Dairy Foods May Contribute to Anti-Inflammatory Effects

Overview

Chronic inflammation plays a central role in the development of cardiometabolic conditions, including cardiovascular disease (CVD) and type 2 diabetes (T2D). Research examining the relationship between foods and overall eating patterns with inflammation has demonstrated that nutrition is a key influencer of chronic inflammation and risk of chronic disease. Authoritative health and wellness organizations and the 2025-2030 Dietary Guidelines for Americans (DGA) recommend nutrient-dense dairy foods (i.e., milk, cheese and yogurt) as part of healthy eating patterns to promote health and reduce risk of diet-related chronic diseases. A growing body of evidence links dairy food consumption with beneficial to neutral outcomes for systemic inflammation in adults across diverse populations and health states, with limited research in children. The current body of evidence supports the role dairy foods play as part of healthy eating patterns that promote health and wellness and help reduce risk of chronic diseases.

Nutrient-dense dairy foods can help promote health and reduce risk of chronic, inflammation-related diseases

Inflammatory responses vary in function and duration, with acute inflammation playing a key role in immune protection and tissue repair while chronic low-grade inflammation is a key driver of diet-related diseases that affect millions of Americans, including obesity, CVD and T2D.[1–5] A pro-inflammatory state disrupts optimal metabolic and vascular regulation, increasing risk of cardiometabolic diseases through processes that contribute to endothelial dysfunction, atherosclerosis and insulin resistance.[1–3,6] Inflammation is regulated through a variety of pro- and anti-inflammatory biomarkers (**Table 1**). [7–13]

Mounting evidence indicates that nutrition is a powerful modulator of chronic inflammation and, by extension, chronic disease risk.[14,15] Healthy eating patterns that include 2-3 servings of dairy foods daily, such as Mediterranean-style diets, the Dietary Approaches to Stop Hypertension (DASH) eating plan and lacto-ovo vegetarian patterns, have been associated with beneficial or neutral contributions to inflammatory markers including CRP, IL-6 and adiponectin.[16-19] Authoritative health organizations and guidelines – including the DGA, American Heart Association (AHA), American Diabetes Association (ADA), the Bone Health and Osteoporosis Foundation and National Medical Association – recognize nutrient-dense dairy foods (i.e., milk, cheese and yogurt) as part of healthy eating patterns to lower risk of chronic diseases such as CVD, T2D and osteoporosis.[20-25] The 2025–2030 DGA recommends 3 servings of dairy foods daily for a 2,000-calorie eating pattern.[24]

Dairy food consumption is not linked with chronic inflammation and may be anti-inflammatory in adults

Several recent systematic reviews of randomized controlled trials (RCTs) indicate that dairy food consumption has either beneficial or neutral effects on inflammation in both healthy adults and those with metabolic disorders.[26-31] A meta-analysis of 11 RCTs involving 633 adults from North and Central America, Europe and Australia found that higher dairy food consumption significantly reduced concentrations of CRP, IL-6 and TNF-α and increased adiponectin concentrations compared with lower or no dairy food consumption.[26] Five other systematic reviews reported modest to neutral anti-inflammatory effects of dairy foods on biomarkers such as CRP, interleukins and other cytokines, TGFß1 and IL-13.[27-31] These findings were observed in both healthy and metabolically impaired adults, with some evidence suggesting a potentially more pronounced benefit among those with metabolic conditions including overweight or obesity.[26,28,29,31] A systematic review of 52 clinical trials concluded that consuming both low- and high-fat dairy foods may have anti-inflammatory activity.[31]

As some consumers substitute plant-based beverages for dairy milk, a small but growing body of research has begun to examine how this substitution relates to inflammatory markers. A 2024 systematic review and meta-analysis of five trials (147 total adults) found that substituting soy beverage for dairy milk led to an approximately 22% reduction in the pro-inflammatory marker CRP.[32] A separate review of seven intervention studies examining dairy milk replacement with plant-based alternative beverages more broadly reported neutral or inconclusive effects on inflammatory markers.[33] Together, these two studies do not point to a consistent effect, and more research is needed to validate and better understand these findings.

