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Barley Seeds (*Hordeum vulgare* L.)



Sten – Wikipedia - 2004



SanjayArcharya – Wikipedia - 2017

- Farmed in India since antiquity; considered a holy grain.
- Contains soluble fiber, beta.-glucans, shown to decrease cholesterol levels and reduce blood levels of low-density lipoproteins (LDLs), and reduces the risk of cardiovascular disease.

- Has a low glycemic index, is a safe carbohydrate for diabetes, and contains antioxidants that assist with maintaining proper levels of blood glucose and insulin.
- Beneficial for gut health or maintaining microflora in the colon environment.
- Has been shown to reduce visceral fat (belly fat deep in abdominal cavity and surrounding intestines, liver, and stomach).
- Anti-tumor properties; helps immune system arrest cancer cell proliferation and its spreading.
- Anti-arthritic.
- Phytochemicals include antioxidant compounds phenolic acids, proanthocyanidins, flavonoids, lignans, tocols, phytosterols, and folates (Vitamin B9).
- Flavonoids in barley grains or seeds have been found to have anti-cancer, anti-allergy, anti-inflammatory, and protective digestive system properties.
- Phenolics found to help prevent cancer cell proliferation and neutralize cell-damaging free radicals.
- Lignans are antiviral, antibacterial, anti-fungal.
- Tocols are known to dissolve atherosclerotic blockages in the carotid artery, reducing the risk of stroke.
- Phytosterols, phytostanols, (precursors for the chemical reactions for forming various fatty acids and glucose derivatives), known to lower blood cholesterol levels and prevent colon cancer.
- Rich in calcium, magnesium, zinc, iron, potassium, phosphorus, and both water-soluble vitamins (Vitamin B complex and C), and fat-soluble vitamins ((Vitamin A, D, E, K).
- Contains fat-transport molecules triacylglycerol, diacylglycerol, monoacylglycerol, and essential fatty acids linoleic acid, oleic acid and linolenic acid that reduce LDL cholesterol (Raj, et. al., 2023).

Bird Pepper - Pod Pepper (Cayenne) *Capsicum annuum* 'Pequin'
AKA Red Pepper, Guinea Pepper, Bird's Eye Pepper.

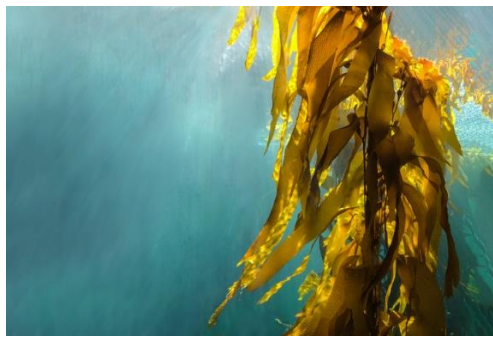


Stephen J Alexander - 2009 Wikipedia

- Contains capsaicin, its major active phytochemical compound known for its anti-obesity effects, including reducing abdominal fat.
- Proven to be an effective anti-cancer agent, suppresses neoplasia or the body's abnormal growth of cells or tissues and increases cancer cell self-destruction or apoptosis.
- Studies indicate capsaicin may be effective against neurodegenerative diseases such as Alzheimer's.

- Capsaicin has been shown to sustain fat oxidation or the continued breakdown of fats or triglycerides down to free fatty acids, and thus maintaining an elevated resting energy expenditure when not exercising.
- Capsinoid supplement intake, another compound in cayenne, showed body weight reductions and increased VO₂ rates (oxygen consumption capacity during exercise).
- Capsinoids have been found to increase the utilization or metabolic activation of brown adipose tissue for energy, and to increase thermogenesis or heat production.
- Capsaicin and capsinoid compounds in cayenne pod pepper have the effect of reducing food choices of carbohydrates, which excess can cause excess sugar in the blood and result in being converted to body fat (Zheng, et. al., 2017).

