Medicinal Properties in Whole Foods

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“Functional foods,” “nutraceuticals,” “designer foods” and “medicinal foods” are terms that describe foods, and key ingredients isolated from foods, that have non-nutritive or tertiary functional properties. Researchers, healthcare practitioners, laypersons, and the popular media use these words interchangeably. The purpose of this article is to detail valid scientific information available on the anti-hypercholesterolemic and insulin regulating properties of barley grass and fenugreek.

Whole Food Protection: Regulating Insulin Levels and Preventing Atherosclerosis

Atherosclerosis, or hardening of the arteries, and specifically atherosclerosis of the heart vessels, plays a significant role in the development of heart disease, the most prevalent cause of death in the United States. High blood triglyceride levels, low HDL cholesterol levels, and high blood pressure are all associated with atherosclerosis of the blood vessels that supply the heart. Likewise, these risk factors are associated with the insulin resistance syndrome (IRS) that is also linked to heart disease. IRS involves a decline in the ability of the hormone insulin to properly regulate glucose levels in the body. Interestingly, select foods, such as barley grass and fenugreek, that are known to reduce atherosclerotic plaque, also possess insulin regulating actions, suggesting an elegant interplay between ancestral mechanisms of action of whole foods and the pathogenesis of disease states with ostensibly unrelated characteristics. As we continue to research the mechanisms of action of foods and herbs that have traditionally been used to address health challenges, one might consider looking to these actions to gain a clearer understanding of the pathogenesis of poorly understood diseases.

Barley Grass, Atherosclerosis and Insulin Regulation

Barley grass is a bioavailable source of protein and contains a wide array of vitamins, minerals, and enzymes that are crucial for maintaining health. Green young barley leaves have been reported to possess both anti-diabetic and anti-atherosclerotic. A potent flavonoid antioxidant, 2’-O-glycosylisovitexin (20-GIV), was isolated as the putative active agent for these effects.

Indications for Use
• Hypercholesterolemia
• Hyperglycemia

Mechanisms of Action
• Flavonoids in barley grass possess strong antioxidant activity inhibiting lipid peroxidation.
• The fiber content of barley is responsible for the blood cholesterol and glucose-lowering activity of barley. Beta-glucans in barley probably reduce appetite by slowing gastric emptying and stabilizing blood sugar.
• Barley contains hordenine, a sympathomimetic amine that stimulates peripheral blood circulation and bronchodilation.

Research

Barley grass and atherosclerosis

Young barley leaves contain 2’-O-glycosylisovitexin (20-GIV), a flavonoid molecule that may reduce the risk of atherosclerosis by inhibiting the peroxidation of lipids. Using low-density lipoprotein (LDL) and blood plasma from a horse, researchers examined the antioxidative activity of 20-GIV and found that the amount of acetaldehyde (a byproduct of LDL peroxidation) produced was lower in the presence of 20-GIV. Furthermore, the putative inhibition of peroxidation was dose dependent for 20-GIV and fucoidan, a known antioxidant. In blood plasma, 20-GIV was nearly identical to the antiatherosclerotic drug probucol in reducing acetaldehyde production in this model. Identical amounts of 20-GIV and probucol inhibited acetaldehyde formation by 89% and 94%, respectively.

Overview: Barley Grass

These research results coupled with the known mechanisms of action of barley grass strongly suggest that this medicinal food:
• Reduces the risk of atherosclerosis
• Stabilizes blood sugar levels

Contraindications
• Allergic sensitivity to barley
• Celiac disease (gluten sensitivity)
Side Effects
- Anaphylaxis in sensitive individuals

Possible Interactions with Drugs
- Hordein content may potentiate effect of sympathomimetic drugs

Possible Interactions with Diseases or Conditions
- Barley gluten content may exacerbate celiac disease

Typical Dosage
- 450 mg - 900 mg dried grass

Fenugreek, Atherosclerosis and Insulin Regulation
Fenugreek is native to the Mediterranean region, the Ukraine, India, and China and it is widely cultivated in these regions. The fenugreek seed that is used pharmacologically comes exclusively from cultivated plants originating mainly in India, Morocco, China, and Turkey.

Fenugreek is approved by the Commission E, internally to stimulate appetite and externally as a poultice for local inflammation. There is growing evidence that it has a hypoglycemic effect that may function to normalize metabolism and lower blood sugar in diabetics. In addition, it has antioxidant and hypocholesterolemic actions in the body, hence its use in the treatment of atherosclerosis and elevated serum cholesterol and triglycerides levels.

Known Medicinal Constituents
- Complex carbohydrates and fiber (25-45%) and protein (25-30%; rich in lysine and tryptophan but low in sulfur-containing amino acids)
- Proteinase inhibitors acting on human trypsin and chymotrypsin
- Steroid saponins: trigonofenosides A-G (bitter), aglycones, including diosgenin, yamogenin, gitogenin, smilagenin, tigogenin, yuccagenin
- Flavonoids: isoorientin (and arabinoside), isovitexin, orientin (and arabinoside), saponaretin, vicenin-1, vicenin-2, and vitexin
- Novel amino acid 4-hydroxyisoleucine (possibly involved in hypoglycemic activity)
- Sterols and sterol esters

Indications for Use
- Hyperglycemia, non-insulin dependent and insulin dependent diabetes
- Hyperlipidemia

Mechanisms of Action
- Hypoglycemic activity: Fenugreek affects gastrointestinal transit time, slowing glucose absorption. The amino acid constituent 4-hydroxyisoleucine appears to directly stimulate insulin secretion by the pancreas in a glucose-dependent manner. In healthy people, the whole seed extract, gum isolate, cooked seed, and the constituent, trigonelline show hypoglycemic activity.
- Non-insulin dependent diabetes: Ingestion of the extracted seeds improves plasma glucose and insulin response.
- Insulin dependent diabetes: Ingestion of the seed powder reduces plasma glucose, glycosuria, and the daily insulin requirement.