Table 1. Biomarkers of Systemic Inflammation Evaluated in Dairy Intervention and Observational Studies [7-13]

Biomarkers associated with increased inflammation

C-reactive protein (CRP)

Interleukin-1 beta (IL-1ß), Interleukin-6 (IL-6), and Iinterleukin-8 (IL-8)

Lactoferrin

Leptin

Lipopolysaccharide (LPS)

Tumor necrosis factor-alpha

(TNF-α)

Biomarkers associated with decreased inflammation

Interleukin-4 (IL-4), Interleukin-10 (IL-10), and Interleukin-13 (IL-13)

Adiponectin

Transforming growth factor- beta 1 (TGFß1)

Recent observational[34-36] studies link dairy food consumption with benefits for inflammation, while intervention[37-41] studies indicate a beneficial to neutral role of dairy food consumption. The 10-year prospective ATTICA cohort study in Greece (1,885 adults) reported that consuming

>2 servings of dairy foods per day was associated with lower levels of CRP and TNF-α in both men and women and lower levels of IL-6 in men only.[34] Cross-sectional findings from the Women's Health Initiative (35,352 postmenopausal U.S. women) indicated that greater dairy food consumption regardless of fat level was linked with lower CRP levels.[36] Similarly, modeling based on data from the European Prospective Investigation into Cancer (EPIC)-Potsdam cohort, which included 10,880 men and 13,340 women, found that a high-fat dairy pattern was inversely associated with CRP in women.[42] Among 348 middle-aged healthy U.S. adults, total dairy food consumption was neutrally associated with markers of gut inflammation in fecal samples and plasma LPS concentrations.[43] Findings from 1,338 healthy Finnish men in the Kuopio Ischaemic Heart Disease Risk Factor Study also found no significant differences in low-grade inflammation risk between total dairy (including high- and low-fat) or fermented dairy food consumption.[44] A 2025 RCT examined the impact of consuming 3 cups compared to ≤1 cup of dairy foods per day in 30 Canadian adults with overweight/obesity, low physical activity and dairy food consumption plus ≥2 other cardiometabolic risk factors.[37] After 6 weeks, participants consuming 3 servings of dairy foods per day had improved pro-inflammatory TNF-alpha and IL-4 concentrations with no significant changes found in other inflammatory markers. Differences between sexes were found for certain inflammation biomarkers (higher IL-6 in males during high dairy condition).[37]

Study Spotlight: Dairy foods at a range of fat levels are designated as anti-inflammatory components of the dietary inflammation score

In 2019, Byrd et al. conducted a validation study of the Dietary Inflammation Score, which ranks foods by their evidence-based contributions to systemic inflammation.[35] In this U.S.-based study of 639 adults (45-74 years old) with cardiometabolic risk factors, both high-fat and low-fat dairy foods were designated as anti-inflammatory.

Fermented dairy foods may provide benefits for systemic inflammation in adults

A growing body of research examining fermented dairy foods like yogurt, kefir and certain cheeses indicates these foods may beneficially modulate systemic inflammation, with recent studies reporting neutral[38,43-50] to beneficial[27,29,34,40,51-63] outcomes for inflammation. A systematic review and meta-analysis of 14 RCTs across adult populations in 10 countries concluded fermented dairy foods reduced pro-inflammatory CRP concentrations.[62] The same analysis reported increases in interferon-gamma (IFN-γ) and interleukin-2 (IL-2),62 cytokines with complex, context-dependent roles in immune regulation.[64,65] Another systematic review and meta-analysis of 9 clinical trials (523 adults from the U.S., Iran, Korea and Spain) reported probiotic yogurt consumption, particularly for durations longer than 8 weeks, was associated with reductions in CRP, but not IL-6 or TNF-α concentrations.[55] Similarly, a systematic review and meta-analysis of 7 RCTs (385 total participants from Turkey, Brazil, Slovenia and Iran) found no impact of kefir consumption on CRP concentrations; however, in subgroup analysis, CRP concentration was reduced when kefir consumption exceeded 8 weeks.[49]

