Awakening Our Innate Response: Hemp Seed as Food & Medicine
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History

The hemp plant *(Cannabis sativa)* is a member of the Cannabaceae family, which it shares with common hops, whose strobiles (flowers) are a common beer ingredient. Like hops, hemp has a long history of participation in human culture. Likely native to temperate Asia, hemp "followed" early human settlements and easily adapted to domestication, being harvested and put to use by the Chinese 8500 years ago.[1] Hemp was primarily prized as a source of extremely durable fiber for much of its history—remains of hemp cloth dating back six millennia have been discovered.[1] For at least 3000 years the Chinese have also used hemp seed and hemp seed oil for food and medicine.[2] As Michael Pollan has cleverly suggested, certain plants seem to possess an ingenious ability to render themselves indispensable and thus receive the benefits of our constant tending—diversification of gene pools, selective breeding for survival, and coddled environments are just a few of the perks.[3] Indeed, making its way across time and oceans, today the versatile hemp plant offers in return fiber and seeds which are variously used in livestock bedding and feed, specialty papers, textiles, molded plastics, construction materials and body care products, as well as in foods, medicines and nutritional supplements.

Of course, there has also been a long history of use of the leaves and flowers of *Cannabis,* as certain varieties provide high levels of cannabinoids which are sought for their psychoactive properties and are now also studied for their medical uses. However, the cultivars that are bred for seed and fiber naturally contain a negligible percentage of cannabinoids, and so do not present an opportunity for psychoactive uses of the plant, which remains illegal in many countries. To allay government concerns, the Canadian and European Union hemp industries have developed new cultivars to specifically meet strict standards which minimize cannabinoid content while providing a high quality food and fiber crop.[2] While cultivation of any variety of hemp is still illegal in the US, imported hemp-derived food and supplement products have been permitted and are showing up with increasing frequency and variety on health-food store shelves.

Nutritional Composition

The growth in popularity of hemp is not surprising, as the seeds are a rich source of numerous macro- and micronutrients and display properties unique among plant sources of certain proteins and fatty acids. Hemp seeds (technically nuts) also have a pleasant nutty flavor, and so are easily incorporated into familiar products and recipes. Hemp seed's nutrient composition includes fatty acids (35%), proteins (25%), carbohydrates (27%) and numerous vitamins and minerals.[2] Given this complex nutritional profile, it's no surprise that, according to Mahayana Buddhism, Buddha survived six years of asceticism in his quest for enlightenment by eating nothing but one hemp seed each day![1]

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Fatty Acids

Hemp seed's fatty acids are comprised of mostly (>80%) polyunsaturated fatty acids (PUFAs), being especially rich in the essential fatty acids (EFAs) linoleic acid (18:2 *omega*-6; LA) and alpha-linolenic acid (18:3 *omega*-3; ALA). The remaining fatty acids are monounsaturated oleic acid (18:1 omega-9) and a small percentage of saturated fatty acids.[1,2] Metabolites of LA and ALA, gamma-linolenic acid (18:3 *omega*-6; GLA) and stearidonic acid (18:4 *omega*-3; SDA), are also present,[2] making hemp seed the only whole *food* source of GLA (making up 2-5% of total fatty acids).[1] Other sources, such as borage and black currant seeds, require extraction and are taken as supplements.[1] The ratio of *omega*-6 to *omega*-3 in hempseed oil falls between 2:1 and 3:1, considered an optimal intake ratio for humans, another unique feature among common plant-based oils.[1,2]

Proteins

Hemp seed's protein occurs primarily in the form of the storage proteins edestin (67%) and albumin (33%) (easily digested and utilized functional globular proteins), both of which contain a broad profile of amino acids, including all eight essential to human health.[2] The quality of hemp seed protein is comparable to egg white and soy bean, exceeding both in arginine, histidine and glycine content, while providing nutritionally relevant levels of the remaining complement of essential and non-essential amino acids,[2] including sulfur-containing methionine and cystine.[4] Hemp seed is also a significant source of glutamic acid,[2] which, along with glycine and cystine, serves as a precursor to the essential and ubiquitous cellular antioxidant glutathione.

