

**Article Title:** Consumption of Dark Green Leafy Vegetables Predicts Vitamin A and Iron Intake and Status among Female Small-Scale Farmers in Tanzania.  
**Date & Journal:** Nutrients. 2019 May 7

- Inadequate consumption of micronutrient-dense foods such as vegetables and meat are an important contributing cause for anemia and deficiencies of iron and vitamin A in rural communities of Tanzania. A cross-sectional study was conducted in 2016 to examine nutritional and micronutrient status and their associations to the diet of female small-scale farmers in the sub-humid Kilosa ( $n = 333$ ) and the semi-arid Chamwino ( $n = 333$ ) districts, in the Morogoro and Dodoma region. An overall higher prevalence of overweight (19.7%) and obesity (7.1%) than of underweight (5.9%) was detected. Significantly more women in the two villages of Kilosa (27-40%) than in the two villages of Chamwino district (19-21%) were overweight/obese, but also more frequently had anemia (34-41% vs. 11-17%), iron deficiency (24-32% vs. 15-17%), and low serum retinol (21-24% vs. 8-9%). Overall, only a small proportion of women reached recommended daily micronutrient intakes: 27% for vitamin A, 17% for iron, 7% for zinc, and 12-38% for B-vitamins. The amount of dark green leafy vegetables (DGLV) consumed was the main determinant of vitamin A and iron intake by women in Chamwino and corresponded to higher hemoglobin, serum retinol and iron status than in the villages of the Kilosa district; in agreement, DGLV consumption also predicted iron and vitamin A intake in Kilosa district. DGLV consumed with wholemeal millet was advantageous in terms of women's vitamin A and iron intake and status over the predominantly maize-rice-based diet lacking vegetables.

# Greens Research

*See research and sources for each article.*

## CRUCIFEROUS VEGETABLE INTAKE IS INVERSELY ASSOCIATED WITH LUNG CANCER RISK AMONG CURRENT NONSMOKING MEN IN THE JAPAN PUBLIC HEALTH (JPHC) STUDY

- **Background:** Cruciferous vegetables, a rich source of isothiocyanates, have been reported to lower the risk of several types of cancer, including lung cancer. However, evidence from prospective observations of populations with a relatively high intake of cruciferous vegetables is sparse. **Objective:** We investigated the association between cruciferous vegetable intake and lung cancer risk in a large-scale population-based prospective study in Japan. **Methods:** We studied 82,330 participants (38,663 men; 43,667 women) aged 45-74 y without a past history of cancer. Participants were asked to respond to a validated questionnaire that included 138 food items. The association between cruciferous vegetable intake and lung cancer incidence was assessed with the use of Cox proportional hazard regression analysis to estimate HRs and 95% CIs (with adjustments for potential confounding factors). **Results:** After 14.9 y of follow-up, a total of 1499 participants (1087 men; 412 women) were diagnosed with lung cancer. After deleting early-diagnosed cancer and adjusting for confounding factors, we observed a nonsignificant inverse trend between cruciferous vegetable intake and lung cancer risk in men in the highest compared with the lowest quartiles (multivariate HR: 0.85; 95% CI: 0.69, 1.06; P-trend = 0.13). Stratified analysis by smoking status revealed a significant inverse association between cruciferous vegetable intake and lung cancer risk among those who were never smokers and those who were past smokers after deleting lung cancer cases in the first 3 y of follow-up [multivariate HR for never smokers: 0.49 (95% CI: 0.27, 0.87; P-trend = 0.04); multivariate HR for past smokers: 0.59 (95% CI: 0.35, 0.99; P-trend = 0.10)]. No association was noted in men who were current smokers and women who were never smokers. **Conclusion:** This study suggests that cruciferous vegetable intake may be associated with a reduction in lung cancer risk among men who are currently nonsmokers.

## GREEN LEAFY VEGETABLES IN DIETS WITH A 25:1 OMEGA-6/ OMEGA-3 FATTY ACID RATIO MODIFY THE ERYTHROCYTE FATTY ACID PROFILE OF SPONTANEOUSLY HYPERTENSIVE RATS

- **BACKGROUND:** In addition to the actual composition of the diet (i.e. nutrient composition, food groups), the omega-6/omega-3 fatty acid ratio has been demonstrated to influence the tissue fatty acid profile and subsequently the risk for cardiovascular and other diseases. Likewise, the consumption of green leafy vegetables (GLVs) may favorably reduce the risks associated with disease. Although an ~3:1 omega-6/omega-3 fatty acid ratio ( $\omega$ -6/ $\omega$ -3 FAR) is recommended, the typical American diet has an ~25:1  $\omega$ -6/ $\omega$ -3 FAR. Previous research affirms the ability of collard greens (CG), purslane (PL), and sweet potato greens (SPG) to improve the hepatic profile of spontaneously hypertensive rats (SHRs). The aim of the present study was to determine the influence of GLVs, incorporated (4%) into diets with a 25:1  $\omega$ -6/ $\omega$ -3 FAR, on the erythrocyte fatty acid profile of male SHRs.
- **RESULTS:** Significantly lower percentages of total saturated fatty acids ( $p < 0.05$ ) and greater percentages of polyunsaturated fatty acids were present among SHR erythrocytes following the consumption of diets containing CG, PL and SPG. Total polyunsaturated fatty acids were greatest among SHRs consuming diets containing purslane.
- **CONCLUSIONS:** The present study demonstrates the ability of GLVs to mitigate the potential effects of an elevated  $\omega$ -6/ $\omega$ -3 FAR, which may contribute to an atherogenic fatty acid profile, inflammation and disease pathogenesis. Dietary recommendations for disease prevention should consider the inclusion of these GLVs, particularly among those consuming diets with an  $\omega$ -6/ $\omega$ -3 FAR that may promote disease.

# GREEN LEAFY VEGETABLES FROM TWO SOLANUM SPP. (*SOLANUM NIGRUM* L. AND *SOLANUM MACROCARPON* L) AMELIORATE SCOPOLAMINE-INDUCED COGNITIVE AND NEUROCHEMICAL IMPAIRMENTS IN RATS.

- This study examined the modulatory effect of Black nightshade (*Solanum nigrum* L) and African eggplant (*Solanum macrocarpon* L) leaves on cognitive function, antioxidant status, and activities of critical enzymes of monoaminergic and cholinergic systems of neurotransmission in scopolamine-administered rats. Cognitive impairment was induced in albino rats pretreated with dietary inclusions of Black nightshade (BN) and African eggplant (AE) leaves by single administration (i.p.) of scopolamine (2 mg/kg body weight). Prior to termination of the experiment, the rats were subjected to spontaneous alternation (Y-maze) test to assess their spatial working memory. Thereafter, activities of acetylcholinesterase (AChE), butyrylcholinesterase (BChE), monoamine oxidase (MAO), arginase, and antioxidant enzymes (catalase, SOD, and GST) of rat brain homogenate were determined. Also, the malondialdehyde (MDA), nitrite, and GSH contents of the homogenate were determined. The results showed that pretreatment with dietary inclusions of AE and BN significantly reversed the impairment in the rats' spatial working memory induced by scopolamine. Similarly, elevations in activities of AChE, BChE, and MAO induced by scopolamine were significantly reversed in rats pretreated with dietary inclusions of AE and BN. In addition, impaired antioxidant status induced by scopolamine was reversed by pretreatment with dietary inclusions of AE and BN. This study has shown that dietary inclusions of AE and BN could protect against cognitive and neurochemical impairments induced by scopolamine, and hence, these vegetables could be used as a source of functional foods and nutraceuticals for the prevention and management of cognitive impairments associated diseases such as Alzheimer's disease

# INTEGRATED IN VITRO APPROACHES TO ASSESS THE BIOACCESSIBILITY AND BIOAVAILABILITY OF SILICON BIOFORTIFIED LEAFY VEGETABLES AND PRELIMINARY EFFECTS ON BONE.