Results from recent observational studies[34,61] and RCTs[50,52,54,59] also suggest a link between fermented dairy food consumption and regulation of systemic inflammation. In data analyzed from 1,753 U.S. adults in the Framingham Offspring Study, yogurt consumers had lower levels of IL-6 and fibrin compared to non-consumers. The reduction in IL-6 was consistent across body mass index (BMI) categories, while a decrease in fibrin levels was more pronounced among adults with overweight.[61] During a 9-week RCT involving 120 premenopausal women, daily consumption of 12 ounces of low-fat yogurt was associated with reduced levels of pro-inflammatory TNF-α and increased anti-inflammatory TGFß1, regardless of weight status. Plasma LPS concentrations were not affected.[66] In a randomized, parallel trial of 92 women in China with obesity, nonalcoholic fatty liver disease and metabolic syndrome, yogurt compared to milk consumption reduced serum LPS and TNF-α while no changes were observed

observed for CRP or IL-6.[52] Authors hypothesized that yogurt may improve insulin resistance by reducing levels of serum lipids, inflammation, oxidative stress and LPS.[52] In an 8-week, double-blind, parallel-group study in Spain, daily consumption of 1.5 cups of fresh or pasteurized yogurt increased secretion of IL-6, IL-8 and IL-1ß and did not affect CRP or TNF-α.[58]

Emerging research indicates dairy food consumption is linked with beneficial to neutral impacts on inflammation in children

Limited research conducted in children and adolescents suggests a beneficial to neutral relationship between dairy food consumption and inflammatory markers.[51,67–69] Findings of a 2020 systematic review suggest whole and reduced-fat dairy foods are beneficially to neutrally linked with inflammatory biomarkers, based on two observational studies of Australian and U.S. adolescents.[67] O'Sullivan et al. also noted obesity as a potential influencer of results, with surrogate markers of dairy fat consumption (serum phospholipid levels of 17:0) inversely associated with CRP and positively associated with adiponectin in overweight adolescents only.[67] Similarly, a pilot RCT in 46 Australian children (4-6 years old) found no impact of consuming whole-fat compared to reduced-fat dairy foods on CRP levels.[68] In a cohort of 412 Portuguese children, higher dairy food consumption was linked with lower inflammation among healthy weight but not overweight adolescents.[51] Aslam et al. conducted an observational analysis of 1,338 Greek children in the Healthy Growth Study evaluating leptin, a pro-inflammatory adipokine commonly associated with appetite and CRP levels.[69] The study found higher milk consumption was modestly associated with lower leptin levels, whereas cheese consumption was associated with greater levels of leptin and CRP. Further studies examining the impact of dairy foods on systemic inflammation levels and risk factors of chronic disease in children and adolescents are needed.

Nutrient and bioactive compounds in dairy foods may help support inflammatory regulation

Dairy foods (i.e., milk, cheese and yogurt) deliver a dense package of nutrients and bioactive compounds within a complex food structure, known as the dairy food matrix.[70–72] This food matrix – characterized by dairy foods' unique profile of macro and micronutrients, bioactive components and the interactions among them – is increasingly recognized for its potential health effects beyond those of individual nutrients.[70–72]

Emerging evidence indicates the nutrients and bioactive compounds found in dairy foods may have a potential role in modulating inflammation. Mechanistic research suggests fermentation-derived metabolites, as well as live and active cultures and probiotics that can be found in fermented dairy foods, may regulate inflammatory cytokines, exert antioxidant and antihypertensive effects and promote gut health.[73,74] An RCT found that daily low-fat yogurt consumption improved gut barrier function and reduced markers of inflammation.[66] Lactoferrin, a multifunctional glycoprotein naturally present in dairy foods, has been linked with potential antioxidant and anti-inflammatory properties; however, it occurs in relatively low concentrations in milk and many of the biological effects described in the literature are based on supplemental or pharmacological doses rather than typical dietary intake.[8]