Carbohydrates

Digestible (or soluble) and non-digestible (insoluble) fibers comprise the carbohydrate fraction of hemp seed. These fibers exist in the seed in a roughly 4:1 (insoluble : soluble) ratio, though the ratio shifts to roughly 3:2 in seed meal.[2]

Vitamins & Minerals

Hemp contains 90 mg of antioxidant tocopherols /100 g, and is especially high in gamma-tocopherol (>90% occurs in this form)[2]. The tocopherols help stabilize the highly unsaturated fatty acids, preventing oxidation and rancidity. Additional vitamins found in hemp seed include thiamine (B1) and riboflavin (B2), while minerals include phosphorous, potassium, magnesium, calcium, iron, sodium, manganese, zinc and copper.[2]

Further nutritionally unique characteristics of hemp seed include its status as an excellent vegan EFA and protein source that can be cold-milled and pressed, so it is also considered raw food. Hemp is also easily grown organically and is not commonly genetically modified, as is soy, nor exposed to mercury or polychlorinated biphenyls (PCBs), as seafood and fish oil can be. Hemp's proteins are easily digested, containing

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none of the trypsin inhibitors (sometimes called anti-nutrients) found in legumes[4], and are also non-allergenic, as soy and whey proteins are for some individuals.

Medicinal Value

Traditional Chinese Medicine refers to hemp seeds as *huo ma ren* and considers them sweet in flavor and neutral in temperament. According to a translation of the 400-year old medical text *Pen T'sao Kang Mu,* hemp seeds were used "'[t]o mend and help all of the central areas of the chi. The Ancients used this medicine to remain fertile, strong and vigorous… It [could] break up long-standing problems with the blood and flow...[and would] restore the blood, pulse, the veins and arteries.'"[5] Given these qualities, it follows that they are still employed to nourish the yin and lubricate the intestines, making them valuable in constipation due to dryness and yin deficiency, and as a hypotensive agent.[6]

We can also assess hemp's medicinal value based on biochemical activities demonstrated by the seed and some of its primary constituents. Experimental models and clinical trials have suggested beneficial modulation of immune and neurological function, metabolism and endocrine performance, and cardiovascular function. While clinical trials using hemp seed and oil are few, there are numerous models that have examined hemp in animal feeding trials, while others have assessed the activities of relevant fatty acids and fiber, from which we can extrapolate useful information about hemp's attributes.

Balanced Fatty Acids

Dietary EFAs LA and ALA, as well as their metabolites GLA and SDA, are desaturated further into longer-chain fatty acids that serve as precursors for both pro- and anti-inflammatory members of the eicosanoid family (i.e. thromboxanes, leukotrienes and prostaglandins). Additionally, dietary fatty acids affect cell membrane properties system-wide, with particular impacts on membrane fluidity, and thus neuronal signaling, in the central nervous system.[2] Hemp's unique fatty acid composition and balance can have significant impact on inflammatory processes and cell membrane activities, which are the foundation of numerous chronic diseases, including cardiovascular diseases, cancers, neurodegenerative disorders, hypersensitivities and auto-immune conditions.

At the end of the *omega*-6 elongation pathway originating with LA lies arachidonic acid (AA), which is readily incorporated into plasma membranes throughout the body. AA-derived eicosanoids themselves generate inflammatory activity, while also regulating production of inflammatory cytokines, such as tumour necrosis factor-alpha (TNF), interleukin-1 (IL-1) and interleukin-6 (IL-6) and the expression of adhesion molecules involved in inflammatory interactions between leukocytes and endothelial cells,[7] as in vasculature.