Food industries are increasingly oriented toward new **foods** to improve nutritional status and/or to combat nutritional deficiency diseases. In this context, silicon biofortification could be an innovative tool for obtaining new **foods** with possible positive effects on bone mineralization. In this paper, an alternative and quick in vitro approach was applied in order to evaluate the potential health promoting effects of five siliconbiofortified leafy vegetables (tatsoi, mizuna, purslane, Swiss chard and chicory) on bone mineralization compared with a commercial silicon supplement. The silicon bioaccessibility and bioavailability of the five leafy vegetables (biofortified or not) and of the supplement were assessed by applying a protocol consisting of in vitro gastrointestinal digestion coupled with a Caco2 cell model. Silicon bioaccessibility ranged from 0.89 to 8.18 mg/L and bioavailability ranged from 111 to 206  $\mu\text{g/L}$  of Si for both vegetables and supplement. Furthermore, the bioavailable fractions were tested on a human osteoblast cell model following the expression of type 1 collagen and **alkaline** phosphatase. The results obtained highlighted that the bioavailable fraction of biofortified purslane and Swiss chard improved the expression of both osteoblast markers compared with the supplement and other vegetables. These results underline the potentially beneficial effect of biofortified leafy vegetables and also indicate the usefulness of in vitro approaches for selecting the best vegetable with positive bone effects for further in vivo research.

# Title: Nopal (Opuntia Spp.) and Its Effects on Metabolic Syndrome: New Insights for the Use of a Millenary Plant

**Abstract- Background:** Nopal (*Opuntia* spp.) is by excellence the most utilized cactus in human and animal nutrition. It is also a very noble plant; its main physicochemical, nutritional and nutraceutical characteristics allow the use of nopal in diverse food applications. Special focus has been given over the past decades in the use of *Opuntia* for the treatment of metabolic syndrome (MetS), which is predominantly related to Diabetes Mellitus. In this sense, the prevalence of MetS is increasing at a worldwide level. This in turn has led to a notorious demand for natural and nutraceutical food sources.

**Conclusion:** Nopal constitutes one of the most studied members of the Cactaceae family; its potential effects on human health have been described since ancient times, mostly through traditional medicine. The present work highlights the importance of this plant in the treatment of MetS related maladies and points out the importance of elucidating new compounds and their validation for the interactions of nutraceutical compounds which could be related to MetS.

Angulo-Bejarano PI, Gómez-García MDR, Valverde ME, Paredes-López O. Nopal (*Opuntia* spp.) and its Effects on Metabolic Syndrome: New Insights for the Use of a Millenary Plant. *Curr Pharm Des.* 2019;25(32):3457–3477. doi: 10.2174/1381612825666191010171819

## **Integrated in vitro approaches to assess the bio-accessibility and bioavailability of silicon biofortified leafy vegetables and preliminary effects on bone.**

Food industries are increasingly oriented toward new **foods** to improve nutritional status and/or to combat nutritional deficiency diseases. In this context, silicon biofortification could be an innovative tool for obtaining new **foods** with possible positive effects on bone mineralization. In this paper, an alternative and quick in vitro approach was applied in order to evaluate the potential health promoting effects of five silicon biofortified leafy vegetables (tatsoi, mizuna, purslane, Swiss chard and chicory) on bone mineralization compared with a commercial silicon supplement. The silicon bioaccessibility and bioavailability of the five leafy vegetables (biofortified or not) and of the supplement were assessed by applying a protocol consisting of in vitro gastrointestinal digestion coupled with a Caco2 cell model. Silicon bioaccessibility ranged from 0.89 to 8.18 mg/L and bioavailability ranged from 111 to 206  $\mu\text{g/L}$  of Si for both vegetables and supplement. Furthermore, the bioavailable fractions were tested on a human osteoblast cell model following the expression of type 1 collagen and **alkaline** phosphatase. The results obtained highlighted that the bioavailable fraction of biofortified purslane and Swiss chard improved the expression of both osteoblast markers compared with the supplement and other vegetables. These results underline the potentially beneficial effect of biofortified leafy vegetables and also indicate the usefulness of in vitro approaches for selecting the best vegetable with positive bone effects for further in vivo research.

# Article Title: [Fruit and vegetable consumption: what benefits, what risks?]

**Date & Journal:** Rev Prat. 2019 Feb

- Fruit and vegetable consumption: what benefits, what risks? Epidemiological studies on the relationships between fruit and vegetable consumption and the risk of chronic non-communicable diseases indicate a convincing protective effect against cardiovascular diseases, and suggestive protective effect on weight gain, diabetes, colorectal cancer and ER-negative breast cancer. For cardiovascular diseases the risk reductions are observed up to 800 g/day and for cancer up to 600 g/day. Interestingly, each additional portion of fruit or vegetable reduces the risk of cardiovascular diseases. Fruits and vegetables are rich sources of protective constituents: fibres, vitamins -B9, C-, minerals, polyphenols, carotenoids and sulphur compounds -glucosinolates and allyl sulphides-. White fruits -apples, pears-, cruciferous vegetables, green leafy vegetables, fruits and vegetables rich in beta-carotene, and those rich in vitamin C were shown to protective against cardiovascular diseases and, cruciferous and green-yellow vegetables appeared protective against cancer incidence. Promoting the consumption of sufficient quantities of all types of fruits and vegetables, raw and cooked, is essential in a balanced diet in which ultra-processed and sweet products must be limited. An increase in fruit and vegetable consumption up to 800 g/day does not lead to exceeding the toxicological reference values of the contaminants.

# TITLE: A RANDOMIZED CLINICAL TRIAL OF THE EFFECTS OF LEAFY GREEN VEGETABLES AND INORGANIC NITRATE ON BLOOD PRESSURE

Background: A diet rich in fruits and vegetables is associated with lowering of blood pressure (BP), but the nutrient(s) responsible for these effects remain unclear. Research suggests that inorganic nitrate present in leafy green vegetables is converted into NO in vivo to improve cardiovascular function.

Results: A total of 231 subjects (95%) completed the study. The insignificant change in ambulatory SBP (mean  $\pm$  standard deviation) was  $-0.6 \pm 6.2$  mm Hg in the placebo group,  $-1.2 \pm 6.8$  mm Hg in the potassium nitrate group, and  $-0.5 \pm 6.6$  mm Hg in the leafy green vegetable group. There was no significant difference in change between the 3 groups.

Conclusions: A 5-wk dietary supplementation with leafy green vegetables or pills containing the same amount of inorganic nitrate does not decrease ambulatory SBP in subjects with elevated BP. This trial was registered at [clinicaltrials.gov](https://clinicaltrials.gov) as NCT02916615.

