



ISSN: 0976-3376

Available Online at <http://www.journalajst.com>

ASIAN JOURNAL OF  
SCIENCE AND TECHNOLOGY

Asian Journal of Science and Technology  
Vol. 09, Issue, 04, pp.7925-7929, April, 2018

## RESEARCH ARTICLE

### BENEFITS OF BRASSICA ALBA (MUSTARD SEEDS) IN MANAGING METABOLIC DISORDERS

<sup>1</sup>Dr. Luxita Sharma, <sup>2</sup>Vaishali Gupta, <sup>3</sup>Dr. Puneeta Ajmera and <sup>2</sup>Sushmita Kumari

<sup>1</sup>PhD, Assistant Professor - II & Head, Dietetics and Applied Nutrition, Amity Medical School, Amity University, Gurgaon

<sup>2</sup>Student, M.Sc Dietetics and Applied Nutrition, Department of Dietetics and Applied Nutrition, Amity Medical School, Amity University, Gurgaon, India.

<sup>3</sup>Assistant Professor - II, Medical School, Amity University, Gurgaon

#### ARTICLE INFO

##### Article History:

Received 27<sup>th</sup> January, 2018

Received in revised form

18<sup>th</sup> February, 2018

Accepted 07<sup>th</sup> March, 2018

Published online 30<sup>th</sup> April, 2018

##### Key words:

Definition of digital divide, Information Communication Technologies (ICT), disabled people.

#### ABSTRACT

Mustards are members of the cruciferae or Brassicaceae family. Mustards are also widely used as green vegetables, as a salad crop, as an important oil seed crop mainly in India and in many other countries. Mustard seeds are good source of oil and protein. Mustard seeds have a pungent aroma. Mustard is used in practice to treat coughs and colds, and to lessen up the swelling. To stimulate the blood circulation, to treat arthritis and rheumatism, to relax stiff muscles and to warm cold feet plaster of mustards were used. Mustards have the potential to treat the skin related disorders because of high sulfur content. The flow of salivary and gastric juices is also stimulated by mustard and promotes appetite. It has been used as laxative, for the treatment of asthma and induces vomiting or relieving coughs. Ingestion of mustard seeds may impart body odours. The present review was carried out to find the beneficial effects of the Mustard seeds on human body.

Copyright © 2018, Xiao-Fei Gao et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

#### INTRODUCTION

Mustards are members of the cruciferae or Brassicaceae family. It is one of the oldest condiments according to Sanskrit records. It is well known for its condiments, therapeutics and flavouring properties. Today, there is countless variety of mustard throughout the world. Three type of mustard seeds are popularly used in condiments.

**Pale yellow or white mustard (Brassica alba):** It is also known as safed rai in hindi. This type of mustard is originally grown in southern Europe. Now, it is broadly cultivated in Chile, the USA, Australia, Canada, China, North Africa, Denmark, Netherlands, Japan, Italy and the UK. Flowers of this type of mustard are small in size, yellow in colour with four petals. It does not give any odour while crushing.

**Brown or oriental mustard (Brassica juncea):** Earliest it was introduced to northern India from China. And from northern India it has expanded to Afghanistan via Punjab. It is a hybridized variety of mustard produced from Brassica nigra and Brassica campestris. Brown mustard has two varieties, one is 'oriental' which is mainly used by Chinese. And the other variety is stronger and darker 'brown' variety which is mainly used by Indians.

**Black or dark brown mustard (Brassica nigra):** Black mustard seeds are called true mustard. It is also responsible for the evolution of many species in the genus Brassica. This type of mustard is not much popular in Europe or the USA due to harvesting problems. Mustard seeds are cultivated in many regions of the India. Mainly in Bihar, Bengal and Uttar Pradesh. Among the three varieties mentioned above, brown mustard is largely cultivated. In Europe, it is popular for seasoning meat and fish. The leaves, the stem and the seeds are edible parts of this plant. Mustards are also widely used as green vegetables, as a salad crop, as an important oil seed crop mainly in India and in many other countries. Mustard seeds are good source of oil and protein. Mustard seeds have a pungent aroma. It is normally used as condiments but its medicinal value also was recognized by Pythagoras as a remedy for scorpion bites and snake bites. Many other medicinal uses are also there of mustards. The important mustard growing countries in the world are Canada, Nepal, USA, Russia, Myanmar, Romania, Slovakia, Germany, and France. Canada is one of the major exporter of yellow and brown mustards to the world trade market of mustards. It is a cool season crop and is grown in drier regions.