Brown Algae *Phaeophyceae* (or *Fucophyceae*; Christensen, 1978)



Barbaraana - 2016 - iStock

- A type of seaweed, is a key part of the Asian diet and in other countries, and is considered a medicinal food.
- Contains fucoidan, a sulfate-fucose polysaccharide compound recognized as containing anti-coagulant, anti-thrombotic, anti-tumor, anti-inflammatory, and anti-virus properties, including against herpes simplex virus type 1.
- Recent studies show its potential of fucoidan for inhibiting fat accumulation by inhibiting the formation and increase in adipocytes (fat cells).
- One study examined fucoidan and found it inhibited triglyceride (lipids or fats) accumulations during the process of breaking down fats, and concluded that brown algae would be helpful as an anti-obesity agent. The normal process otherwise involves breaking down lipids into triglycerides and fatty acids via lipolysis (Park, 2011).
- Contain high amounts of fibers, minerals, and essential polyunsaturated fatty acids.
- Contain bioactive compounds such as phlorotannins and certain types of polyunsaturated fatty acids not found in terrestrial plants.
- Studies show there is an association between dietary intake of seaweeds and reduced prevalence of cardiovascular disease, hyperlipidemia (excessive fats in the blood), cancer, type 2 diabetes, and obesity.
- Another study showed increased energy expenditure, decreased lipogenesis (reduced formation of new adipocytes or fat cells), decrease in adipose cell sizes, and decreased inflammatory markers such as interleukin-6.
- Other components of the algae contributing to improved fat metabolism is eicosapentanoic acid (EPA) and fiber.
- Has been found to have an appetite-modulating effect that signals satiety levels, due to its bulking effect of its alginates when included in algae-enriched bread (Wan-Loy, 2016).

- Also contains bioactive compounds such as polyphenols, sterols, alkaloids, flavonoids, tannins, essential amino acids.
- Its particular polysaccharides improve the environment in the intestinal tract, particularly, alginic acid or algin or alginate. Thirty to sixty percent of total sugars in brown algae are aglinates.
- The brown color is due to the pigment, fucoxanthin, which has antitumoral, antioxidant, and anti-obesity properties.
- Contains polyunsaturated fatty acids (PUFAs), mainly, linoleic acid (LA), arachidonic acid (DHA), and eicosapentaenoic acid (EPA).
- Besides many sterols such as fucosterol and isofucosterol, precursors to the generation of thousands of regulating hormones, cholesterol is one of the major sterols.
- Phlorotannins in brown algae are found to be antidiabetic, anticancer, anti-inflammatory, antioxidant, neuroprotective, antiviral, antihypertensive, anticoagulant, immunomodulatory, and UV-protective.
- All seafood is subject to be exposed to potentially harmful environmental toxins and elemental compounds such as lead, mercury, and other health hazards.
- Companies should follow safety standards that include detoxification processes that eliminate all impurities and toxins (Lomartire, 2021).

Flax Seeds (*Linum usitatissimum*)



Sanjay Acharya- 2009 - Wikimedia



D. Gordon E. Robertson - 2007 - Wikipedia

- Rich in the class of compounds known as lignans, shown to improve blood lipid profiles, blood pressure, reduction in body weight and reduce fat accumulation in visceral fat.
- An excellent source of fibers; 20-40% soluble fiber (mucilage gums), and 60=80% insoluble cellulose fiber, and lignin.
- Effective against inflammatory adipokines when adiposity (fat storage) is occurring, against inflammatory cytokines associated with low-grade inflammation, and when there is decreased production of anti-inflammatory and anti-diabetic adiponectin in adipose (fat) tissues.
- Lignan-enriched flaxseed powder was found to improve lipid profiles and lower blood pressure in rats fed a high fat and high fructose diet (Park, 2012).