Sundqvist ML, Larsen FJ, Carlström M, et al. A randomized clinical trial of the effects of leafy green vegetables and inorganic nitrate on blood pressure. *Am J Clin Nutr.* 2020;111(4):749–756. doi: 10.1093/ajcn/nqaa024

# TITLE: APPLICATION OF HPLC AND ESI-MS TECHNIQUES IN THE ANALYSIS OF PHENOLIC ACIDS AND FLAVONOIDS FROM GREEN LEAFY VEGETABLES (GLVS)

## Abstract

Diets containing high proportions of fruits and vegetables reduce the risk of onset of chronic diseases. The role of herbal medicines in improving human health is gaining popularity over the years, which also increases the need for safety and efficiency of these products. Green leafy vegetables (GLVs) are the richest source of phenolic compounds with excellent antioxidant properties. Increased consumption of diets containing phenolic compounds may give positive and better results to human health and significantly improves the immune system. Highly selective, susceptible and versatile analytical techniques are necessary for extraction, identification, and quantification of phenolic compounds from plant extracts, which helps to utilize their important biological properties. Recent advances in the pre-treatment procedures, separation techniques and spectrometry methods are used for qualitative and quantitative analysis of phenolic compounds. The online coupling of liquid chromatography with mass spectrometry (LC-MS) has become a useful tool in the metabolic profiling of plant samples. In this review, the separation and identification of phenolic acids and flavonoids from GLVs by LC-MS have been discussed along with the general extraction procedures and other sources of mass spectrometer used. The review is devoted to the understanding of the structural configuration, nature and accumulation pattern of phenolic acids and flavonoids in plants and to highlighting the recent developments in the chemical investigation of these compounds by chromatographic and spectroscopic techniques. It concludes with the advantages of the combination of these two methods and prospects.

Kumar BR. Application of HPLC and ESI-MS techniques in the analysis of phenolic acids and flavonoids from green leafy vegetables (GLVs). *J Pharm Anal.* 2017;7(6): 349–364. doi:10.1016/j.jpha.2017.06.005

# TITLE: EFFECTS OF DIETARY NITRATE ON INFLAMMATION AND IMMUNE FUNCTION, AND IMPLICATIONS FOR CARDIOVASCULAR HEALTH

Abstract: Inorganic dietary nitrate, found abundantly in green leafy and some root vegetables, elicits several beneficial physiological effects, including a reduction in blood pressure and improvements in blood flow through nitrate-nitrite-nitric oxide signaling. Recent animal and human studies have shown that dietary nitrate and nitrite also modulate inflammatory processes and immune cell function and phenotypes. Chronic low-grade inflammation and immune dysfunction play a critical role in cardiovascular disease. This review outlines the current evidence on the efficacy of nitrate-rich plant foods and other sources of dietary nitrate and nitrite to counteract inflammation and promote homeostasis of the immune and vascular systems. The data from these studies suggest that immune cells and immune-vasculature interactions are important targets for dietary interventions aimed at improving, preserving, or restoring cardiovascular health.

Raubenheimer K, Bondonno C, Blekkenhorst L, Wagner KH, Peake JM, Neubauer O. Effects of dietary nitrate on inflammation and immune function, and implications for cardiovascular health [published online ahead of print, 2019 May 30]. *Nutr Rev*. 2019;nuz025. doi:10.1093/nutrit/nuz025

# TITLE: BIOACTIVITY EVALUATIONS OF LEAF EXTRACT FRACTIONS FROM YOUNG BARLEY GRASS AND CORRELATION WITH THEIR PHYTOCHEMICAL PROFILES

Abstract: Background: The pressed juice of Barley Grass (BG) has become very popular among people for various assumed benefits along with many testimonies of people who have been healed from various ailments such as anemia, cancer, GI problems by consuming BG. The aim of our research was to validate the claims of its medicinal values such as chemo-protective action, high anti-oxidants, RBC membrane stabilization activity, and toxicity level.

Conclusion: The study reveals the strong antioxidant and RBC membrane stabilization activity of BG. The Brine Shrimp Lethality Assay found extracts to be bioactive suggesting extracts as a promising candidate for plant-derived anti-tumor compounds. Further, studies are needed to validate the data on cancer cell lines.

Panthi M, Subba RK, Raut B, Khanal DP, Koirala N. Bioactivity evaluations of leaf extract fractions from young barley grass and correlation with their phytochemical profiles. *BMC Complement Med Ther.* 2020;20(1):64. Published 2020 Feb 28. doi:10.1186/s12906-020-2862-4

# TITLE: EXTRACTION OF POLYSACCHARIDES FROM MACA: CHARACTERIZATION AND IMMUNOREGULATORY EFFECTS ON CD4 + T CELLS

Abstract -The immunomodulatory effects of maca polysaccharides (MCPs) on macrophages have been demonstrated in many studies. However, the effects of MCPs on CD4+ T cells have not been studied. Four water-soluble MCPs, labeled MCP1 (weight-average molecular weights [Mws] of 896.1 and 276.6 kDa), MCP2 (Mws of 337.8 and 219.0 kDa), MCP3 (Mws of 110.6, 58.1, and 38.9 kDa), and MCP4 (Mws of 15.7, 12.6, and 12.1 kDa), were obtained from maca by graded ethanol precipitation. The immunoregulatory effects of MCPs on CD4+ T cells were evaluated for the first time. The experimental results indicated that all MCPs had immunoregulatory effects on CD4+ T cells. However, the effects of MCP2 were stronger compared to the other three components, not only in promoting the proliferation of CD4+ T cells but also in terms of secretion of interferon- $\gamma$  (IFN- $\gamma$ ). The molecular weight and monosaccharide compositions of MCPs were analyzed to explore the structure-activity relationship. The results suggested that the molecular weight and the galactosamine (GalN) of MCPs might be determining factors for its bioactivity. These findings suggest that the MCP2 isolated in our study have immune potentiation effects on CD4+ T cells.

Chang Y, Lu W, Chu Y, et al. Extraction of polysaccharides from maca: Characterization and immunoregulatory effects on CD4+ T cells. *Int J Biol Macromol.* 2020;154:477–485. doi:10.1016/j.ijbiomac.2020.03.098

# TITLE: NOPAL (OPUNTIA SPP.) AND ITS EFFECTS ON METABOLIC SYNDROME: NEW INSIGHTS FOR THE USE OF A MILLENARY PLANT

Abstract- Background: Nopal (*Opuntia* spp.) is by excellence the most utilized cactus in human and animal nutrition. It is also a very noble plant; its main physicochemical, nutritional and nutraceutical characteristics allow the use of nopal in diverse food applications. Special focus has been given over the past decades in the use of *Opuntia* for the treatment of metabolic syndrome (MetS), which is predominantly related to Diabetes Mellitus. In this sense, the prevalence of MetS is increasing at a worldwide level. This in turn has led to a notorious demand for natural and nutraceutical food sources.

Conclusion: Nopal constitutes one of the most studied members of the Cactaceae family; its potential effects on human health have been described since ancient times, mostly through traditional medicine. The present work highlights the importance of this plant in the treatment of MetS related maladies and points out the importance of elucidating new compounds and their validation for the interactions of nutraceutical compounds which could be related to MetS.

Angulo-Bejarano PI, Gómez-García MDR, Valverde ME, Paredes-López O. Nopal (*Opuntia* spp.) and its Effects on Metabolic Syndrome: New Insights for the Use of a Millenary Plant. *Curr Pharm Des.* 2019;25(32):3457–3477. doi: 10.2174/1381612825666191010171819

# TITLE: ANTIOXIDANT, IMMUNOMODULATING, AND MICROBIAL-MODULATING ACTIVITIES OF THE SUSTAINABLE AND ECOFRIENDLY SPIRULINA

## Abstract

The highly nutritional and ecofriendly Spirulina (*Arthrospira platensis*) has hypolipidemic, hypoglycemic, and antihypertensive properties. Spirulina contains functional compounds, such as phenolics, phycocyanins, and polysaccharides, with antioxidant, anti-inflammatory, and immunostimulating effects. Studies conducted on Spirulina suggest that it is safe in healthy subjects, but attitude to eating probably affects the acceptability of Spirulina containing foods. Although the antioxidant effect of Spirulina is confirmed by the intervention studies, the concerted modulation of antioxidant and inflammatory responses, suggested by in vitro and animal studies, requires more confirmation in humans. Spirulina supplements seem to affect more effectively the innate immunity, promoting the activity of natural killer cells. The effects on cytokines and on lymphocytes' proliferation depend on age, gender, and body weight differences. In this context, ageing and obesity are both associated with chronic low grade inflammation, immune impairment, and intestinal dysbiosis. Microbial-modulating activities have been reported in vitro, suggesting that the association of Spirulina and probiotics could represent a new strategy to improve the growth of beneficial intestinal microbiota. Although Spirulina might represent a functional food with potential beneficial effects on human health, the human interventions used only supplements. Therefore, the effect of food containing Spirulina should be evaluated in the future.

