_2$D (3 : 34). Furthermore, 1,25-$(OH)_2$ D suppresses cell growth and causes apoptosis in ovarian cancer cell lines [10].

Some studies have shown an inverse association between dietary calcium and ovarian cancer, but not all. Though the molecular mechanisms by which calcium may affect ovarian cancer are mainly unclear, the following are some potential pathways:

1. Calcium's impacts on apoptosis, cell growth, and proliferation, to name a few.
2. Calcium receptor (CaR) impacts on cell proliferation and differentiation
3. alcium's role in reducing parathyroid hormone (PTH) synthesis..

As a result, calcium may be able to counteract PTH's mitogenic and antiapoptotic actions by inhibiting PTH synthesis. Low-fat milk intake was shown to be inversely related to the incidence of ovarian cancer in a case-control study.

1.1.4. Bladder cancer:

Bladder cancer is the 9th most prevalent cancer in the planet. Because most chemicals or metabolites, including carcinogens, are discharged via the urine system, a role for food and nutrition in bladder carcinogenesis seems conceivable. Milk and dairy products consumption has been linked to a lower risk of bladder cancer. To present, meta-analyses of cohort data show a negative relationship between milk consumption and the incidence of colorectal and bladder malignancies. Consumption of skim milk and fermented milk with a low fat level has been linked to a lower risk of bladder cancer, whereas whole milk with a high fat content has been linked to a higher risk of bladder cancer. Casein is the most abundant protein in skim milk powder and has anticancer properties. Whey-rich diets have been proven to decrease colon and mammary malignancies in experimental animals.

1.1.5. Prostate cancer:

Prostate cancer (PCa) is the second most common malignancy in men (Greenlee and others 2000). While it has been shown that genetic factors play a role in the development of hereditary prostate cancer (HPC), the preventive and/or therapeutic effects of different dietary components have only recently been discovered. Several epidemiologic findings have sparked interest in vitamin D as a prostate cancer preventative agent. High circulating levels of vitamin D and its active metabolite 1,25(OH)2-vitamin D (1,25(OH)2D) (500- to 1000-fold more active than vitamin D) appear to inhibit prostate carcinogenesis in vitro by reducing prostate cellular proliferation and enhancing cellular differentiation, according to laboratory evidence. Induced apoptosis also reduced cell adhesion and migration, as well as metastasis, despite the fact that calcium-rich dairy products, which lower blood vitamin D levels, are linked to a greater risk of prostate cancer.

1.2. Functional chemical-enriched compounds:

A meal may be considered "functional" if it has been shown to have a positive impact on one or more target functions in the body, in addition to providing sufficient nourishment. Fortified-functional dairy products are added-value products that include at least one chemical or microbiological component that has been shown to have a health benefit. Mineral- and vitamin-enriched milk products are the most common fortified dairy products, since mineral and vitamin deficiencies are a major public health issue in many poor nations, as well as in

developed ones. Iron, zinc, selenium, iodine, and calcium are all common mineral and trace element deficits. Vitamin A, vitamin D, and folic acid deficiency are perhaps the most common vitamin deficiencies today.

Calcium enrichment of foods and dairy products is gaining popularity as people become more aware of the significance of getting enough calcium. Aside from osteoporosis prevention, sufficient calcium consumption has been linked to a lower risk of hypertension, colon cancer, kidney stones, and lead absorption. As a result, vitamins A and D, calcium, and iron are often added to dried milk and flavored milk powders. Although dairy products are a good source of calcium, they may be fortified with calcium salts to increase the amount of calcium in each meal. In the United States, the daily calcium requirement for children and adults is 800 mg and 1200 mg, respectively. Calcium fortification of dairy products including cheese, ice cream, skim milk, and yogurt has become commonplace in recent years.

2. DISCUSSION

During the processing of milk and milk products, as well as during storage time, numerous compounds are produced or changed that could associate with different types of cancer. Severe heating in the dairy industry and exposure to sunlight are the most important factors that could produce changes in dairy ingredients (such as proteins, fats, carbohydrates, and vitamins) and generate compounds with carcinogenic and mutagenic potential. Improper reactions such as pyrolysis, fat oxidation, and the Maillard reaction can noticeably be intensified by elevated temperatures. High-fat and creamy dairy products (such as some types of yogurt, cheeses, and desserts) are susceptible to fat auto-oxidation and photo-oxidation and the oxidation reactions can lead to formation of free radicals and polymerized compounds that are carcinogenic. Severe heat treatments enhance fat oxidation. The Maillard reaction has considerable consequences on the quality of heated milk and milk products in terms of color, flavor, and nutritional value, and probable toxic compounds. Also, some Maillard reaction products can enter oxidative reactions. Heat treatments and homogenization of milk causes oxidation of valuable anticancer CLA through exposure to high temperatures, high pressures, and reduction of fat globule size. Cholesterol oxidation products (COPs) are found in dairy products. Published results have suggested that the content of COPs in milk and dairy products is very small. Formation of COPs in milk and milk products can only occur under harsh conditions such as the application of high heating temperatures for a long period or long storage at high temperatures, and in the case of foods in the dehydrated state or at low water activities. In addition, powdered milk contains oxidized cholesterol, a product that further contributes to the oxidative stress in those who consume the milk. COPs have many biological effects such as atherogenic, cytotoxic, mutagenic, and carcinogenic. Additives such as flavors, colors, sweeteners, antioxidants, and antimicrobial preservatives could possess toxic side effects when exceeding their respective permitted dose of consumption per day. For instance, brilliant blue FCF, used as a coloring agent, can induce cancer, malignant tumors, asthma, and hyperactivity. An acceptable daily intake (ADI) of Brilliant Blue FCF is 12.5 mg/kg bw/d that has been previously evaluated by the Joint FAO/WHO Expert Committee on Food Additives and the EU Scientific Committee for Food. In 1984, according to the present data set on the absorption, distribution, metabolism and excretion, genotoxicity, subchronic, reproductive, developmental and long-term toxicity, and carcinogenicity, the SCF revised the ADI to 10 mg/kg bw/day.

