Brassica Juncea's anti-Diabetic Properties: a Review

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April 19, 2022

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Abstract

Mustard (Brassica Juncea) is a cruciferous plant that is used as a food spice and traditional medicine in Asian and African countries. Brassica Juncea contains vitamins, minerals, dietary fiber, chlorophylls, glucosinolates, polyphenols, and volatile components. Recently, various bioactive chemicals and associated therapeutically fascinating pharmacological effects of its edible green leaves have been identified. Mustard has several pharmacological effects, including anti-oxidation, anti-inflammation, bacteriostatic, and antiviral activities. Mustard has been used to cure various diseases, including cancer, obesity, depression, diabetes, and cataract. This study looks at the characteristics of plants, phytochemicals, and biological processes that are associated with diabetes. This review might help influence the development and application of Mustard resources as an anti-hyperglycemic therapy.

Keywords: Brassica juncea, diabetes, holistic pharmacology, anti-hyperglycemic activity

Introduction

Brassica juncea, also known as Indian mustard or mustard green, is a mustard family plant in the Brassicaceae (Cruciferae) family (Fig. 1). It has its origins mainly in Central Asia (northwest India). The biggest expanding nations include India, Bangladesh, Pakistan, Nepal, Central Africa, China, Japan and southern Russia. Indian mustard is widely distributed as a cultivar and transgenic escape in subtropical and temperate climates. In America, Japan, China, and other countries and areas, the seeds of this plant are widely used as a traditional hot spice, a source of edible oil and protein, and a type of supplementary or alternative medicine. In traditional medicine, the leaves are utilised as stimulants, diuretics, and expectorants, as well as a spice (Farrell, 1985). Brassica juncea seed essential oil, also known as mustard oil, has long been utilised in hair care products (Yu et al, 2003).

The most potent chemical element in such marketed oils is allyl isothiocyanate, which is produced from its precursor during seed processing (Yu et al., 2003). This isothiocyanate is now primarily recognized as the most crucial cancer chemopreventive phytochemical, with other potential health benefits (Okulicz, 2010; Zhang et al., 2010). Among cruciferous vegetables, Brassica juncea leaves have the highest content of glucosinolates (McNaughton and Marks, 2003).

The primary goal of this study is to describe the existing preclinical information on the plant's diabetes and to highlight some unique therapeutic options that its edible leaves and seeds may provide.

Fig.1. Brassica juncea (L.) - Indian mustard

Kingdom Plantae - Plants
Subkingdom Tracheobionta - Vascular plants
Superdivision Spermatophyta - Seed plants
Division Magnoliophyta - Flowering plants
Class Magnoliopsida - Dicotyledons
Subclass Dilleniidae
Order Capparales
Family Brassicaceae - Mustard family
Genus Brassica L. - Mustard
Species *Brassica juncea* (L.) Czern. and Coss. - Indian mustard

Table 1. Isolated constituents of *Brassica juncea* and their pharmacological activities

No.	**Isolated constituents**	**Activities**	References
1.	**Glucosinolates** Sinigrin (allyl glucosinolate)	Goitrogenic	Yu et al, 2003; Schreiner et al., 2009.
2.	**Isothiocyanates** I. Allyl isothiocyanate II. Phenyl isothiocyanate	Fungicidal activity, antitumor activity, Antimicrobial, Anti-tumour and antioxidant activity	Kumar et al., 2009; Manesh and Kuttan, 2003. Thejass and Kuttan, 2007.
3.	**Phenolic compounds** (Sinapic Acid, Sinapine)	Anxiolytic activity, antioxidant, Cognition-improving activity	Yoon et al., 2007; Zou et al., 2002.
4.	**Fatty Acids** (α-linolenic acid)	Astrocyte developing activity and other health benefits	Joardar et al., 2007

5.	**Kaempferol glycosides**	Antioxidant activity	Jung et al., 2009
6.	**Other Flavonoid compound** Isorhamnetin 3,7-di-O-ß-D-glucopyranoside (Isorhamnetin diglucoside)	Antioxidant effects	Yokozawa et al., 2002, 2003.

Brassica juncea Pharmacology and Anti-Hyperglycemia Effect

Brassica juncea seeds are commonly used in almost all traditional Indian medicinal systems. Furthermore, the revelation that edible mustard oil is high in polyunsaturated fatty acids and phytosterols has sparked speculation that it may have cardioprotective and other health benefits. These ideas are backed up by data gathered during an epidemiological study in India (Rastogi et al., 2004). Publications on therapeutically fascinating bioactivities of the plant's pharmacologically standardised extracts for therapeutic purposes are becoming increasingly prevalent due to many new epidemiological studies proving the vast spectrum of health benefits of cruciferous green vegetables.