Finamore A, Palmery M, Bensehaila S, Peluso I. Antioxidant, Immunomodulating, and Microbial-Modulating Activities of the Sustainable and Ecofriendly Spirulina. *Oxid Med Cell Longev*. 2017;2017:3247528. doi:10.1155/2017/3247528

# TITLE: FUNCTIONAL PROPERTIES OF SPINACH (SPINACIA OLERACEA L.) PHYTOCHEMICALS AND BIOACTIVES

Abstract Overwhelming evidence indicates that diets rich in fruits and vegetables are protective against common chronic diseases, such as cancer, obesity and cardiovascular disease. Leafy green vegetables, in particular, are recognized as having substantial health-promoting activities that are attributed to the functional properties of their nutrients and non-essential chemical compounds. Spinach (*Spinacia oleracea* L.) is widely regarded as a functional food due to its diverse nutritional composition, which includes vitamins and minerals, and to its phytochemicals and bioactives that promote health beyond basic nutrition. Spinach-derived phytochemicals and bioactives are able to (i) scavenge reactive oxygen species and prevent macromolecular oxidative damage, (ii) modulate expression and activity of genes involved in metabolism, proliferation, inflammation, and antioxidant defence, and (iii) curb food intake by inducing secretion of satiety hormones. These biological activities contribute to the anti-cancer, anti-obesity, hypoglycemic, and hypolipidemic properties of spinach. Despite these valuable attributes, spinach consumption remains low in comparison to other leafy green vegetables. This review examines the functional properties of spinach in cell culture, animals and humans with a focus on the molecular mechanisms by which spinach-derived non-essential phytochemicals and bioactives, such as glycolipids and thylakoids, impart their health benefits.

Roberts JL, Moreau R. Functional properties of spinach (*Spinacia oleracea* L.) phytochemicals and bioactives. *Food Funct.* 2016;7(8):3337–3353. doi:10.1039/c6fo00051g

# TITLE: THE GUT MICROBIOTA AT THE INTERSECTION OF DIET AND HUMAN HEALTH

## Abstract

Diet affects multiple facets of human health and is inextricably linked to chronic metabolic conditions such as obesity, type 2 diabetes, and cardiovascular disease. Dietary nutrients are essential not only for human health but also for the health and survival of the trillions of microbes that reside within the human intestines. Diet is a key component of the relationship between humans and their microbial residents; gut microbes use ingested nutrients for fundamental biological processes, and the metabolic outputs of those processes may have important impacts on human physiology. Studies in humans and animal models are beginning to unravel the underpinnings of this relationship, and increasing evidence suggests that it may underlie some of the broader effects of diet on human health and disease.

Gentile CL, Weir TL. The gut microbiota at the intersection of diet and human health. *Science*. 2018;362(6416):776–780. doi:10.1126/science.aau5812

# TITLE: TARGETING THE GUT MICROBIOTA BY DIETARY NUTRIENTS: A NEW AVENUE FOR HUMAN HEALTH

Abstract- The gut microbiota is a complex ecosystem consisted of trillions of microbes that have co-evolved with their host for hundreds of millions of years. During the last decade, a growing body of knowledge has suggested that there is a compelling set of connections among diet, gut microbiota and human health. Various physiological functions of the host, ranging from metabolic and immune regulation to nerve and endocrine development, are possibly mediated by the structural components of microbial cell or the products of microbial metabolism, which are greatly influenced by dietary macronutrients and micronutrients. Thus, governing the production and activity of these microbial-associated small molecules and metabolites through dietary intervention may provide promising strategies for the improvement of human health and disease. In this review article, we first provide an overview of current findings about the intimate interrelationships between diet and gut microbiota. We also introduce the physiological effects of some microbial-associated small molecules and metabolites on the host as well as the detailed signaling mechanisms.

Li D, Wang P, Wang P, Hu X, Chen F. Targeting the gut microbiota by dietary nutrients: A new avenue for human health. *Crit Rev Food Sci Nutr.* 2019;59(2):181–195. doi:10.1080/10408398.2017.1363708

# TITLE: THE FOOD-GUT HUMAN AXIS: THE EFFECTS OF DIET ON GUT MICROBIOTA AND METABOLOME

## Abstract

Gut microbiota, the largest symbiont community hosted in human organism, is emerging as a pivotal player in the relationship between dietary habits and health. Oral and, especially, intestinal microbes metabolize dietary components, affecting human health by producing harmful or beneficial metabolites, which are involved in the incidence and progression of several intestinal related and non-related diseases. Habitual diet (Western, Agrarian and Mediterranean omnivore diets, vegetarian, vegan and gluten-free diets) drives the composition of the gut microbiota and metabolome. Within the dietary components, polymers (mainly fibers, proteins, fat and polyphenols) that are not hydrolyzed by human enzymes seem to be the main leads of the metabolic pathways of gut microbiota, which in turn directly influence the human metabolome. Specific relationships between diet and microbes, microbes and metabolites, microbes and immune functions and microbes and/or their metabolites and some human diseases are being established. Dietary treatments with fibers are the most effective to benefit the metabolome profile, by improving the synthesis of short chain fatty acids and decreasing the level of molecules, such as p-cresyl sulfate, indoxyl sulfate and trimethylamine N-oxide, involved in disease state. Based on the axis diet-microbiota-health, this review aims at describing the most recent knowledge oriented towards a profitable use of diet to provide benefits to human health, both directly and indirectly, through the activity of gut microbiota.

De Angelis M, Garruti G, Minervini F, Bonfrate L, Portincasa P, Gobbetti M. The Food-gut Human Axis: The Effects of Diet on Gut Microbiota and Metabolome. *Curr Med Chem.* 2019;26(19):3567–3583. doi:10.2174/0929867324666170428103848

# TITLE: IMPACT OF A PROBIOTIC PRODUCT ON BOWEL HABITS AND MICROBIAL PROFILE IN PARTICIPANTS WITH FUNCTIONAL CONSTIPATION: A RANDOMIZED CONTROLLED TRIAL

Abstract - Objective: To investigate the clinical efficacy of a multi-strain probiotic product on bowel habits and microbial profile in participants with functional constipation.

Results: There were no significant between-group differences in the PAC-SYM score, despite significant within-group differences ( $P < 0.001$ ) over the study period. The probiotic group showed a faster normalization of stool frequency and consistency, with most participants achieving a normalized profile after 1 week. Fecal samples of the probiotic group exhibited higher relative abundance of Ruminococcaceae ( $P = 0.0047$ ), including the Ruminococcus genus, and lower relative abundance of Erysipelotrichaceae ( $P = 0.0172$ ) at end-point compared with baseline. Placebo group samples showed similar abundance profiles over the study, with the exception of Clostridiaceae, which was lower at the study end-point ( $P = 0.0033$ ). Among treated participants, all four probiotic strains were significantly more abundant after the intervention.