**Other common names for mustard seeds in India:** English – Black mustard, Brown mustard or white mustard depending upon the type of mustard.

Hindi – Sarson  
Punjabi – Rai

\*Corresponding author: Dr. Luxita Sharma

PhD, Assistant Professor - II & Head, Dietetics and Applied Nutrition, Amity Medical School, Amity University, Gurgaon

Gujarati – Rai  
Tamil – Kadugu  
Marathi – Mohari  
Telugu – Avalu

### Properties

Mustard seed are round, normal in size and having nutty, sweeter and slightly burning flavour. The whole mustard seed do not possess any flavor but can have a pungent aroma which varies with different type of mustards. Black mustard seeds possess the greatest pungency. Brown mustard seeds are more pungent than the white or yellow type of mustard. Variety of isothiocyanate compound present in mustard tissue as glucose is responsible for flavor and pungency in seeds. In addition to providing color and flavor, mustard seeds have preservatives and anti-oxidant properties. There are differences in the properties of the leaves, seeds, and oil, depending upon the type of mustard seeds. Mustard oil has high content of allyl isothiocyanate, mustard and its constituent allyl isocyanate have bacteriostatic and bacteriocidal properties.

### Glucosinolates in mustard seeds

The main glucosinolate in brown/oriental mustard is sinigrin which on hydrolysis by enzyme myrosinase yields allyl isothiocyanate (AITC), is important for pungency and flavour. Glucosinolates and isothiocyanates have been linked to antibacterial, anticancer and antifungal activity.

Mustard oil has been used for the treatment of various skin diseases and wounds and its medicinal properties being attributed to the isothiocyanate and the glucosinolates products. Isothiocyanates (ITCs) from these sources show interesting chemo preventative activities against many chronic-degenerative diseases including cardiovascular disease, cancer, neurodegeneration and diabetes. The therapeutic benefits of ITCs include their anti-cancer activity, their anti-inflammatory activity, antioxidant activity, antibacterial and antifungal activity, and wound healing properties.

### Mustard Composition

Mustard seeds are made up of oil (29-40%), protein (23-30%), carbohydrate (12-18%), minor components including minerals (4%) and phytate (2-3%).

Mustard seeds are rich in Vitamin A, Iron and calcium. They are also rich source of protein and oil.

100 grams of mustard seeds contain:

Water	-	5.67g
Protein	-	19.51 g
Fat	-	40.19 g
Fiber	-	14.10 g
Carbohydrate	-	16.80
Energy	-	127
Calcium	-	402 mg
Iron	-	13.49 mg
B-Carotene	-	36.72ug
Vitamin B2 (Riboflavin)	-	0.33 mg
Vitamin B9 (Folic acid)	-	94.88 ug
Total carotenoids	-	675 ug
Linolenic acid (W3)	-	3341 mg
Linoleic acid (W6)	-	4932 mg
Oleic acid (W9)	-	4012 mg

Total saturated fatty acids - 2112 mg  
Total mono unsaturated FA - 21032 mg  
Total poly unsaturated FA - 8910 mg

Mustard seeds are good sources of aluminium, arsenic, chromium, phosphorus, selenium. Mustard seed oil contains 11% saturated and 89% unsaturated fatty acid. In unsaturated fatty acid, 12.27% is linoleic acid (W6) and 8.31% is linolenic acid (W3) and 9.98 is oleic acid (W9). Mustard oil contain less amount of saturated fatty acids and high amount of mono unsaturated fatty acid. Mustard oil contains quite high content of erucic acid. After soybeanoil and palm oil, Mustard oil is the most important vegetable oil of use. The protein is of excellent quantity and nutritional quality, being rich in essential amino acids e.g. lysine, leucine, phenylalanine, threonine with adequate amounts of sulphur containing amino acids. Arginine is also present in good amount.