- Flaxseeds contain a high amount of omega 3 polyunsaturated fat, alpha-linolenic acid (ALA) in addition to lignans and fibers, which protect against cardiovascular disease, including: arrhythmias, myocardial fibrosis, myocardial infarction, coronary artery disease, and atherosclerosis..
- Reduces high systolic and diastolic blood pressure in peripheral arterial disease.
- The alpha-linolenic acid and secoisolariciresinol diglucoside (SDG) and derivative fatty acids from flax seeds have been found to inhibit tumor growth in breast, ovary, endometrial, cervix, prostate, lung, colon, and liver cancers.
- Flaxseeds positively impact how the body metabolizes its phytochemical compounds into various metabolites with anti-tumor actions.
- Omega-3 fatty acids also improve brain function, brain size, and the glands that modulate behavior and moods, and maintain spatial and learning tasks.
- Flaxseed has also been shown to improve brain functions in neural disease.
- Reduces severity of hot flashes in post-menopausal women, improves skin texture, has antibacterial actions on illness-causing bacteria in the intestines (Park, 2012).

Ginger Root (*Zingiber officinale*)



Congerdesign – Pixabay - 1714196_640

- Found to modulate obesity through potential mechanisms such as increasing thermogenesis (increasing heat production), lipolysis (breaking down fats for energy), suppression of lipogenesis (suppressing formation of body fat), and inhibiting intestinal fat absorption, and controlling appetite (Attari, et. al., 2018).
- Contains essential amino acids that play a role in metabolism, the rate at which all biological processes occur.
- High in choline, a nutrient that supports brain, nerve, and muscle movement functions, and prevents fatty liver.
- Contains the essential fatty acid linoleic acid important for cell membrane maintenance and brain and nervous system functions.
- Is a cholagogue, stimulates bile flow from the liver in fat metabolism.
- Rids the body of accumulations of toxic wastes (Gilbert, 2021).
- Choline in ginger root is essential for transporting lipids from the liver in fat metabolism; in choline deficiency, fat accumulates in the liver, leading to NAFLD (non-alcoholic fatty liver disease).
- Choline deficiency is associated with overweight or obesity, and is needed to produce an important neurotransmitter, acetylcholine for memory, mood, brain and nervous system functions, including muscle control (Choline, 2022)
- An effective tool for the prevention of and alleviating peptic ulcer disease.
- Has positive effects on the lining of the stomach; prevents intestinal parasites.

- Helps to strengthen blood vessels, reduces the risk of blood clots.
- Contains some essential amino acids that play a major role in metabolism (the biochemical processes that occur in living organisms that are necessary to maintain life).
- Contains asparagines, one of the most common amino acid on Earth that is a component of many proteins the body produces.
- High in choline, a biochemical that supports nerve, brain and muscle movement functions, and prevents fatty liver (Linus, 2017).
- High in caprylic acid, a beneficial saturated fatty acid that has antibacterial, antiviral, antifungal and anti-inflammatory properties.
- Contains other essential minerals: calcium, chromium, iron, magnesium, manganese, germanium, potassium, phosphorus and sodium.
- Contains silica, commonly found in bones, tendons, the aorta (largest artery in the body), kidneys and liver, hair, skin and nails (Munjias, et. al., (2013).
- Contains a primary essential fatty acid linoleic acid from which the body makes other critical fatty acids for cell membrane maintenance, brain and nervous system health.
- Also contains oleic acid, a naturally occurring fatty acid in humans and animals, classified as a monounsaturated omega-9 fatty acid.
- Contains the B vitamin nicotinic acid (niacin), and vitamin C.
- Contains essential amino acids: tryptophan, methionine, phenylalanine, and valine.
- Analgesic (painkiller), resolves dampness and phlegm.
- Carminative (relieves flatulence), anti-inflammatory, healing, antispasmodic, aphrodisiac, diaphoretic (induces perspiration), bactericidal, cholagogue (stimulates bile flow from the liver), tonic (invigorates or strengthens), antibacterial.
- Has a strong antioxidant and soothing effect.
- Strengthens the immune system, has anti-parasitic properties and inhibits the growth of bacteria.
- Contains trace elements that help maintain a well-functioning digestive system.
- Effective for renal (kidney), intestinal and biliary colic (in the liver, gallbladder and bile ducts).
- Used to speed recovery from colds, cough, flu, sinusitis, pulmonary stagnation, soothes throat pain, an expectorant.
- Anti-inflammatory, used for reducing allergy symptoms as well as bronchial asthma and skin rashes.
- Helps reduce cholesterol levels.
- Used as an analgesic for diseases of joints, for arthrosis degenerative disease of the joint where the cartilage lining the joint erodes over time, and for rheumatism and arthritis.
- Used to reduce inflammation from sprains, swelling, and muscle aches.
- Contains ginsenosides, anticancer saponins, so therefore is an anticarcinogenic, chemopreventive agent, or reduces severity of symptoms from cancer treatments, and inhibits proliferation of cancer cells, induces apoptosis or cancer cell self-destruction.
- A universal remedy for ridding the body of accumulated toxic waste (Wee, et. al., 2011).