Conclusions: No significant differences were observed in symptomology, with both groups showing a more than 20% improvement. However, the probiotic helped modulate bowel function earlier than the placebo, with a corresponding shift to a more fibrolytic microbiota.

Martoni CJ, Evans M, Chow CT, Chan LS, Leyer G. Impact of a probiotic product on bowel habits and microbial profile in participants with functional constipation: A randomized controlled trial. *J Dig Dis*. 2019;20(9):435–446. doi:10.1111/1751-2980.12797

# TITLE: THE CHEMICAL COMPOSITION AND NUTRITIONAL VALUE OF CHIA SEEDS-CURRENT STATE OF KNOWLEDGE

Abstract- Chia (*Salvia hispanica*) is an annual herbaceous plant, the seeds of which were consumed already thousands of years ago. Current research results indicate a high nutritive value for chia seeds and confirm their extensive health-promoting properties. Research indicates that components of chia seeds are ascribed a beneficial effect on the improvement of the blood lipid profile, through their hypotensive, hypoglycaemic, antimicrobial and immunostimulatory effects. This article provides a review of the most important information concerning the potential application of chia seeds in food production. The chemical composition of chia seeds is presented and the effect of their consumption on human health is discussed. Technological properties of chia seeds are shown and current legal regulations concerning their potential use in the food industry are presented.

Kulczyński B, Kobus-Cisowska J, Taczanowski M, Kmiecik D, Gramza-Michałowska A. The Chemical Composition and Nutritional Value of Chia Seeds-Current State of Knowledge. *Nutrients*. 2019;11(6):1242. Published 2019 May 31. doi:10.3390/nu11061242

# TITLE: CHIA SEEDS (*SALVIA HISPANICA*): HEALTH PROMOTING PROPERTIES AND THERAPEUTIC APPLICATIONS – A REVIEW

## Abstract

Chia has been known for over 5,500 years. Chia seeds were one of the most important components of the diet of Mayas and Aztecs. The chemical composition and technological properties of chia give the plant a high nutritional potential. Chia is a good source of polyunsaturated fatty acids: omega-3 and omega-6, soluble dietary fiber. It also contains appreciable amount of proteins and phytochemicals. Nutritional value of chia is the reason why it is used in prophylaxis of several non-infectious diseases such as obesity, hypertension, cardiovascular diseases (CVDs), cancer and diabetes. Nutritional and therapeutic aspects of chia are currently being researched by many scientific centres. The aim of this article is to present the nutritional and therapeutic values of chia.

Marcinek K, Krejpcio Z. Chia seeds (*Salvia hispanica*): health promoting properties and therapeutic applications – a review. *Rocz Panstw Zakl Hig.* 2017;68(2):123–129.

# TITLE: FLAXSEED BIOACTIVE COMPOUNDS AND COLORECTAL CANCER PREVENTION

## Abstract

Purpose of review: Flaxseed and its bioactive components have been associated with a decreased risk of colorectal cancer incidence and progression. This review aims to summarize recent research regarding the role of flaxseed and each of its major dietary bioactive components in reducing colorectal cancer.

Recent findings: In both human and animal model experiments, flaxseed consumption had beneficial effects on colon physiology associated with reduction in colorectal cancer risk or occurrence. Considered separately, each of flaxseed's major bioactive components, including fiber, alpha-linolenic acid, lignans, and other phytochemicals, is also associated with decreased risk of colonic neoplasms and regulation of cell growth through several potential mechanisms. Collectively, experimental data suggests that consumption of flaxseed and/or its bioactive components may reduce colorectal cancer risk by a variety of mechanisms. Future studies should focus on the mechanisms by which whole flaxseed can prevent colorectal cancer.

DeLuca JAA, Garcia-Villatoro EL, Allred CD. Flaxseed Bioactive Compounds and Colorectal Cancer Prevention. *Curr Oncol Rep.* 2018;20(8):59. Published 2018 Jun 5. doi:10.1007/s11912-018-0704-z

# TITLE: CHIA SEEDS: AN ANCIENT GRAIN TRENDING IN MODERN HUMAN DIETS

## Abstract

Currently, in order to ensure adequate intake of nutrients to complement the normal diet, the consumption of seeds such as *Salvia hispanica* L. (commonly known as chia seeds) is increasing. For this reason, investigations concerning the composition and potential health effects of chia seeds are being carried out. Moreover, the recent approval of chia seeds as a Novel Food by the European Parliament allows its consumption and incorporation in a wide range of foods; thus, they have become widely available. Concerning their nutritional aspects, chia seeds are an excellent source of fat (20% to 34%), particularly polyunsaturated fatty acids such as  $\alpha$ -linolenic (60%) and linoleic (20%) acids. Moreover, high levels of protein (16% to 26%), mainly prolamins, and dietary fibre contents (23% to 41%) have been reported. Vitamins (mostly B complex) and minerals (calcium, phosphorus, and potassium, among others) have also been described in appreciable amounts. Additionally, due to the absence of gluten, these seeds are appropriate for coeliac patients. Regarding other bioactive compounds, chia seeds are also a source of antioxidants, such as chlorogenic and caffeic acids, quercetin and kaempferol. Due to their described composition, chia seeds have been related to different medicinal effects, particularly anti-inflammatory and antidiabetic activities and positive effects on cardiovascular disease and hypertension. The aim of this paper is to perform a systematic review of chia seeds to provide an update of the knowledge about their morphology, nutritional and chemical composition, possible human health benefits and role as a functional food.

Melo D , Machado TB , Oliveira MBPP . Chia seeds: an ancient grain trending in modern human diets. *Food Funct.* 2019;10(6):3068–3089. doi:10.1039/c9fo00239a

# TITLE: EFFECTS OF OAT BRAN ON NUTRIENT DIGESTIBILITY, INTESTINAL MICROBIOTA, AND INFLAMMATORY RESPONSES IN THE HINDGUT OF GROWING PIGS

Abstract- Oat bran has drawn great attention within human research for its potential role in improving gut health. However, research regarding the impact of oat bran on nutrient utilization and intestinal functions in pigs is limited. The purpose of this study was to investigate the effects of oat bran on nutrient digestibility, intestinal microbiota, and inflammatory responses in the hindgut of growing pigs. Twenty-six growing pigs were fed either a basal diet (CON) or a basal diet supplemented with 10% oat bran (OB) within a 28 day feeding trial. Results showed that digestibility of dietary gross energy, dry matter, organic matter, and crude protein were lower in the OB group compared to the CON group on day 14, but no differences were observed between the two groups on day 28. In the colon, the relative abundance of operational taxonomic units (OTUs) associated with *Prevotella*, *Butyrivibrio*, and *Catenibacterium* were higher while those associated with *Coprococcus* and *Desulfovibrio* were lower in the OB group compared to the CON group. Oat bran decreased mRNA expression of caecal interleukin-8 (IL-8), as well as colonic IL-8, nuclear factor- $\kappa$ B (NF- $\kappa$ B), and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) of the pigs. In summary, oat bran treatment for 28 day did not affect dietary nutrient digestibility, but promoted the growth of cellulolytic bacteria and ameliorated inflammatory reactions in the hindgut of growing pigs.

