CALIFORNIA STRAWBERRIES®

HEALTH RESEARCH AT A GLANCE



Published | In Process | Submitted for Publication | Review | Epidemiologic | Randomized Clinical Trial | Meta-analysis | In vitro

Category	Title	Key Findings	Study Type
California Strawberries: The Basics	Strawberry as a functional food: an evidence based review	Nutritional epidemiology shows an inverse association between strawberry consumption and hypertension or inflammation; controlled feeding studies have identified the ability of strawberries to attenuate postprandial oxidative stress, inflammation, and hyperglycemia, or hyperlipidemia in subjects with cardiovascular risk factors.	Review
	Promising health benefits of the strawberry: a focus on clinical studies	Strawberries are rich in nutrients and phytochemicals — including vitamins, anthocyanins, ellagitanins, quercetin, and catechin. These bioactive components seem to be responsible for medicinal and therapeutic effects on human health.	Review
	Review of functional and pharmacological activities of berries	The review shows that berries and their bioactive compounds possess medicinal properties and have therapeutic potential.	Review
	Association of flavonoid-rich foods and flavonoids with risk of all-cause mortality	When compared with non-consumers, frequent consumers of red wine, tea, peppers, blueberries and strawberries were at reduced risk of all-cause mortality.	Epidemiologic
	Strawberry intake on human health and disease outcomes: a comprehensive literature review	Comprehensive review of clinical trials and observational studies between 2000 and 2023. Inclusion of strawberries in the diet can have positive postprandial impact, with daily intake improving outcomes of lipid metabolism and inflammation in those at increased cardiovascular risk.	Review
Heart Health	Effects of four weeks of strawberry consumption on cardiometabolic and vascular outcomes in adults with cardiometabolic risk: a randomized controlled trial	Complete; publication pending	Randomized Clinical Trial
	High anthocyanin intake is associated with a reduced risk of myocardial infarction in young and middle-aged women	Those who consumed more than three servings of anthocyanin-rich strawberries and blueberries per week had a 32 percent lower risk of heart attack than women who did not consume berries.	Epidemiologic
	Freeze-dried strawberries lower serum cholesterol and lipid peroxidation in adults with abdominal adiposity and elevated serum	Daily consumption of strawberries significantly reduced total and LDL cholesterol levels and nuclear magnetic resonance (NMR)-derived small LDL particle concentrations, and decreased lipid peroxidation.	Randomized Clinical Trial
	Effects of a dietary strawberry powder on parameters of vascular health in adolescent males	Results indicated that daily strawberry consumption has the potential to improve markers of microvascular health.	Randomized Clinical Trial
	Daily consumption of strawberries improves plasma nitric oxide and adiponectin levels in pre- and stage 1-hypertensive postmenopausal women	Early analysis suggested that daily consumption of strawberries may improve vascular function by lowering systolic blood pressure, mean arterial pressure, pulse pressure, brachial-ankle pulse wave velocity (PWV) and femoral-ankle PWV.	Randomized Clinical Trial
	Strawberry consumption, cardiometabolic risk factors, and vascular function: A randomized controlled trial in adults with moderate hypercholesterolemia	Chronic consumption of a strawberry beverage increased percent flow mediated dilation and attenuated postprandial systolic blood pressure compared to control beverage.	Randomized Clinical Trial