Horseradish Tree (Leaves) (*Armoracia rusticana*)



Jamain - 2011 - Wikipedia

- Leaves are high in vitamin C; potency analysis studies show they are higher in vitamin C compared to other vegetables (Rivelli, 2017).
- Found to contain a high amount of antioxidant polyphenolic compounds that act as lipase (fat-digesting) inhibitors that block the absorption of fats (Calabrone, et. al., 2015).
- Leaves contain a predominant amount of the aliphatic glucosinolate, sinigrin, which has been shown to have anti-cancer, anti-inflammatory, and antimicrobial properties (Galanakis, 2020).
- Leaves have been applied in traditional medicine as an expectorant, and soothing agent for respiratory conditions, such as bronchitis and sinusitis.
- Horseradish leaves have been found to stimulate blood flow in joints and thereby relieve inflammation.
- Horseradish is ten times higher in anti-cancer glucosinolates than broccoli.
- Studies also show inhibitory effects on various cancers of breast, colon, lung, pancreas, prostate, and stomach cells.
- Shown to have antibacterial, antiseptic, and diaphoretic properties (Walters, 2021).

Psyllium Husk (*Plantago ovata*) (From Plantain Seeds)



Petra - Pixabay



Bastique (Cary Bass) - 2010 - Wikipedia

- Used in traditional Indian medicine system of Ayurveda against skin irritations, hemorrhoids, constipation and diarrhea.
- Contains water-soluble fiber that has a regulating effect on intestinal and colon environments.
- Known for its beneficial prebiotic effects, and regulating effects on irritable bowel syndrome, abdominal pain, inflammatory bowel disease-ulcerative colitis, obesity, diabetes, hypercholesterolemia, and preventing cancer.
- A non-digestible carbohydrate comprised of monosaccharides arabinose and xylose that forms a viscous gel-like mucilage that adheres to toxins and materials in the colon to be easily excreted (Franco, 2020).
- Has been found to improve BMI and mean waist circumference, which are correlated with obesity, type 2 diabetes, cardiovascular diseases, and some cancers.
- Improves digestion in test subjects, and may reduce weight and anthropometric measurements.
- Psyllium husk fiber from plantain seeds improves digestion and increases satiety.
- Improves one's lipid profile (a measurement of cholesterol and triglycerides in the blood).
- Studies showed that psyllium husk fiber improved glycemic and plasma lipid profiles, and significantly lowered the risk of type 2 diabetes.
- Along with lifestyle modification, psyllium husk fiber has been shown to improve fasting blood glucose, and lower the HOMA-IR value (Homeostatic Model Assessment for Insulin Resistance), which measures how much insulin the body needs to keep blood sugar levels normalized.
- Psyllium husk fiber has also been shown to improve the biomarkers of cardiovascular health.

A fasting blood sugar level of 99 mg/dL or lower is normal; i.e., insulin is able to normally uptake excess blood sugar out of the bloodstream and into the body's cells and tissues. A post-fasting blood sugar level of 100 to 125 mg/dL indicates a certain amount of insulin resistance or the inability to remove excess blood sugar, and therefore indicates one has prediabetes. A post-fasting blood sugar level of 126 mg/dL or higher indicates a diabetes condition.