He B, Bai Y, Jiang L, et al. Effects of Oat Bran on Nutrient Digestibility, Intestinal Microbiota, and Inflammatory Responses in the Hindgut of Growing Pigs. *Int J Mol Sci*. 2018;19(8):2407. Published 2018 Aug 15. doi:10.3390/ijms19082407

# TITLE: OAT BRAN, BUT NOT ITS ISOLATED BIOACTIVE B-GLUCANS OR POLYPHENOLS, HAVE A BIFIDOGENIC EFFECT IN AN IN VITRO FERMENTATION MODEL OF THE GUT MICROBIOTA

Abstract- Wholegrain oats are known to modulate the human gut microbiota and have prebiotic properties (increase the growth of some health-promoting bacterial genera within the colon). Research to date mainly attributes these effects to the fibre content; however, oat is also a rich dietary source of polyphenols, which may contribute to the positive modulation of gut microbiota. In vitro anaerobic batch-culture experiments were performed over 24 h to evaluate the impact of two different doses (1 and 3 % (w/v)) of oat bran, matched concentrations of  $\beta$ -glucan extract or polyphenol mix, on the human faecal microbiota composition using 16S RNA gene sequencing and SCFA analysis. Supplementation with oats increased the abundance of Proteobacteria ( $P < 0.01$ ) at 10 h, Bacteroidetes ( $P < 0.05$ ) at 24 h and concentrations of acetic and propionic acid increased at 10 and 24 h compared with the NC. Fermentation of the 1 % (w/v) oat bran resulted in significant increase in SCFA production at 24 h (86 (sd 27) v. 28 (sd 5) mm;  $P < 0.05$ ) and a bifidogenic effect, increasing the relative abundance of Bifidobacterium unassigned at 10 h and Bifidobacterium adolescentis ( $P < 0.05$ ) at 10 and 24 h compared with NC. Considering the  $\beta$ -glucan treatment induced an increase in the phylum Bacteroidetes at 24 h, it explains the Bacteroidetes effects of oats as a food matrix. The polyphenol mix induced an increase in Enterobacteriaceae family at 24 h. In conclusion, in this study, we found that oats increased bifidobacteria, acetic acid and propionic acid, and this is mediated by the synergy of all oat compounds within the complex food matrix, rather than its main bioactive  $\beta$ -glucan or polyphenols. Thus, oats as a whole food led to the greatest impact on the microbiota.

Kristek A, Wiese M, Heuer P, et al. Oat bran, but not its isolated bioactive  $\beta$ -glucans or polyphenols, have a bifidogenic effect in an in vitro fermentation model of the gut microbiota. Br J Nutr. 2019;121(5):549–559. doi:10.1017/S0007114518003501

# TITLE: PUMPKIN SEED EXTRACT: CELL GROWTH INHIBITION OF HYPERPLASTIC AND CANCER CELLS, INDEPENDENT OF STEROID HORMONE RECEPTORS

Abstract- Pumpkin seeds have been known in folk medicine as remedy for kidney, bladder and prostate disorders since centuries. Nevertheless, pumpkin research provides insufficient data to back up traditional beliefs of ethnomedical practice. The bioactivity of a hydro-ethanolic extract of pumpkin seeds from the Styrian pumpkin, *Cucurbita pepo* L. subsp. *pepo* var. *styriaca*, was investigated. As pumpkin seed extracts are standardized to cucurbitin, this compound was also tested. Transactivational activity was evaluated for human androgen receptor, estrogen receptor and progesterone receptor with in vitro yeast assays. Cell viability tests with prostate cancer cells, breast cancer cells, colorectal adenocarcinoma cells and a hyperplastic cell line from benign prostate hyperplasia tissue were performed. As model for non-hyperplastic cells, effects on cell viability were tested with a human dermal fibroblast cell line (HDF-5). No transactivational activity was found for human androgen receptor, estrogen receptor and progesterone receptor, for both, extract and cucurbitin. A cell growth inhibition of ~40-50% was observed for all cell lines, with the exception of HDF-5, which showed with ~20% much lower cell growth inhibition. Given the receptor status of some cell lines, a steroid-hormone receptor independent growth inhibiting effect can be assumed. The cell growth inhibition for fast growing cells together with the cell growth inhibition of prostate-, breast- and colon cancer cells corroborates the ethnomedical use of pumpkin seeds for a treatment of benign prostate hyperplasia. Moreover, due to the lack of androgenic activity, pumpkin seed applications can be regarded as safe for the prostate.

Medjakovic S, Hobiger S, Ardjomand-Woelkart K, Bucar F, Jungbauer A. Pumpkin seed extract: Cell growth inhibition of hyperplastic and cancer cells, independent of steroid hormone receptors. *Fitoterapia*. 2016;110:150–156. doi:10.1016/j.fitote.2016.03.010

# TITLE: AN APPRAISAL OF PUMPKIN SEED EXTRACT IN 1, 2-DIMETHYLHYDRAZINE INDUCED COLON CANCER IN WISTAR RATS

## Abstract

Background: Cancer is one of the most important public health burdens in developed and developing countries. Colon cancer (CC) is the sixth most common cause of death in India and third most important cause in developed countries. For treating cancer, several synthetic agents are available but they cause side effects. Therefore, there is a need to investigate plant derived anticancer agents with lesser side effects. In this direction, we have made an attempt to unravel the potential of pumpkin seed extract for treating colon cancer.

Results: A significant difference in the aberrant crypt foci (ACF) number in all treatment groups compared to control and DMH groups were noted. Pretreatment group at a dose of 200 mg/kg showed a significant decrease in the colon length/weight ratio. Pretreatment groups showed a significant change in the colonic glutathione (GSH) and superoxide dismutase (SOD) levels when compared to control and DMH control. The nitrite content was decreased in treatment group 200 mg/kg at  $5.203 \pm 0.852$  when compared to DMH control at  $8.506 \pm 3.866$ . All treatment groups demonstrated decreased hyperplasia and ACF in histology.

Chari KY, Polu PR, Shenoy RR. An Appraisal of Pumpkin Seed Extract in 1, 2-Dimethylhydrazine Induced Colon Cancer in Wistar Rats. J Toxicol. 2018;2018:6086490. Published 2018 Sep 2. doi:10.1155/2018/6086490

# TITLE: DOES LARCH ARABINOGALACTAN ENHANCE IMMUNE FUNCTION? A REVIEW OF MECHANISTIC AND CLINICAL TRIALS

## Abstract

The common cold is a viral infection with important economic burdens in Western countries. The research and development of nutritional solutions to reduce the incidence and severity of colds today is a major focus of interest, and larch arabinogalactan seems to be a promising supportive agent. Arabinogalactan has been consumed by humans for thousands of years and is found in a variety of common vegetables as well as in medicinal herbs. The major commercial sources of this long, densely branched, high-molecular-weight polysaccharide are North American larch trees. The aim of this article is to review the immunomodulatory effects of larch arabinogalactan derived from *Larix laricina* and *Larix occidentalis* (North American *Larix* species) and more specifically its role in the resistance to common cold infections. In cell and animal models, larch arabinogalactan is capable of enhancing natural killer cells and macrophages as well as the secretion of pro-inflammatory cytokines. In humans a clinical study demonstrated that larch arabinogalactan increased the body's potential to defend against common cold infection. Larch arabinogalactan decreased the incidence of cold episodes by 23 %. Improvements of serum antigen-specific IgG and IgE response to *Streptococcus pneumoniae* and tetanus vaccination suggesting a B cell dependent mechanism have been reported in vaccination studies with larch arabinogalactan, while the absence of response following influenza vaccination suggests the involvement of a T cell dependent mechanism. These observations suggest a role for larch arabinogalactan in the improvement of cold infections, although the mode of action remains to be further explored. Different hypotheses can be envisaged as larch arabinogalactan can possibly act indirectly through microbiota-dependent mechanisms and/or have a direct effect on the immune system via the gut-associated lymphoid tissue (GALT).