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Heart Health	Consumption of flavonoid-rich fruits, flavonoids from fruits and stroke risk: a prospective cohort study	Consumption of flavonoid-rich fruits — specifically citrus fruits, strawberries and grapes — was associated with a significantly lower risk of stroke in women but not in men.	
	Effects of strawberry intervention on cardiovascular risk factors: a meta-analysis of randomised controlled trials	Strawberry interventions significantly reduced C-reactive protein levels by .63 mg/l but did not affect blood pressure, lipid profiles or fasting blood glucose. In addition, strawberry interventions significantly reduced total cholesterol among people with baseline levels >5 mmol/l and reduced LDL-cholesterol among people with baseline levels >3 mmol/l.	
	Effects of strawberry supplementation on cardiovascular risk factors: a comprehensive systematic review and meta-analysis of randomized controlled trials	Strawberry supplementation decreased circulating oxidized LDL, C-reactive protein, total cholesterol and diastolic blood pressure. It also raised fasting blood sugar but had no effect on other CVD risk factors examined.	
	Randomized double-blind controlled trial of freeze-dried strawberry powder supplementation in adults with overweight or obesity and elevated cholesterol	Low-dose supplementation with freeze-dried strawberry powder, equivalent to approximately 1 serving/day of fresh strawberries, improved cholesterol in adults with overweight or obesity, compared to both the high-dose and control.	
	The effect of berry-based food interventions on markers of cardiovascular and metabolic health: a systematic review of randomized controlled trials	More than two-thirds of high-quality trials have reported beneficial effects of berry consumption on markers of CVD risk.	
Metabolic Health and Inflammation	Strawberries improve insulin resistance and related cardiometabolic markers in adults with prediabetes: a randomized controlled crossover trial	Daily supplementation with freeze-dried strawberry powder, equivalent to approximately 2.5 servings/day of fresh strawberries, significantly improved glycemic control markers after 12 weeks. These included serum insulin, insulin resistance, fasting glucose, and glycated hemoglobin. Strawberry intervention also decreased body weight, high-sensitivity CRP, and interleukin-6.	
	Strawberry anthocyanin and its association with postprandial inflammation and insulin	Inflammatory responses and post-meal insulin response were significantly decreased with the strawberry intervention.	
	Attenuation of meal-induced inflammatory and thrombotic responses in overweight men and women after 6-week daily strawberry (fragaria) intake: a randomized placebo-controlled trial	Regular consumption of strawberries may provide protection from high fat/carbohydrate meal-induced increases in fibrinolytic and inflammatory factors in at-risk men and women.	
	Dietary flavonoid intake and weight maintenance: three prospective cohorts of 124086 men and women followed for up to 24 years	Higher intake of foods rich in flavonols, flavan-3-ols, anthocyanins, and flavonoid polymers may contribute to weight maintenance in adulthood.	
	A dose-response evaluation of freeze-dried strawberries independent of fiber content on metabolic indices in abdominally obese individuals with insulin resistance in a randomized, single- blinded, diet-controlled crossover trial	A beverage with 40g of freeze-dried strawberry (FDS) powder significantly reduced post-meal insulin concentrations. In addition, pelargonidin-glucuronide, an anthocyanidin found in strawberries, was inversely associated with mean insulin concentrations after the 20 and 40g FDS beverages and oxidized-LDL was reduced after 20g FDS.	
	Maximizing the health effects of strawberry anthocyanins: Understanding the influence of the consumption timing variable	Strawberry consumption improved metabolic and anti-inflammatory outcomes, especially if consumed before the meal.	
Metabolic Health and Inflammation	Strawberries improve pain and inflammation in obese adults with radiographic evidence of knee osteoarthritis	Participants who received the equivalent of four servings fresh strawberries per day reported reduced intermittent and total pain. Analysis also revealed reduced markers of inflammation.	