Diabetes and hyperlipidemia are two of the most common life-threatening metabolic diseases encountered in obese adults who are sedentary. Medical words such as diabetes, insulin resistance, and medical syndrome have been developed as a result of the close link between these two illnesses. The therapeutic advantages of an aqueous mustard seed extract against hyperglycemia and insulin deficit in streptozotocin-induced diabetic rats were dose-dependent (250, 350, and 450 mg/kg/day) in recent research (Thirumali et al., 2011). Brassica juncea's anti-hyperglycemic action appears to be contingent on the presence of functional -cells that produce insulin since it decreased glucose levels in moderately diabetic rats but not in severely diabetic rats. Brassica juncea seeds' antioxidant activity possibly slowed the death of islet cells in the pancreas. Brassica juncea may have antioxidant and free radical scavenging characteristics, according to this study (Grover et al., 2002). Khan et al. (1995b) discovered that Brassica juncea increases glucose intake while lowering glycogenolysis and gluconeogenic enzymes in normal rats.

It cannot be used to treat severe diabetes on its own, and it may not be helpful at all in patients with insulin-dependent diabetes. In another study, Brassica juncea was found to significantly prevent the development of insulin resistance in rats fed a fructose-rich diet. Blood glucose levels climbed by 29.4 percent, insulin levels increased by 101.2 percent, and cholesterol levels increased by 26.7 percent after 30 days on a high-fructose diet, indicating the development of insulin resistance. However, adding 10% Brassica juncea seeds powder to a high-fructose diet for 30 days lowered fasting blood glucose, insulin, and cholesterol levels but did not bring them back to normal.

Thus, the findings imply that Brassica juncea can aid in treating pre-diabetic insulin resistance and that its increased usage as a dietary additive in diabetes patients should be encouraged (Yadav et al., 2004). One study looked at the effects of Brassica juncea and Murraya koeingii on diabetic nephropathy parameters such as urine volume, serum creatinine, and urinary albumin (UAE) levels. Although feeding Brassica juncea lowered UAE levels, the change was not statistically significant. When Brassica juncea was utilised, serum creatinine levels were dramatically lowered. Brassica juncea is best used as a dietary supplement in pre-diabetics or mild diabetic patients who maintain a strict exercise and nutrition plan since it only has a limited anti-hyperglycemic impact in a severe hyperglycemic condition. By decreasing the rise in creatinine levels, Brassica juncea has been demonstrated to delay the development of diabetic nephropathy (Grover et al., 2003).

Four distinct Brassica juncea preparations were used to examine antioxidant characteristics, such as those of Brassica juncea leaf extracts (CH_2Cl_2, EtOAc, BuOH, and H_2O fractions obtained from leaves). The in vitro spin trapping test was utilised in one of these research (Kim et al., 2003), with 1, 1-Diphenyl-2-picrylhydrazyl (DPPH) serving as the spin trap reagent. The antioxidant activity of the EtOAc and BuOH fractions studied was strong. In this study, the BuOH fraction was examined in vivo using diabetic rats produced by streptozotocin (STZ) as the experimental paradigm.

After ten consecutive daily treatments (50 to 200 mg/kg/day), the BuOH fraction demonstrated dose-dependent superoxide (O_2^-) scavenging capabilities and reduced blood levels of nitrite/nitrate, glucose, glycosylated haemoglobin, and thiobarbituric acid (TBA) reactive chemicals. The book component of mustard leaf modulates glucose metabolism and reduces lipid peroxidation and oxygen radical levels, minimising the damage caused by oxidative stress in diabetes, according to this study (Kim et al., 2003). However, another study by the same group (Yokozawa et al., 2003) indicated that the EtOAc fraction was the most active in all of the models used in the study (Yokozawa et al., 2003). These two research findings might be helpful in generating Brassica juncea leaf extracts that are rich in the active components linked to its anti-diabetic activities.

Several flavonols contained in Brassica juncea leaves have been proven to be effective scavengers of free radicals and peroxynitrite (Jung et al., 2009), and its ethanol extract has recently been shown to be useful in preventing lipid peroxidation in ground pork (Lee et al., 2010). Isorhamnetin 3, 7-di-O—D-glucopyranoside (Isorhamnetin diglucoside), one of the flavonol components of the leaves, has also been shown to have therapeutic advantages against hyperglycemia in STZ-induced diabetic rats (Yokozawa et al., 2002). Intestinal bacteria convert Isorhamnetin diglucoside to the flavonol Isorhamnetin, suggesting that the parent flavonol, not its naturally occurring glycoside, is the active principle involved in leaf extracts' anti-diabetic activity in animal models.