### Comparison between yellow and brown mustard

- Yellow mustard has higher content of protein than brown mustard. Whereas, the content of oil of brown mustard is higher (36.32%) than yellow mustard (31.78%).
- Higher amount of Arginine (7.76%) and linoleic acid (21.36) is present in brown mustard than in yellow mustard (4.7%) and (12.37%) respectively.
- Yellow mustard contains higher amount of proline (8.07%) and Erucic acid (37.89%) than brown mustard (4.19%) and (23.9%) respectively.
- High content of erucic acid is the factor that limits the use of mustard seed oil in human food and hence, are animal food formulas. It is because the Erucic acid is indigestible for human and animals.

Dark brown mustard contains phenol, flavonoids, alkaloids, sterols, terpenes, etc. which may be responsible for the activity against microorganisms.

### Mustard protein

The highcontent of protein of mustard seed makes it an attractive and potential source of food-grade vegetable protein. The ratio of amino acids found in the mustard seeds have a great importance in human nutrition. The main proteins in mustard are the seed storage proteins e.g. cruciferin and napin, and are found within the cotyledon. There has been developing processes to extract and isolate mustard proteins, and find applications in human nutrition. The interest of mustard protein arises because of a need to find a market place for the mustard meals produced from the mustard oil production. Aqueous extraction processes are technologies in which water is used as an extraction medium for the extraction of protein and other soluble components in oilseeds for the production of food-grade proteins and industrial oils from dehulled yellow mustard flour. This process push out the dangers associated with solvent (e.g. hexane) extractions and allows the recovery of good-quality protein products and vegetable oil simultaneously. Commercial technologies are not available for protein recovery from *Sinapis alba* or *Brassica juncea* mustard seeds till now. This could change by a Canadian company soon as it is indicating to commercialize a diafiltration or ultrafiltration extraction process developed and patented.

## Yellow mustard mucilage

All type of mustard seeds havemucilage but only yellow mustard is of main importance because of its great yield and functionality. *Sinapisalba*contains around 5% mucilage compared to less than 1% in the brown, oriental or black mustards. Yellow mustard mucilage is prepared from a component of by-product of mustard flour production e.g. mustard bran. The preparation though, not have regulatory approval as a food component and could be used for applications in other fields. The extract of mustard mucilage was used into the cosmetic industry for use as emollient, skin conditioner, film former and viscosity control agents for aqueous systems. Applications of Products included self-tanning solutions, anti-aging formulas, lotions, creams, liquid soap, and formulas of sunscreen. Now, the company is not producing yellow mustard mucilage because of a competition from oat mucilage and limited market.

## Preparation of mustard products

Traditionally, mustard products was manufactured by crushing the mustard seed, evacuating the crude oil from the crushed seed, then soaking the mustard flour in a liquid to allow development of flavor and pungency. Traditional processing methods of producing mustard flours involved soaking the dehulling. Ground flours kept in hot water to activate the myrosinase enzyme and then re-drying the wet flour. Flours of different degrees of hotness were obtained. However, shelf life this was limited because residual isothiocyanate were converted to other products. In the 1960-1970s new thermal treatments were used to control the pungency effectively and shelf life of mustard ingredients. In place of hot water, saturated steam was used to fractionally or completely inactivate the myrosinase enzyme. McCormicks introduced a special spray dried mustard flour that could be used in place of traditional dry ground mustard flour in mayonnaise formulations. It was possible to minimize the mustard level in a standard mayonnaise recipe by 25% without adversely affecting its taste and thickness. Also due to enhanced functional properties of the spray dried mustard, the egg yolk content in the formulation could also be decreased by 7.5%. Due to this there was decrement in the ingredient costs. Shiro Sakai in 1993, developed a process that thermally inactivated the myrosinase enzyme in de-oiled cracked seeds prior to being ground into flour resulting in a product with less pungency, enhanced protein content, good flavor, and greater shelf life.

Use of mustard as a food ingredient heightened up considerably in the 1990s. It was because at that time, A Canadian-based UFL Foods, introduced a new thermal process for the inactivation of myrosinase enzyme in yellow mustard seeds. Inactivation of this enzyme interrupted the glucosinolates from being converted to isothiocyanates, compounds that are responsible for mustard's "hot" flavour.