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Metabolic Health and Inflammation	Dietary strawberries improve cardiometabolic risks in adults with obesity and elevated serum LDL cholesterol in a randomized controlled crossover trial	Consuming 2.5 servings of strawberries for four weeks significantly improved insulin resistance, lipid particle profiles, and serum PAI-1 (a predictor of type 2 diabetes) in adults with metabolic syndrome.	
	The anti-obesogenic effects of dietary berry fruits: A review	Cell and animal studies have indicated that strawberries and their phenolic compounds may have anti-obesogenic effects.	
	Effects of acute dietary polyphenols and post-meal physical activity on postprandial metabolism in adults with features of the metabolic syndrome	Freeze-dried strawberry powder distinctly improved postprandial insulin and markers of oxidative damage and inflammation.	
	Strawberry and cranberry polyphenols improve insulin sensitivity in insulin-resistant, non-diabetic adults: a parallel, double-blind, controlled and randomised clinical trial	Insulin sensitivity increased in participants who consumed a strawberry and cranberry polyphenol beverage and a lower first-phase insulin secretion response during the first 30 minutes of an oral glucose tolerance test.	
	Role of berry bioactive compounds on lipids and lipoproteins in diabetes and metabolic syndrome	Based on the emerging evidence, colorful berry fruits may thus be included in a healthy diet for the prevention and management of CVD.	
	Dietary fruits and arthritis	Commonly available fruits, such as blueberries, raspberries, strawberries, and pomegranates have shown promising results in reducing pain and inflammation in experimental models and in human clinical studies of arthritis. There is also some evidence on the role of specific fruit polyphenols, such as quercetin and citrus flavonoids in alleviating rhuematoid arthritis symptoms.	
	Dietary strawberries improve biomarkers of antioxidant status and endothelial function in adults with cardiometabolic risks in a randomized controlled crossover trial	Significant increases were observed in serum antioxidant capacity and superoxide dismutase activity as well as decreases in lipid peroxidation after both low and high dose strawberry phases when compared with the control phase. Significant decreases were also observed in soluble vascular cell adhesion molecule-1 and tumor necrosis factor-α with the high dose strawberry phase.	
	Dose-related effects of strawberry intake on cardiometabolic risk factors and the relationship of changes in flow mediated dilation (FMD) to cardiovascular risk	Submitted for publication	
Brain Health	Berry fruit enhances beneficial signaling in the brain	In cell and animal models, berry fruits mediate signaling pathways involved in inflammation and cell survival and attenuated age- and pathology-related deficits in behavior.	
	Dietary intakes of berries and flavonoids in relation to cognitive decline	Higher consumption of strawberries (≥2 servings/week) was associated with slower rates of cognitive decline, appearing to delay cognitive aging by up to 2.5 years. Greater intakes of anthocyanidins and total flavonoids was also associated with slower rates of cognitive decline.	
	Dietary strawberry improves cognition in older adults: a randomized, double-blind, placebo-controlled trial	Initial findings indicated improvements in word recognition and spatial memory among participants consuming the equivalent of 2 cups per day of fresh strawberries.	
	Association of strawberries and anthocyanidin intake with Alzheimer's dementia risk	Strawberry intake was associated with a 34% reduced risk of Alzheimer's dementia compared to no or rare intake. The authors attributed the effect to pelargonidin, a primary bioactive present in strawberries.	
	Long-term dietary flavonoid intake and subjective cognitive decline in US men and women	Higher intake of total flavonoids and the consumption of many flavonoid-rich fruits and vegetables, including strawberries, were significantly associated with lower odds of subjective cognitive decline.	