- Psyllium husk, or the plantain seed's coat or outer layer of the seed, contains insoluble (non-digestible) fiber, but also contains a medicinally active polysaccharide that is a mucilage or colorless gel, which has a high water-holding capacity and is therefore an excellent source of soluble fiber.

- Psyllium husk is well known for its laxative effect, and its cleansing and regulating effect on constipation, irritable bowel, abdominal pain, diarrhea, inflammatory bowel, and ulcerative colitis.
- Plantain seed psyllium husk has also been found to improve conditions associated with obesity, such as hypercholesterolemia (high blood cholesterol), and has important prebiotic effects for a healthy colon flora environment (Bacha, 2022).
- One study investigated the effect of psyllium husk supplementation on weight loss that included diet counseling and exercise. Results showed a significant weight loss in the experimental group compared to the control group, and researchers concluded that psyllium fiber intake increases satiety and subsequently reduces excess food intake (Pai, 2019).

Turmeric Root (*Curcuma longa*)



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- Turmeric root is known to suppress the number and activity of immune cell macrophages, which produce cytokines, proteins that cause inflammation in fat tissues, the heart, and impair pancreas function, resulting in increasing insulin resistance or the inability to uptake sugars out of the blood and into the body's muscle and liver cells.
- Helps maintain normal cholesterol levels and has a lipid-lowering effect by reducing the amount of fats in the circulatory system.
- Destroys free radical molecules and stimulates production of antioxidant enzymes for continuing to destroy free radicals.
- Prevents development of Type 2 diabetes, prevents edema or intercellular water retention.
- Useful in weight loss; effectively breaks down fats and significantly simplifies the process of dietary fats digestion by promoting the flow of bile from the gall bladder (Gilbert, 2021).
- Effective in the fight against various forms of gastritis and liver problems.
- Reduces the adverse consequences of obesity such as diabetes by inhibiting the inflammatory effect of macrophages, which produce cytokines that cause inflammation in the heart and pancreas and prevent glucose absorption or uptake into the muscles and liver, resulting in hazardously high levels of blood sugar in the bloodstream.
- Increases the effectiveness of skin cancer treatment when directly applied to the damaged area.
- Used for the treatment of acne, inflammation caused by osteoarthritis, and diseases of the cardiovascular system.
- Helps the immune system deal with psychological stress.
- Supports the health of bones and joints; reduces joint pain and swelling through decreased production of cyclo-oxygenase-2 enzymes; turmeric is a COX-2 inhibitor.
- Keeps cholesterol levels in the normal range and has a lipid-lowering effect (reduces fats in the circulatory system).