After grinding, the mustard powder gives an ingredient with outstanding stabilizing, emulsifying, binding and thickening properties, but lacked the strong hot flavour. It was also known as cold or deodorized powder. Deodorized mustard powder became a popular ingredient in cooked cured meats. Because of its high protein content and low cost. Deheated ground mustard is now sold in more than 50 countries in meat products, salad dressing, cheese spreads, condiments, gravies

and mayonnaise and can be a substitute for guar and egg ingredients in food preparations. The main goal of mustard processing is to enhance the pungency and taste and increase the shelf life of mustard. Though there are some challenges to doing this. The quality of the final product of mustard is dependent upon the production of heat during processing, the moisture and oil content, and enzyme activity mainly myrosinase.

## Some of the mustard products are

Whole mustard seeds, mustard flour, ground mustard, de-oiled mustards, heated deactivated mustards, mustard brans and mustard oils. These are used in meat products, condiments, baked goods, and emulsion type dressings.

## Uses

Many products are derived from dark brown, brown and yellow mustards and are added in foods for its flavour and unique properties. The products of mustard give stability, emulsification, preservative and nutritive properties to the foods in which they are added.

## Mustard is used in variety of ways

**As vegetables:** Mustard leaves, called as mustard greens can be eaten as vegetables or salads and have a redishy taste.

**As flavoring:** Whole seeds are mostly used in flavoring, mustard seeds are enjoyed with roast beef and ham, as a dip for raw fish, with fruits and chilly peppers. In Indian cooking, mainly in vegetarian meals in south. Mustard seeds are used in a way that, firstly they are popped up in any heated ghee or oil and then used in sauces, chutneys, pickles, curries, sambhar, and dals and in a variety of foods. Ground mustard seeds are used to provide flavor and consistency in Bengali curries of fish. It is used in varieties of food e.g. Seafood, meat loaf, salad dressings. Mustard seeds are also used in salads in the form of sprouts.

## Therapeutic roles of Mustard

The ancient Greek knew that mustard could be used as antidote to snake bites and scorpion bites. Mustard is used in practice to treat coughs and colds, and to lessen up the swelling. To stimulate the blood circulation, to treat arthritis and rheumatism, to relax stiff muscles and to warm cold feet plaster of mustards were used. Mustards have the potential to treat the skin related disorders because of high sulfur content. The flow of salivary and gastric juices is also stimulated by mustard and promotes appetite. It has been used as laxative, for the treatment of asthma and induces vomiting or relieving coughs. Ingestion of mustard seeds may impart body odours.

In ayurveda, as well as in yunani system, mustard seeds and its oil are widely used. Seeds are useful in itching, skin diseases, visceral diseases, and worm infection. Mustard oil is stimulative, pungent and promotes digestion. Use of mustard oil in excess amount result in impotency in males. It is also used in many Ayurveda medicated oils to massage in any paralytic diseases of narcosis system.

**Table 1. Mustard Products and its uses**

Product Form	Seed type	Application	Reason for use
Oil	Brown mustard	Edible oil (in India) and Industrial uses	Due to pungency and taste Rich content of erucic acid makes for an excellent lubricant
	Yellow mustard	Lubricant, lighten Mayonnaise (in Sweden)	Lubricant
Mustard flour (without bran )	White mustard oil extract (WMEO)	Ingredient in salad dressings, BBQ sauce, processed meats/pickles, mayonnaise.	Good antimicrobial agent Flavour Emulsifier
	Yellow mustard		Provides various profiles of flavor from mild to hot & pungent.
Ground Mustard including bran	Yellow mustard	Oriental Mustard	Provides stability to oil-water emulsions, Bulking agent, Lessen product contraction during cooking.
	Brown mustard	Meat products Seasoning Salad dressings, condiments, pickled products. Brown mustard used mainly for preparation of hot, spicy table mustards .	Preservative (isothiocyanates inhibit microbial growth) preserves colour and freshness in fruit dessert.
Cracked mustard seeds	Yellow mustard	Brown mustard	Thickener
Deheated mustard	Yellow mustard	Mustards, Seasonings, topical blends and salad dressings	
	Yellow mustard	Finely ground: Myrosinase enzyme not activated	Bland tasting rich protein source Water binder
De-oiled groundmustard		Bakery products, processed cheese slices and beverages	Antioxidant Stabilizer Thickener
		Meat products Sauces Mayonnaise (can be used in place of egg yolk) Products of tomatoes e.g. ketchup	Potential as reducing agent in bakery mixes to break down gluten matrix and improves stretchability
Mustard Bran		Meat products (hot dogs, sausages, Creamy dressings Mayonnaise	Fixed oil component is cold-expelled concentrating the protein (minimum 40%), mucilage, phospholipids and fiber.
	Yellow mustard	Coarse flakes or ground to fine powder Natural thickener in sauces	Water holding capacity, thickener Low cost, Oriental mustard bran has hotter flavour, some amount of mucilage is also present.