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- Anorexia induced in rats using adrenergic agonist d-fenfluramine was not significantly prevented by fenugreek, suggesting its hypoglycemic activity is not adrenergic in nature.
- Steroid saponins are thought to mediate fenugreek's potentiation of appetite. They also mediate the cholesterol-lowering activity of fenugreek by inhibiting absorption of bile acids taurocholate and deoxycholate in a dose-dependent manner.

Research
Fenugreek, Blood Sugar, and Cholesterol
Sauvajou et al. extracted and purified 4-hydroxyisoleucine, an insulinotropic agent, from fenugreek seeds. The novel amino acid increased glucose-induced insulin secretion in a dose-dependent manner by acting directly on isolated rat and human islets of Langerhans.

An interesting characteristic of 4-hydroxyisoleucine is that it only appears to be active in the presence of supranormal glucose concentrations (6.6-16.7 mmol/L). At low (3 mmol/L) and basal (5 mmol/L) concentrations of glucose, the amino acid does not stimulate insulin secretion. Although the mechanism is not known, this characteristic suggests that there is a low risk for the isolated substance to cause hypoglycemia in normoglycemic individuals. However, this cannot be said conclusively for the fenugreek whole herb. It should also be noted that this study was performed in vitro on isolated tissues, so it is not known if the amino acid would have the same function in vivo. In light of the fact that fenugreek seeds are known to have antidiabetic properties in traditional medicine, this study lends support to a clinical application of the herb in non-insulin dependent (Type II) diabetes.

Additional studies support the hypoglycemic activity of fenugreek. Fenugreek seed powder given alone or in conjunction with vanadate lowered blood sugar and increased the growth rate of chemically diabetic rats almost to control levels. Because chemically induced diabetes destroys insulin-secreting cells, it seems unlikely that fenugreek acts by potentiating insulin secretion in this model. Fenugreek treatment also significantly lowered liver and kidney glucose-6-phosphate and fructose-1,6-bisphosphate levels. The combination of fenugreek and vanadate was more effective than administered insulin in restoring these parameters and fenugreek attenuated vanadium toxicity.

In human subjects with Type I (insulin-dependent) diabetes, fenugreek seed significantly decreased fasting blood sugar and improved oral glucose tolerance test results. In addition, a 54% decrease in 24-hour urinary glucose excretion was observed. Serum total, LDL and VLDL cholesterol, and triglycerides were decreased while HDL cholesterol remained unchanged. Again, fenugreek cannot be acting as an insulinotropic agent in Type I diabetes, as a lack of insulin secreting cells is indicated in this form of the disease.

Nonetheless, these results suggest that fenugreek may be quite useful in balancing serum glucose and lipids in humans, especially with respect to the diabetic condition.
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Antioxidant Activity of Fenugreek
Fenugreek has been shown to significantly improve blood levels of glutathione and beta-carotene (antioxidants) in normal and alloxan diabetic rats. Conversely, fenugreek decreased alpha-tocopherol levels and had no effect on ascorbic acid levels. Chemically induced diabetes in animals causes a disruption in free radical metabolism, which is normalized by supplementation with fenugreek in the diet. This study suggests that fenugreek may potentiate Phase II detoxification mechanisms.

Overview: Fenugreek
These clinical results coupled with the results of earlier trials strongly suggest that fenugreek:
- Reduces blood glucose levels
- Normalizes free radical metabolism in diabetic animals
- Normalizes triglyceride and cholesterol levels

Contraindications
- Fenugreek allergy
- Do not use during pregnancy. Fenugreek has potential oxytocic and uterine stimulant activity.

Side Effects
- Skin sensitization is possible with repeated external use of the drug.
- May cause oxytocic and uterine stimulant activity. Avoid using during pregnancy.

Possible Interactions with Drugs
- Insulin/hypoglycemic drugs: Fenugreek has hypoglycemic activity and therefore has the potential to interact with hypoglycemic drugs and insulin resulting in an exaggerated hypoglycemia.
- Anticoagulants: Theoretically, may potentiate anticoagulant drug activity and increase the risk of bleeding.
- Hormone therapy: Theoretically, fenugreek may interfere with hormone therapy.
- Monoamine oxidase inhibitors (MAOIs): Fenugreek may potentiate MAOI drug activity.
- Corticosteroids: Theoretically, fenugreek may reduce corticosteroid drug activity.
- All drugs: Fenugreek's high mucilage content may decrease or delay the absorption of oral drugs.

Possible Interactions with Diseases or Conditions
- Fenugreek allergy: avoid using.
- Kidney stones: Fenugreek may decrease calcium oxalate deposition in the kidneys, reducing the risk of kidney stone formation.
- Diabetes: Fenugreek can affect blood sugar levels that should be monitored closely by diabetics.

Typical Dosage
1-2 grams of seed or equivalent three times daily or one cup of the tea (500 mg seed in 150 mL cold water for three hours, strained) several times a day. Do not exceed six grams of seed per day to avoid side effects.

Final Thought
The research summarized above and supporting studies suggest that the use of anti-atherosclerotic foods, such as fenugreek and barley grass, may also offer insulin-regulating properties. Intriguingly, atherosclerosis and insulin resistance syndrome are interrelated, both representing significant risk factors to the incidence and onset of heart disease. This data may suggest that the mechanisms of action of medicinal foods traditionally used to treat heart challenges such as heart disease may offer clues towards gaining a clearer picture of the pathological trends associated with analogous disease states previously less understood.

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