Dion C, Chappuis E, Ripoll C. Does larch arabinogalactan enhance immune function? A review of mechanistic and clinical trials. *Nutr Metab (Lond)*. 2016;13:28. Published 2016 Apr 12. doi:10.1186/s12986-016-0086-x

# TITLE: DIETARY INULIN AND TRICHURIS SUIIS INFECTION PROMOTE BENEFICIAL BACTERIA THROUGHOUT THE PORCINE GUT

## Abstract

The gut microbiota (GM) displays a profound ability to adapt to extrinsic factors, such as gastrointestinal pathogens and/or dietary alterations. Parasitic worms (helminths) and host-associated GM share a long co-evolutionary relationship, exerting mutually modulatory effects which may impact the health of the host. Moreover, dietary components such as prebiotic fibers (e.g. inulin) are capable of modulating microbiota toward a composition often associated with a healthier gut function. The effect of helminth infection on the host microbiota is still equivocal, and it is also unclear how parasites and prebiotic dietary components interact to influence the microbiota and host health status. Some helminths, such as *Trichuris suis* (porcine whipworm), also exhibit strong immunomodulatory and anti-inflammatory effects. We therefore explored the effects of *T. suis*, alone and in interaction with inulin, both in fecal microbiota during the infection period and luminal microbiota across four intestinal segments at the end of a 4-week infection period. We observed that *T. suis* generally had minimal, but mainly positive, effects on the microbiota. *T. suis* increased the relative abundance of bacterial genera putatively associated with gut health such as *Prevotella*, and decreased bacteria such as *Proteobacteria* that have been associated with dysbiosis. Interestingly, dietary inulin interacted with *T. suis* to enhance these effects, thereby modulating the microbiota toward a composition associated with reduced inflammation. Our results show that administration of *T. suis* together with the consumption of prebiotic inulin may have the potential to positively affect gut health.

Stolzenbach S, Myhill LJ, Andersen LO, et al. Dietary Inulin and *Trichuris suis* Infection Promote Beneficial Bacteria Throughout the Porcine Gut. *Front Microbiol.* 2020;11:312. Published 2020 Mar 4. doi:10.3389/fmicb.2020.00312

# TITLE: DIETARY SUPPLEMENTATION WITH INULIN-PROPIONATE ESTER OR INULIN IMPROVES INSULIN SENSITIVITY IN ADULTS WITH OVERWEIGHT AND OBESITY WITH DISTINCT EFFECTS ON THE GUT MICROBIOTA, PLASMA METABOLOME AND SYSTEMIC INFLAMMATORY RESPONSES: A RANDOMIZED CROSS-OVER TRIAL

## Abstract

**Objective:** To investigate the underlying mechanisms behind changes in glucose homeostasis with delivery of propionate to the human colon by comprehensive and coordinated analysis of gut bacterial composition, plasma metabolome and immune responses.

**Results:** Both IPE and inulin supplementation improved insulin resistance compared with cellulose supplementation, measured by homeostatic model assessment 2 (mean±SEM 1.23±0.17 IPE vs 1.59±0.17 cellulose, p=0.001; 1.17±0.15 inulin vs 1.59±0.17 cellulose, p=0.009), with no differences between IPE and inulin (p=0.272). Fasting insulin was only associated positively with plasma tyrosine and negatively with plasma glycine following inulin supplementation. IPE supplementation decreased proinflammatory interleukin-8 levels compared with cellulose, while inulin had no impact on the systemic inflammatory markers studied. Inulin promoted changes in gut bacterial populations at the class level (increased Actinobacteria and decreased Clostridia) and order level (decreased Clostridiales) compared with cellulose, with small differences at the species level observed between IPE and cellulose.

**Conclusion:** These data demonstrate a distinctive physiological impact of raising colonic propionate delivery in humans, as improvements in insulin sensitivity promoted by IPE and inulin were accompanied with different effects on the plasma metabolome, gut bacterial populations and markers of systemic inflammation.

Chambers ES, Byrne CS, Morrison DJ, et al. Dietary supplementation with inulin-propionate ester or inulin improves insulin sensitivity in adults with overweight and obesity with distinct effects on the gut microbiota, plasma metabolome and systemic inflammatory responses: a randomised cross-over trial. *Gut*. 2019;68(8):1430–1438. doi:10.1136/gutjnl-2019-318424

# TITLE: DRIED FRUIT INTAKE AND CANCER: A SYSTEMATIC REVIEW OF OBSERVATIONAL STUDIES

## Abstract

Insufficient intake of total fruits and vegetables is linked to an increased cancer risk, but the relation is not understood for dried fruits. Dried fruits are generally perceived, by both consumers and researchers, as a less attractive but shelf-stable equivalent to fresh fruits and constitute a small but significant proportion of modern diets. Chemical compositions of raw and dried fruits, however, may differ substantially. Several clinical and laboratory intervention studies have reported the protective effects of dehydrated fruits against the progression of some cancers and the modulating effects of dried fruits on common cancer risk factors. In this systematic review, we identified, summarized, and critically evaluated 9 prospective cohort and 7 case-control studies that examined the relations between traditional dried fruit (raisins, prunes, dates) consumption and cancer risk in humans. Prospective cohort studies determined that significant reductions in relative risk of precancerous colorectal polyps, incidence of prostate cancer, or mortality from pancreatic cancer, by, respectively, 24%, 49%, and 65%, were associated with 3-5 or more servings of dried fruits per week. Selected case-control studies revealed inverse associations between dried fruit intake and risk of cancer as well. The reported associations were comparable to or stronger than those observed for total or raw fruits. Although the small number and high heterogeneity impede meta-analysis of these studies, we conclude that currently available data provide some initial evidence that consumption of dried fruits may be associated with a lower cancer incidence or mortality in populations. The data suggest that higher intake of raisins and other dried fruits may be important in the prevention of cancers of the digestive system. Because only a limited number of health outcome and dried fruit intake relations have been evaluated in prospective studies to date, reanalyzing existing high-quality epidemiological data may expand the knowledge base.

Mossine VV, Mawhinney TP, Giovannucci EL. Dried Fruit Intake and Cancer: A Systematic Review of Observational Studies. *Adv Nutr.* 2020;11(2):237–250. doi: 10.1093/advances/nmz085

# TITLE: INTAKE OF DIETARY FIBER, FRUITS, AND VEGETABLES AND RISK OF DIVERTICULITIS

## Abstract

**Objectives:** Although low fiber intake has been considered a risk factor for diverticulitis, prospective evidence is limited in women despite having a disproportionate burden of disease, with little known about variation in the protective effects according to food sources. We assessed the associations of intakes of fiber and major food sources of fiber including fruits and vegetables with risk of diverticulitis in a large cohort of women.

**Methods:** We followed 50,019 women in the Nurses' Health Study (1990-2014) who were aged 43-70 years and free of diverticulitis, cancer, and inflammatory bowel disease at baseline. Incident diverticulitis was identified through self-report with validity confirmed by review of medical records.

**Results:** We documented 4,343 incident cases of diverticulitis, encompassing 1,106,402 person-years of follow-up. Compared with participants in the lowest quintile, the multivariable hazard ratio of diverticulitis in the highest quintile of total fiber intake was 0.86 (95% confidence interval: 0.78-0.95; P-trend = 0.002). Fiber from fruits and cereals, but not vegetables, was associated with a decreased risk of diverticulitis. Furthermore, intake of total whole fruit intake and specific fruits such as apples/pears and prunes were associated with reduced risk of diverticulitis with a multivariable hazard ratio for diverticulitis of 0.95 (0.92-0.98; P-trend < 0.001) for every serving increase of total whole fruit intake per day.