**Table 2. Mustard components and their effects on health**

Mustard component	Effects on Health
Protein (modified or native )	Source of rich quality protein Allergen
Proteins-hydrolyzed	Hydrolyzed proteins with bioactivities such as, antihypertensive, calcium-absorbing, antioxidative, antithrombotic, etc
Glucosinolates as source of Isothiocyanates	Having anticarcinogenic effects Antimicrobial Antiinflammatory Wound healing
Phenolics	Antiinflammatory Wound healing Antioxidant activity Antimicrobial activity
Mucilage (from white mustard)	Anticarcinogenic effects

It is also considered as diuretic, emetic, rubefacient, and stimulant. Mustard relieves congestion. It is used in abdominal pain, anorexia, worms, diseases of spleen, wounds etc.

### Allyl Isothiocyanate (AITC) and cancer

Some investigations performed on the types of cancers are listed below:

- Bladder cancer development and recurrence: Allyl isothiocyanate (AITC) particularly delivered to bladder cancer tissue through urinary excretion and effectively inhibits bladder cancer development due to its ability to bring out cell cycle arrest and apoptosis.
- AITC may particularly target cancer cells as it has also been shown to be effectively more toxic to prostate cancer cells and colon cancer cells than to normal prostate and colon cells.

### Effects of mustard Oil on health

Diacyl glycerol rich mustard oil (DAG) oil is effective in preventing accumulation of body fat and obesity related disorder. DAG ingestion reduces postprandial hypertriglyceridemia compared with triacylglycerol (TAG) ingestion.

Mustard oil contains two essential fatty acids (EFA) and tocopherol. Mustard oil could be a raw material to produce a healthful edible oil which is low in calorie. According to a study, DAG rich mustard oil lower the plasma leptin content (leptin is an antiobesity hormone), reduce body weight, and reduced atherosclerotic factors such as plasma TAG, and non-HDL cholesterol.

### Effects of yellow mustard bran on health

According to a study, yellow mustard bran could lower the glycaemic response of carbohydrate-rich test meal and increase satiety. The findings of this study revealed that intake of 5 g bran of yellow mustard consumed in potato or leek soup mainly reduced peak blood glucose. According to a research based upon a rat model, consumption of a diet containing 10% *Brown mustard* seed powder could play an important role in the management of insulin resistance of pre-diabetic state.

### Uses of mustard in ayurveda

Mustard seeds have a wide application in diseases like leucoderma, cracked skin, fever, leprosy, wasting, swelling, rheumatoid arthritis, neurological disorders, gynecological disorders, breast milk disorders, wounds, and retention of placenta. A paste of mustard seeds with other herbs is applied externally in tumor of thyroid gland as well as lymphadenitis.

Mustard is said to be useful in cardiac disorders, but can derange blood. It is a lipid covering agent. Mustard oil is recommended in diabetes, frozen thigh, elephantiasis. Mustard oil is recommended for internal use in filariasis. The mustard oil is a good hair tonic also. Though the red and white variety of mustard have almost similar properties, the white variety is preferred for internal use (isothiocyanate, found in mustard seeds has the potency to inhibit carcinogenesis, tumorigenesis in breast, colon, lung, and skin tissue in animals. Mustard leaf also exhibits antioxidant effects. The healing properties of mustard seeds may due to its high content of vitamins and minerals including iron, magnesium, manganese, selenium, phosphorus, calcium, niacin, fiber, and zinc. It is also a good source of W-3 fatty acids. Isothiocyanate has been studied widely for its anticancer effects. In animal studies, mainly kidney, brain and colorectal cancers, intake of isothiocyanate from mustard seeds has been shown to inhibit growth of existing cancer cells while protecting against the formation of new cancer cells.