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As *omega*-6 PUFAs are present in excess in the Standard American Diet, especially from AA-rich meats and animal products, it follows that numerous acute and chronic inflammatory diseases are also prevalent. By incorporating *omega*-3 fatty acids into the diet, such as ALA and longer-chain fatty acids such as SDA, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), AA can be displaced from cell membranes in favor of these anti-inflammatory eicosanoid precursors.[7] ALA also competes with LA for desaturating enzyme, thus reducing AA metabolism. *Omega*-3 fatty acids may also directly regulate TNF-alpha, IL-1, IL-6 and adhesion molecules independent of eicosanoid modulation.[7] At the same time, the *omega*-6 PUFAs, GLA and its metabolite dihomo-gamma-linolenic acid (DGLA), can also induce anti-inflammatory and anti-proliferative activity via an increase in production of series 1 prostaglandins (PGE1),[8] though in this case changes in AA content of cell membranes is unchanged. However, as PGE1s are 20 times more potent than AA-derived series 2 prostaglandins, even at low doses of GLA the net effect is anti-inflammtory.[8]

These fatty acid-derived membrane-altering and anti-inflammatory mechanisms likely lie at the heart of much of hemp seed's activity. Research has demonstrated potential roles in preventing and ameliorating conditions such as atopic dermatitis (eczema),[9,10] rheumatoid arthritis,[11] Alzheimer's disease[12] and diabetic neuropathy,[8] bipolar disorder,[13] and tumorogenesis and metastasis, especially in the colon.[8]

Cardiovascular health is another primary area of application for dietary PUFAs and their metabolites in general. PUFAs can shift the fatty acid profile of low-density lipoproteins (LDL) in a favorable manner, as compared to saturated fats and, in an appropriate *omega*-3:6 ratio, can lower arterial levels of both LDL-cholesterol and blood pressure. Bleeding time can also be increased through a reduction in platelet aggregation, which also can reduce peripheral blood pressure and clot formation.[2]

Clinical and animal models have specifically examined hemp seed's potential to reduce plasma triglycerides and increase HDL-cholesterol,[14] while also reducing platelet aggregation in the presence of high levels of circulating cholesterol.[15] Cardiac reperfusion injury has also been prevented with hemp feeding, with ALA being selectively deposited in cardiac tissue.[16] Numerous non-hemp studies on ALA and GLA[8,17,18] further support the strong potential for hemp seed to protect against atherosclerosis, thrombosis and platelet dysfunction, coronary heart disease and cardiac death.

Fiber

Both soluble and insoluble fibers demonstrate numerous health benefits. Soluble fiber feeds immunomodulating gut flora (which, in turn, produce butyrate, which nourishes colonic cells and modulates their gene expression),[19] slows glucose absorption, slows gastric emptying, and increases bile acid excretion.[20] Soluble fiber decreases serum total and LDL-cholesterol concentrations and improves insulin resistance. However, while

cardiovascular risk factors are reduced by soluble fiber intake, it is the consumption of insoluble fiber that has been closely associated with lower incidence of cardiovascular disease and diabetes.[21,20] A diet high in insoluble fiber is also strongly associated with lower risk of diverticular disease[22] and has shown protective effects against colon oncogenesis in animal models.[19] Given that hemp seed is a good source of both types of fiber, as well as accompanying antioxidant and anti-inflammatory nutrients, its consumption would likely provide metabolic and cardiovascular protection similar to other varieties of fiber- and nutrient-dense nuts, seeds and grains—common sources of fiber in epidemiological studies.[20]

In summary, hemp contains significant levels of valuable PUFAs, including an ideally balanced ratio of EFAs, which serve as building materials for flexible cellular membranes and as precursors for regulatory biochemicals, including inflammatory mediators. Its globular proteins are easily digested and utilized by the body to build hormones, enzymes and antibodies, while specific amino acids serve as antioxidant precursors. Hemp's soluble and insoluble fibers benefit digestive, metabolic and cardiovascular health. Research points the way toward myriad benefits of this remarkable food, while nutritional wisdom and traditional use have already confirmed the value of hemp seed in bringing about and maintaining vibrant health.

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