In this study, ten daily oral dosages of the diglucoside (10 and 20 mg/kg/day) effectively reduced blood glucose and glycosylated haemoglobin levels. Although anti-hyperglycemic and anti-hyperlipidemic properties of Brassica juncea seeds have been related to anti-oxidative capacities (Khan et al., 1997), such interpretations are yet hypothetical. Furthermore, the plant contains phytosterols and other non-antioxidant components, and phytosterols' cholesterol-lowering capabilities have just lately been identified (Gupta et al., 2011).

Conclusions and prospects for the future

Preclinical findings on Brassica juncea not only add widespread Ayurvedic use of mustard seeds and oils but also suggest that its leaf might be more effectively used for health reasons in accordance with Ayurvedic holistic principles. Almost all Ayurvedic practitioners advice appropriate food choices for specific healthcare goals. Modern medical experts now frequently prescribe fruits and vegetables in general, and Brassicaceae vegetables in particular, for anyone suffering from or at risk of diabetes and its complications. However, there has been little effort made into creating and manufacturing a pharmacologically well-standardised phytopharmaceutical or nutraceutical that is especially designed for these applications. None of the numerous and widely used nutritional supplements (including vitamins, minerals, phytochemicals, and other products) were produced particularly for this purpose, and none have been pharmacologically examined. In an ideal world, such commodities would not only be anticipated based on their bio-activity profiles but also safe, long-lasting, and affordable to the vast majority of people in impoverished and developing countries.

This ideal goal, however, is not scientifically nor economically feasible at this moment. This is due to a lack of precise scientific information, as well as intricate socioeconomic factors related to diabetes's genesis, etiology, and progression (Williams and Fruhbeck, 2009).

Given the conditions, research into the medicinal potential of Brassica juncea seeds and leaves may lead to a more logical or appropriate medical usage of this culinary plant. These studies should eventually pay off by providing the data needed to generate more rationally additional medicinally beneficial molecules, not only from this plant but from others that contain comparable bioactive phytochemicals.

For this purpose, a number of therapeutic phytochemistry-based pharmacological strategies are now available, the majority of which are similar to the so-called "Reverse pharmacology" strategy (Patwardhan and Mashelkar, 2009), which is now widely recommended in India for discovering drug leads from Ayurvedic and other traditionally known medicinal plants. This strategy should only be used after a plant's medicinal characteristics have been more completely proved, either by observational or more objective clinical studies. Alternative procedures must be used because this criteria has yet to be satisfied for Brassica juncea (save for the oil derived from its seeds, which has been connected to probable health benefits in epidemiological study). All viable options need close collaboration among medicinal phytochemists, pharmacologists, and other researchers from a variety of different sub-disciplines of modern medicine, as well as significant time and money commitments.

Modern pharmaceutical corporations are reluctant to invest in research on a plant that is extensively grown and harvested since patent rights for Brassica juncea-derived products can be easily misused or evaded in the marketplace. Diabetes, on the other hand, is already a major health problem in developed and developing countries, and there are presently no especially acceptable, practicable, or cost-effective remedies available to successfully combat the epidemic in these areas. In such a situation, rapid creation of economically viable techniques and models capable of identifying edible vegetables and fruits capable of meeting these countries' health-care demands through the use of easily available and economically less expensive experimental procedures is required.

With the possibility that the Brassica juncea leaf could be an anti-diabetic vegetable, researchers are working to better understand its health benefits in accordance with Ayurvedic principles, which suggest that health can only be maintained through proper adjustments of the balance between bodily functions and mental and spiritual functions. These researches led to the development of a provisionally standardised extract derived from commercially available plant leaves that was well tolerated by test animals. After repeated daily oral dosing, it efficiently countered hyperglycemia and hyperlipidemia in diabetic rats.

These findings not only support our hypothesis that many herbal medications' widespread appeal is due to their subtle and yet little understood effects on the gut-brain axis, but they also strongly suggest their potential value in the battle against diabetes. Because many of the bioactive phytochemicals found in Brassicaceae plants are also found in other edible and medicinal plants, practical pharmacological models and tools capable of identifying their therapeutically interesting bioactivities could be used to improve or rationalise the pharmacological standardisation of a wide range of medicinal plants.

Holistic approaches based on postmodern polypharmacology concepts may be a more reasonable and financially feasible choice for making better use of traditional knowledge and increasing medicinal plant commercial and therapeutic exploitation. As a consequence, Brassica juncea looks to be another edible Ayurvedic plant that should be studied more thoroughly, not only for medicinal purposes but also for the development of innovative pharmacological models for treating patients with a range of health problems.

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