- Evidence shows that the curcumin in turmeric exhibits several cardio-protective properties: anti-inflammatory actions prevent cardiac injury; its antioxidant properties help improve circulatory pathways in the heart while destroying free radicals such as cytokines; suppresses atherosclerotic lesions in heart tissues; decreases thrombosis or abnormal clotting; may prevent strokes and lessen inflammation and blood vessel spasms after a stroke.
- Contains at least ten antioxidants that scavenge free radical molecules (foreign molecules such as synthetic chemicals from processed foods, agrichemicals, industrial chemicals); its antioxidants protect against free radical damage to cell membranes and DNA while stimulating the immune system to neutralize free radicals by producing its own antioxidant enzymes.
- Contains an important group of compounds called curcuminoids: curcumin (diferuloylmethane), demethoxycurcumin, and bisdemethoxycurcumin.
- Contains beneficial essential oils: termerone, curlone, curumene, cineole, and *p-cymene*, as well as various natural sugars, proteins and resins.
- Improves brain function through helping the brain produce more Brain-Derived-Neurotrophic Factor (BDNF), found to be effective in delaying or even reversing many brain and age-related diseases and depression, and in preventing the shrinking of the brain's hippocampus, the area of the brain that functions for learning and memory.
- Curcumin in turmeric has been shown to cross the blood-brain barrier and improve the neurodegenerative process of Alzheimer's disease by blocking B-amyloid, the substance that causes plaques that narrow circulatory passages in the brain.
- Strong anti-allergic, antibacterial, anti-carcinogenic (anti-cancer), anti-inflammatory antifungal, anti-mutagenic, anti-septic and anti-spasmodic and anti-viral.
- Found to hinder the development of chronic inflammation, tumors, and leukemia.
- Found to prevent the development of Type 2 diabetes in pre-diabetics by lessening insulin resistance.
- The curcumin and other antioxidants in turmeric have been found to destroy cancer cell cultures taken from the bloodstream, ovaries and the skin; studies show curcumin reduces new the growth of new blood vessels in tumors and prevents metastasis (spreading of cancerous cells).
- Overwhelming scientific evidence shows that turmeric can prevent cancer altogether by blocking certain enzymes needed for cancer growth; researchers have attested that there was not any type of cancer cell upon which turmeric did not work, including colon, mammary, prostate, liver cancer, esophageal, and oral cancers.
- Researchers have also found that turmeric's curcumin treatments prevent cervical cancer cell proliferation by altering their HPV-associated (Human Papillovirus) pathways.
- Turmeric has been proven to be effective in the treatments of many serious ailments, including multiple sclerosis, anemia, atherosclerosis, back pain, fibromyalgia, bloating and intestinal gas, bronchitis, conjunctivitis, bursitis, Crohn's disease, dyspepsia (heart burn), diarrhea, stomach pain, hepatitis, gallbladder infections and gallstones, genital herpes, hemorrhoids, irritable bowel syndrome, gingivitis (gum disease), kidney inflammation and infections, peptic ulcer (stomach ulcers caused by *Helicobacter pylori* bacteria), skin inflammatory conditions including eczema, liver disease, leprosy, food poisoning, fever, poor circulation, menstrual disorders, lung infections, edema (intercellular water retention), parasites, poor circulation, urinary tract infections (UTI), worms, ringworm.
- Used for healing wounds.
- Balances the reproductive system, lactation, purifies reproductive organs and breast milk, purifies the semen.
- Is an astringent (tightening, toning), carminative (relieves flatulence), cholagogue (promotes the flow of bile from the gall bladder to the duodenum, the first and shortest segment of the small intestine), diuretic (promotes increased production of urine), stimulant (increases alertness, attention and energy), and vulnerary (heals wounds).
- Mosquito repellent (Vyas, 2015).

Extracts

Beetroot (*Beta vulgaris* L.) Extract (Root Pulp)



Pamsai - 2010 - Wikipedia

Darwin Bell - 2006 - Wikipedia

- Rich in fatty acids, contains biologically active phytochemicals: phytosterols, and antioxidant phytonutrients: betalains, betacyanins, betanin, betaxanthins, phenolics and anthocyanins, key factors against cardiovascular and cerebrovascular diseases, cancer, diabetes, and respiratory diseases.
- Contains beneficial heart and colon healthy fibers.
- Betanin is shown to have antitumor properties by inhibiting cancer cell proliferation, causing apoptosis and autophagy (self-destruction), and is a chemopreventive agent preventing unpleasant side effects of chemotherapy.
- Contains dietary nitrate, associated with lowering blood pressure, and is converted to nitrite by bacterial action on the tongue (its microbiome), which then has shown vasoprotective properties.
- Research found that beetroot lowered heart rate, especially when followed by moderate-intensity aerobic (fat-burning) exercise in obese individuals.
- Has been found to have an acute effect on the circulating immune system and platelets (involved in clotting) in older adults.
- Phytochemicals in beetroot was found to downregulate (lower the level of) hyperglycemia (high blood sugar).
- Benefits hyperlipidemia (high blood lipids) due to its betalains, which scavenge lipid free radicals, inhibiting peroxidase, nitrite-induced oxidase, and LDL.
- Beet root was found to reduce serum glucose levels, atherosclerosis, and hyperlipidemia, and increase production of bile acids, which help lower cholesterol production and inhibit short-chain fatty acids, leading to reduction of body fat.
- Nitrate in beetroot is converted to nitrite and is then converted to nitric oxide (NO) and other nitrogen-active compounds, all of which improve athletic performance in various aerobic (fat-burning) physical activities.
- Nitric oxide is an essential component of the energy production ATP cycle, and has been recognized that a deficiency is associated with cognition impairment.
- Beetroot is recognized as a nitric oxide generator, and its nitrate is associated with enhanced prefrontal cortex cerebral blood flow and therefore cognitive functioning, as well as improving femoral artery flow-mediated dilatation (Chen, 2021) (Clifford, 2015).