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Brain Health	Effects of a mixed berry beverage on cognitive functions and cardiometabolic risk markers; a randomized cross-over study in healthy older adults	The berry intervention reduced total and LDL-cholesterol compared to baseline and in comparison to the control beverage. The control beverage increased insulin concentrations in comparison to the berry beverage. Subjects performed better in the working memory test after the berry beverage compared to after the control beverage.	
	Pelargonidin and berry intake association with Alzheimer's Disease neuropathology: a community-based study	Berry intake was not associated with AD pathology. However, excluding participants with dementia or mild cognitive impairment at baseline, strawberry and pelargonidin intake were associated with fewer phosphorylated tau tangles.	
	Dietary strawberries improve serum metabolites of cardiometabolic risks in adults with features of the metabolic syndrome in a randomized controlled crossover trial	The presence of several metabolites, including serum phosphate, benzoic acid, and hydroxyphenyl propionic acid, indicate improved energy-metabolism pathways, compliance measures, and microbial metabolism of strawberry polyphenols. The authors concluded that dietary supplementation with strawberries significantly improves the serum metabolic profiles of cardiometabolic risks in adults.	
	Early intervention in cognitive aging with strawberry supplementation	Daily strawberry intake by overweight adults with insulin resistance and subjective cognitive decline resulted in diminished memory interference and reduction of depressive symptoms, benefits consistent with improved executive ability.	
	Strawberries modestly improve cognition and cardiovascular health in older adults	Daily strawberry consumption was linked to improved cognitive function, lower blood pressure and higher antioxidant capacity in healthy older adults. Participants consumed freeze-dried strawberry powder equivalent to 2 servings daily, or a control powder for 8 weeks. Following strawberry consumption, cognitive processing speed increased by 5.2%, systolic blood pressure decreased by 3.6% and total antioxidant capacity significantly increased by 10.2%.	
	The effects of strawberry supplementation on memory and gait among obese older adults	Complete; publication pending	
Bone Health	Effects of strawberries on bone biomarkers in pre-and stage 1-hypertensive postmenopausal women: a secondary analysis	Analysis revealed benefits for bone health due to increased synthesis of serum insulin-like growth factor 1 (IGF-1). This growth hormone is known to stimulate bone formation.	
Cancer Prevention	Isolation and identification of strawberry phenolics with antioxidant and human cancer cell antiproliferative properties	Strawberry crude extracts and phenolic compounds inhibited the growth of human oral, colon, and prostate cancer cells.	
	Randomized phase II trial of lyophilized strawberries in patients with dysplastic precancerous lesions of the esophagus	A 60g/day of lyophilized strawberries dose reduced the histologic grade of dysplastic premalignant lesions in 80.6% of the 36 patients at this dose who were evaluated for histology. It also reduced the expression of several inflammatory markers.	
	Berry fruits for cancer prevention: current status and future prospects	Berry bioactives have several anti-cancer effects, partially because of their abilities to counteract, reduce, and also repair damage resulting from oxidative stress and inflammation. Berry bioactives also regulate several pathways of cancer cell proliferation, apoptosis, and tumor angiogenesis and sensitize tumor cells to chemotherapy treatments.	
	Berry extracts exert different antiproliferative effects against cervical and colon cancer cells grown in vitro	Strawberries were the most effective berries at inhibiting the viability of cervical cancer and colon cancer cells in vitro. Researchers attributed the antiproliferative effects to the ellagitannins found in those berries.	
	Chemopreventive effects of strawberry and black raspberry on colorectal cancer in inflammatory bowel disease	Strawberry and black raspberry interventions have been shown to suppress cytokines release, decrease oxidative stress, reduce genomic instability, and inhibit signaling pathways. The chemopreventive activity of strawberry and black raspberry is likely due to multiple nutrients and bioactives, especially anthocyanins.	

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Antioxidant Function	Metabolic fate of strawberry polyphenols after chronic intake in healthy older adults	The results suggest that strawberry polyphenols are absorbed and extensively metabolized, and can persist in the circulation.	
	Effects of dietary strawberry supplementation on antioxidant biomarkers in obese adults with above optimal serum lipids	Results indicate the potential for strawberries to protect against oxidative stress, a risk factor for cardiovascular disease.	
	Pharmacokinetic characterization and bioavailability of strawberry anthocyanins relative to meal intake	Bioavailabillity of pelargonidin metabolites in plasma, which are inversely associated with insulin and glucose responses, was greater when a strawberry beverage was consumed two hours prior to a meal.	
Digestive Health	California strawberry consumption increased the abundance of gut microorganisms related to lean body weight, health and longevity in healthy subjects	After four weeks of strawberry supplementation, results showed alterations in the gut microbiota that are associated with weight control and longevity. These results were partially reversed after 2 weeks of a customary diet without strawberries.	
	Changes in cognitive performance, gut microbiota, and metabolism following strawberry supplementation in at-risk middle-aged individuals	Complete; publication pending	