3. CONCLUSION

Milk and dairy products may have both beneficial and adverse effects with regard to the risk of different cancers. The evidence indicating healthful effects of milk and milk product consumption on prevention of cancers is considerably greater than those representing harmful impacts. In fact, there is certainly no evidence that milk consumption might increase death from any condition. The occasional reports about the probable causative effect of milk or milk product consumption on some types of cancer, such as prostate cancer, that there is ample convincing evidence through thousands of years of consumption that shows their definite impact on health, health maintenance, survival, and longevity. Moreover, a decisive and conscientious consideration of the relevant literature reveals that the probable harmful effect of milk and dairy product consumption related to cancer is dose-dependent. Therefore, harm for normal people could only occur with absolutely excessive and indiscriminate consumption rather than regular moderate daily intake as advised by nutritionists and products that are grossly (and illegally) contaminated with environmental pollutants or certain toxicants could spell harm to human health.

REFERENCES:

[1] V. K. Shiby and H. N. Mishra, "Fermented Milks and Milk Products as Functional Foods-A Review," *Critical Reviews in Food Science and Nutrition*. 2013, doi: 10.1080/10408398.2010.547398.

[2] V. K. Shiby, & H. N. Mishra, and H. N. Mishra, "Critical Reviews in Food Science and Nutrition Fermented Milks and Milk Products as Functional Foods—A Review Fermented Milks and Milk Products as Functional Foods—A Review," *Crit. Rev. Food Sci. Nutr.*, 2013.

[3] M. L. Marco *et al.*, "Health benefits of fermented foods: microbiota and beyond," *Current Opinion in Biotechnology*. 2017, doi: 10.1016/j.copbio.2016.11.010.

[4] L. M. Beltrán-Barrientos, A. Hernández-Mendoza, M. J. Torres-Llanez, A. F. González-Córdova, and B. Vallejo-Córdoba, "Invited review: Fermented milk as antihypertensive functional food," *J. Dairy Sci.*, 2016, doi: 10.3168/jds.2015-10054.

[5] L. M. Beltrán-Barrientos *et al.*, "Randomized double-blind controlled clinical trial of the blood pressure–lowering effect of fermented milk with Lactococcus lactis: A pilot study2," *J. Dairy Sci.*, 2018, doi: 10.3168/jds.2017-13189.

[6] F. B. Ahtesh, L. Stojanovska, and V. Apostolopoulos, "Anti-hypertensive peptides released from milk proteins by probiotics," *Maturitas*. 2018, doi: 10.1016/j.maturitas.2018.06.016.

[7] H. Beheshtipour, A. M. Mortazavian, R. Mohammadi, S. Sohrabvandi, and K. Khosravi-Darani, "Supplementation of spirulina platensis and chlorella vulgaris algae into probiotic fermented milks," *Compr. Rev. Food Sci. Food Saf.*, 2013, doi: 10.1111/1541-4337.12004.

[8] C. Jans *et al.*, "African fermented dairy products – Overview of predominant technologically important microorganisms focusing on African Streptococcus infantarius variants and potential future applications for enhanced food safety and security," *International Journal of Food Microbiology*. 2017, doi: 10.1016/j.ijfoodmicro.2017.03.012.

[9] N. Soleymanzadeh, S. Mirdamadi, and M. Kianirad, "Antioxidant activity of camel and bovine milk fermented by lactic acid bacteria isolated from traditional fermented camel milk (Chal)," *Dairy Sci. Technol.*, 2016, doi: 10.1007/s13594-016-0278-1.

[10] Z. Hafeez, C. Cakir-Kiefer, E. Roux, C. Perrin, L. Miclo, and A. Dary-Mourot, "Strategies of producing bioactive peptides from milk proteins to functionalize fermented milk products," *Food Research International*. 2014, doi: 10.1016/j.foodres.2014.06.002.