Tomato Extract (*Solanum lycopersicum*) (Fruit Pulp)



FoeNyx 2005 - Wikipedia

- Contain the bioactive compounds present in tomato and other fruits, berries, leafy greens, and vegetables: phytofluene, beta-carotene, flavonoids, carotenoids, and lycopene, which have a beneficial effect on weight, body mass index, blood pressure, and inflammatory responses.
- Is an abundant source of the antioxidant, lycopene (a carotenoid), and has been shown to be anti-cancer, and possess anti-osteoporotic and anti-atherogenic (prevents plaques in the arteries) properties.
- Found to reduce levels overall cholesterol levels, and LDLs, and inflammatory biomarkers related to obesity such as adipokine cell signaling proteins.
- Lycopene has been shown to ameliorate metabolic abnormalities related to obesity: insulin resistance, excess adipocytes and blood lipids, high blood pressure (Chaudhary, et. al., 2018).
- Studies suggest that the compound apo-10'-lycopenoic acid (derived by enzyme cleavage action of lycopene) can counteract a high-fat diet and hepatic steatosis or an excess build-up of fat in the liver (Wang, 2020).
- Lycopene extracts and other precursors in tomatoes phytoene (PT), and phytofluene (PTF) have been found to be effective against a high-fat diet, with related hepatic (liver) inflammation, high blood lipids, and carcinogenesis.
- Tomato extracts supplementation have been shown to decrease inflamed lesions in the liver, decrease total plasma cholesterol when associated with a high fat diet, and is found to actually store phytoene and phytofluene in the liver as a reserve (Melendez, et. al., 2013).

Vitamins

Thiamine (Vitamin B1)

- A special coenzyme for metabolizing or utilizing carbohydrates, fats, and proteins.
- Important for the use of essential fatty acids.
- Involved in energy production in cell mitochondria, protein and neurotransmitter synthesis.

- Thiamine deficiencies lead to metabolic acidosis (the buildup of too much acid and the body is unable to neutralize it), impaired glucose metabolism, degradation of mitochondrial energy production functions, muscle cramps, pain, fatigue, memory and concentration difficulties, depression, decreased libido, digestive system malfunctions, increased heart rate, and nystagmus, which includes reduced vision and depth perception, involuntary eye movements, and balance and coordination problems.
- Long-term deficiency can result in neurological disorders, Beriberi, muscle atrophy, weakening of heart contractions, low blood pressure, and nerve paralysis.
- Antioxidant, an effective scavenger of free radicals such as ROS (reactive oxygen species).
- Accelerates the cells' energy production cycle in the process of converting pyruvate to acetyl-CoA while inhibiting the breakdown of pyruvate to lactate, the chemical that causes muscle soreness (Mrowicka, et. al., 2023).

Riboflavin (Vitamin B2)

- Plays a key role in energy metabolism as a coenzyme involved in many cellular biochemical reactions for the process of reducing or constructing molecules.
- Used in inflammatory conditions such as infections on the skin or the corners of the mouth, inflammation of the tongue, and sepsis or an infection that spreads throughout the body.
- Helps prevent cataracts.
- Can prevent lipid peroxidation (the degeneration of fatty acids that can render them as free radicals that destroy healthy cells).
- Antinociception – Helps attenuate the body's response to pain and injury.
- Aids in the prevention of osteoporosis or bone degeneration and fragility.
- Aids the immune system.
- Decreases the risk of PMS (premenstrual syndrome) that affects mood swings, food cravings, fatigue, depression, irritability.
- Deficiencies include: hormone function disruptions, hair loss, migraine headaches, anemia, cataracts, cheilosis (cracking, scaling of corners of the mouth), inflammation of mucous membranes in the stomach, disruption of digestion and metabolization of proteins, fats, and carbohydrates (Suwannasom, et. al., 2020).