**Discussion:** Higher intake of dietary fiber and fiber from different food sources, except for vegetable fiber, are associated with a lower risk of diverticulitis in women. A greater intake of whole fruit is also associated with reduced risk.

Ma W, Nguyen LH, Song M, et al. Intake of Dietary Fiber, Fruits, and Vegetables and Risk of Diverticulitis. *Am J Gastroenterol*. 2019;114(9):1531–1538. doi: 10.14309/ajg.00000000000000363

# TITLE: BIOACTIVITY AND POTENTIAL HEALTH BENEFITS OF LICORICE

## Abstract

Licorice is an herbal plant named for its unique sweet flavor. It is widely used in the food and tobacco industries as a sweetener. Licorice is also used in traditional Chinese medicine (TCM) and complementary medicine. Because the use of licorice has long been a part of TCM, the details of its therapeutic applications have been thoroughly established. In modern science, licorice is of interest because of its broad range of applications. Extracts of and compounds isolated from licorice have been well studied and biologically characterized. In this review, we discuss the nutraceutical and functional activities of licorice as well as those of the extracts of and the isolated compounds from licorice, including agents with anti-inflammatory activity, cell-protective abilities, and chemopreventive effects. The side effects of licorice are also enumerated. A comparison of the activities of licorice described by modern science and TCM is also presented, revealing the correspondence of certain characteristics.

Kao TC, Wu CH, Yen GC. Bioactivity and potential health benefits of licorice. *J Agric Food Chem.* 2014;62(3):542–553. doi:10.1021/jf404939f

# TITLE: PREVENTION AND TREATMENT OF INFLUENZA, INFLUENZA-LIKE ILLNESS, AND COMMON COLD BY HERBAL, COMPLEMENTARY, AND NATURAL THERAPIES

## Abstract

In recent years viral respiratory tract infections, especially influenza viruses, have had a major impact on communities worldwide as a result of unavailability of effective treatment or vaccine. The frequent alterations in the antigenic structures of respiratory viruses, particularly for RNA viruses, pose difficulties in production of effective vaccines. The unavailability of optimal medication and shortage of effective vaccines suggests the requirement for alternative natural therapies. Several herbal remedies were used for prevention and treatment viral respiratory illnesses. Among those that were found effective included maoto, licorice roots, antiwei, North American ginseng, berries, Echinacea, plants extracted carnosic acid, pomegranate, guava tea, and Bai Shao. There is scientific evidence regarding the effectiveness of several complementary therapies for colds. Oral zinc may reduce the length and severity of a cold. Taking vitamin C supplements on a regular basis only slightly reduces the length and severity of colds. Probiotics were found better than placebo in reducing the number episodes of acute upper respiratory tract infections, the rate of episodes of acute upper respiratory tract infection and reducing antibiotic use. Alkaline diets or drinks might have antiviral properties as in vitro studies demonstrated inactivation effect of alkaline medium on respiratory virus. Earthing might have a natural anti-inflammatory effect for human body. It is now accepted that an overwhelming inflammatory response is the cause of human deaths from avian H5N1 influenza infection. Earthing accelerates immune response following vaccination, as demonstrated by increases of gamma globulin concentration. No in vivo or clinical studies were found that investigate the role of alkalization

Mousa HA. Prevention and Treatment of Influenza, Influenza-Like Illness, and Common Cold by Herbal, Complementary, and Natural Therapies. *J Evid Based Complementary Altern Med.* 2017;22(1):166–174. doi:10.1177/2156587216641831

# TITLE: ASTRAGALUS MEMBRANACEUS NANOPARTICLES MARKEDLY IMPROVE IMMUNE AND ANTI-OXIDATIVE RESPONSES; AND PROTECTION AGAINST AEROMONAS VERONII IN NILE TILAPIA OREOCHROMIS NILOTICUS

## Abstract

The effects of dietary administration of *Astragalus membranaceus* nanoparticles (ANP) on immune and anti-oxidative responses, growth performance and disease resistance of *Oreochromis niloticus* were evaluated in the present study. Fish were divided into three groups and received the ANP at rates of 0 (control), 1, and 2%/kg diet for four weeks. After the four-week feeding trial, three fish from each replicate were sampled for immune and anti-oxidative responses evaluation, ten fish from each group were challenged with *A. veronii*, and nine fish from each group were subjected to cold and hypoxia challenges. It was obvious from the results that ANP significantly enhanced lysozyme activity and nitrous oxide (NO) activities, as well as improved superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx) activities. Also, aspartate aminotransferase, alanine transaminase, glucose, and cortisol measurements showed significantly lower levels in incorporated groups compared to the control. Growth performance; and amylase and lipase digestive enzymes activities also showed markedly improved results. Expression of heat shock protein 70 (HSP70) and interleukin 1, beta (IL-1 $\beta$ ) genes were significantly upregulated throughout the entire experimental period. When challenged with *A. veronii*, the mortality of treated groups was significantly ( $P < 0.05$ ) lower than the control. Current results proofs that dietary ANP had a synergistic effect on immune and anti-oxidative responses, growth performance and disease resistance of *Oreochromis niloticus*.

Elabd H, Wang HP, Shaheen A, Matter A. *Astragalus membranaceus* nanoparticles markedly improve immune and anti-oxidative responses; and protection against *Aeromonas veronii* in Nile tilapia *Oreochromis niloticus*. *Fish Shellfish Immunol.* 2020;97:248–256. doi:10.1016/j.fsi.2019.12.025

# TITLE: ASTRAGALUS POLYSACCHARIDES ENHANCE THE IMMUNE RESPONSE TO AVIAN INFECTIOUS BRONCHITIS VIRUS VACCINATION IN CHICKENS

## Abstract

Astragalus polysaccharides (APS) are biological macromolecules extracted from Astragalus species that have strong immunoregulatory properties. In this study, APS were employed as an adjuvant for an avian infectious bronchitis virus (IBV) vaccine, and its effects on the cellular immune and humoral immune responses to vaccination in chicken were investigated. One hundred and fifty chicken were randomly divided into five groups (n = 30, each group). The chickens in all groups, except for the unvaccinated control group, were vaccinated with an IBV DNA vaccine. Three of the four vaccinated groups were administered different doses of APS (APSL, 10 mg/kg; APSM, 50 mg/kg; and APSH, 100 mg/kg) after the first vaccination, and the remaining vaccinated group served as a control, without any additional treatment. At 14, 28, and 42 days after the first vaccination, serum anti-IBV antibody titers; peripheral lymphocyte proliferation; and the mRNA expression of IL-1 $\beta$ , IL-2, IL-8, and TNF- $\alpha$  in the spleen were assessed by enzyme-linked immunosorbent assay (ELISA), the cell counting kit-8 (CCK-8), and real time quantitative RT-PCR (qRT-PCR), respectively. At most time points, the titer of IBV-specific antibodies, lymphocyte proliferation, and IL-1 $\beta$ , IL-2, IL-8, and TNF- $\alpha$  mRNA expression levels were higher in three APS groups than in the vaccine control group, and these increases were dose-dependent. These data suggest that APS could be used as an adjuvant for IBV vaccination to provide better protection against IBV infection.

Zhang P, Wang J, Wang W, et al. Astragalus polysaccharides enhance the immune response to avian infectious bronchitis virus vaccination in chickens. *Microb Pathog.* 2017;111:81–85. doi:10.1016/j.micpath.2017.08.023