Studies conducted with in vitro models and humans also suggest a potential anti-inflammatory role of vitamin D, which can be found in fortified dairy foods such as milk. For example, in vitro studies indicate vitamin D may interact with immune cell receptors to reduce activation of pro-inflammatory cytokines.[75] In a multi-center parallel trial in Iran of 289 adults with abdominal obesity, consumption of low-fat dairy foods fortified with vitamin D, including yogurt and milk, resulted in improvements in CRP after 2.5 months.[60] In an RCT of 75 adults with T2D in Iran, consumption of yogurt fortified with vitamin D significantly increased adiponectin, whereas no change was observed among participants consuming plain yogurt.[56] Similarly, a double-blind RCT among 79 adults in Iran found that daily consumption of 200 mL (about ¾ cup) of milk for 10 weeks increased serum adiponectin concentrations, with vitamin D-fortified milk eliciting a greater anti-inflammatory effect.[76]

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Mechanistic research suggests bioactive lipids present in dairy foods containing fat may beneficially influence immune and metabolic pathways.[77] In a 2026 RCT of 30 Canadian adults with overweight or obesity and cardiometabolic disease risk factors, consuming a diet with 3 servings of dairy foods (i.e., low-fat milk, Skyr yogurt and full-fat cheddar cheese) per day led to reductions in TNF-α and IL-1ß compared with a diet low in dairy foods (<1 serving/day) but with higher total saturated fat content.[37] In addition, the Framingham Offspring prospective cohort study (2,391 U.S. adults) showed saturated fat intake from dairy foods was inversely related to CRP and fibrinogen in men, with no association found with saturated fat intake from non-dairy food sources.[78] Further mechanistic and clinical research examining the individual components found in dairy foods – and the potential interactions among them – could help to clarify the role of a food's matrix in pathways related to chronic inflammation and its impact on overall health.

Conclusion

Nutrient-dense dairy foods (i.e. milk, cheese and yogurt) deliver a package of nutrients and bioactive compounds that may collectively contribute to health. A growing body of evidence indicates dairy food consumption across a range of fat levels is associated with beneficial to neutral systemic inflammation profiles. The current evidence base is consistent with leading authoritative nutrition guidance, such as the 2025-2030 DGA, which recommends dairy foods as part of healthy eating patterns to improve health and reduce risk of chronic diseases.

Key Takeaways for Health & Wellness Professionals

- **Healthy eating patterns that include dairy foods are associated with reduced risk of inflammation-related chronic diseases.** Authoritative health organizations and guidelines recognize nutrient-dense milk, cheese and yogurt as key components of healthy eating patterns that can help support overall health and lower risk of CVD, T2D and osteoporosis.[20–25]
- **The body of evidence shows dairy foods are not linked to chronic inflammation and may have anti-inflammatory effects.** Clinical and observational research indicates a beneficial to neutral role of dairy consumption on inflammatory biomarkers across various adult populations.[26–31,34–41]
- **Fermented dairy foods may offer unique anti-inflammatory benefits.** Consuming yogurt, kefir and certain cheeses has been linked with favorable changes to inflammatory biomarkers.[27,29,34,40,51–63,66]
- **Dairy foods across a range of fat levels can fit within anti-inflammatory eating patterns.** Both low-fat and full-fat dairy foods have been classified as anti-inflammatory components in a validated dietary inflammation scoring model.[35]
- **The dairy food matrix may help explain the potential role milk, yogurt and cheese can play in fighting inflammation.** Dairy foods offer a powerful package of nutrients and bioactives – including those found in fermented and fortified varieties, across a range of fat levels – which may work together to influence inflammatory pathways beyond individual nutrients alone.[37,66,70–75,77,78]

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