Niacin (Vitamin B3)

- Is converted in the body to its metabolically active form, coenzyme nicotinamide adenine dinucleotide (NAD), and nicotinamide adenine dinucleotide phosphate (NADP), which are required by over 400 enzymes to perform catalytic (the speeding up of) reactions in the body, more than any other vitamin-derived coenzyme.
- NAD is involved in transferring energy in carbohydrates, fats, and proteins into the body's primary unit of energy, ATP (adenosine triphosphate). The body converts the some of the amino acid tryptophan to NAD.
- NADP enables reactions that build or synthesize cholesterol and fatty acids while serving a vital role as an antioxidant that protects against the degenerative oxidation of fats, which prevents fats from becoming damaging free radicals.
- Niacin deficiency leads to a skin discoloration condition known as pellagra, which also affects the tongue, digestive tract disorders leading to constipation, diarrhea, and vomiting, and leads to headache, fatigue, apathy, depression, and loss of memory.

- Loss of memory due to niacin deficiency can progress to abnormal behaviors: aggressiveness, paranoia, hallucinations, and suicidal behaviors (Niacin, 2022).

Pyridoxine (Vitamin B6)

- Is involved in over 100 enzyme biochemical reactions in protein and amino acid metabolism.
- The active coenzyme forms in the body, Pyridoxal 5" phosphate (PLP) and pyridoxamine 5" phosphate (PMP) are involved in the utilization and actions of amino acid metabolism, or the building of new cells, tissue, and biochemicals.
- PLP is involved in metabolizing or utilizing carbohydrates and lipids.
- Plays a role in cognitive development by synthesizing chemical neurotransmitters in the nervous system.
- Maintains normal homocysteine levels (an amino acid) in the blood.
- Is involved in gluconeogenesis or the building of new red blood cells, and in glycogenolysis, the process of reducing glycogen, the body's complex carbohydrate or muscle starch, to glucose, the body's simple sugar that fuels the brain and all cellular processes (Vitamin B6 Fact Sheet, 2023).

Mineral

Chromium Picolinate (CrP)

- An essential trace mineral needed for normal digestion, reduction and utilization of nutrients from carbohydrates, fats, and proteins.
- Increases insulin activity while improving glucose metabolism, important in diabetes and obesity.
- Stimulates heat production that increases energy expenditure, thereby decreasing body fat (Tian, et. al., 2013).
- CrP is directly involved in protein, fat, and protein metabolism when the body pairs it with organic compounds such as picolinic acid to aid in absorption.
- CrP helps increase the rate at which insulin and amino acids are taken up into the muscle cells.
- Studies showed an increase in lean body mass and a decrease in body fat percentages after 90 days of supplementation with CrP (Willoughby, et. al., 2018)
- Body fat is effectively dissipated by an increase in a sustained elevated heartrate during aerobic exercise. During aerobic exercise, the lungs, working harder than when at a resting heartrate, increases oxygen intake, and the body switches over from the normal expending of blood glucose for energy, to the heat-releasing fat-burning ATP energy-production cycle.
- Weight loss attempts often result in loss of lean body mass rather than body fat. When the body is forced to sacrifice lean body mass, it slows the rate at which the it burns calories to conserve its energy stores (body fat) as it perceives it is in a state of famine.
- Chronic wasting away of valuable lean body tissues results in system malfunctions in the muscle, skeletal, urinary, cardiovascular, and nervous and endocrine (hormonal) systems.
- Maintaining lean body mass while losing bodyfat requires both aerobic exercise and maintaining only a dietary slight calorie deficit.
- Certain plant compounds and plant-derived minerals such as chromium picolinate are known to be involved in reducing body fat without losing healthy lean body mass (muscles, connective tissues, cartilage, organ tissues). (Gilbert, 2023).

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