### Conclusion

Among the numerous varieties of mustards only three types of mustard seeds are most popular. They are used in a wide range of varieties of foods. It has hot flavor and mainly used as a condiment. Though it is used in small amounts, but it has major health benefits because of its therapeutic nature. Being rich in oil, protein and vitamin A, iron and calcium they play a lead role in Indian as well as foreign countries cooking system. In India, it is known by different names in different states. Isothiocyanate is the main compound responsible for the therapeutic properties and pungency in mustards. Mustard seeds provide colour and flavor to the food and in addition to it, it also has preservative, anti-oxidative, anti-inflammatory, antifungal properties. The bacteriocidal and bacteriostatic effect of mustards is due to allyl isothiocyanate compound. Mustard oil is rich in unsaturated fatty acid. The nutritional quality of mustard seeds is excellent. Now a days, many products of mustards are available in the market e.g. mustard seeds, mustard flour, ground mustard, de-oiled mustards, heated deactivated mustards, mustard brans and mustard oils. Isothiocyanate of mustard seeds has chemopreventive effects against many diseases e.g. cardiovascular diseases, cancer, diabetes, neurodegeneration. Mustard could be used as antidote to snake bites and scorpion bites, to treat coughs and colds, to lessen up the swelling, to stimulate the blood

circulation, to treat arthritis and rheumatism, to relax stiff muscles and to warm cold feet, plaster of mustards were used. Mustards have the potential to treat the skin related disorders because of high sulfur content. It also stimulates the salivary and gastric juices promotes appetite. It has been for the treatment of asthma. Mustard seeds have a wide application in diseases like leucoderma, cracked skin, fever, leprosy, wasting, swelling, rheumatoid arthritis, neurological disorders, gynecological disorders, breast milk disorders, wounds, and retention of placenta. It is a lipid covering agent. Mustard oil is recommended frozen thigh, elephantiasis. Mustard oil is recommended for internal use in filariasis. Researches are going on to reveal the therapeutic health benefits of mustard seeds.

### REFERENCES

- Abul-Fadl, M.M., El-Badry, N., Ammar, M.S. 2011. Nutritional And Chemical Evaluation For Two Different Varieties Of Mustard Seeds. *World Applied Sciences Journal.*, 9:1225-1230.
- Inyang, I.J., Eyo, A.A.O., Olazide, T.M., Essien, A. 2014. Effects of Ethanolic Extract of Mustard Seeds on the Brain and Kidney Tissues of Albino Wistar Rats. *Journal of Biology.*, 4: 75-77.
- Longvah, T., Ananthan, R., Bhaskarachary, K., Venkalah, K. 2017. Indian Food Composition Tables. National Institute of Nutrition., p. 17-142.
- Manohar, R., Pushpan, R. 2009. Mustard and its uses in Ayurveda. *Indian Journal of Traditional Knowledge*, 8: 401-403.
- Mishra, A., Dash, P., Murthy, P.N., Siddique, H.H., Kushwaha, P. 2012. A Classical Review on Rajika. *Journal of Botanical Sciences.*, 1:18-21.
- Mustard components: Research and Commercialisation, A final report for The Saskatchewan Mustard Development Commission. Mustard: Protein, Mucilage And Bioactives. *The Pathfinders Research And Management LTD*; 2016. p. 11-93.
- Thomas, J., Kuruvilla, K.M., Hrideek, T.K. Mustard. 2004. Handbook of herbs and spices. p. 196-204.
- Tomar, R.S., Shrivastava, V. 2014. Efficacy evaluation of ethanolic extract of *Brassica nigra* as potential antimicrobial agent against selected microorganisms. *International Journal of Pharmaceutical Science and Health Care*, 3: 117-121.

\*\*\*\*\*