Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(5): 377-383
Received: 07-07-2017
Accepted: 08-08-2017

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Therapeutics, phytochemistry and pharmacology of *Alsi* (*Linum usitatissimum* Linn): An important Unani drug

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Abstract
Linum usitatissimum Linn is one of the most important medicinal plants traditionally used for various health as well as nutritional purposes. It is an annual herbaceous plant growing up to 60-120 cm of height. Its flowers are small and are blue, bluish violet or white in terminal panicles. The fruits are capsular with five cells, each containing 2 seeds. It is cultivated mainly for the purpose of oil and fibre and usually with wheat plant. It grows in almost all types of soil where sufficient moisture is available. Flaxseed has been classified as functional food because it provides numerous health benefits in addition to serving as a source of nutrients. The plant has shown diverse biological and pharmacological activities. It has been used in Unani Medicine (*Tibb-e-Unani*) from time immemorial. Keeping in view the high medicinal importance of the drug in Unani Medicine, this review provides available information on traditional uses, phytochemistry and pharmacological properties of Unani drug *Alsi*.

Keywords: *Linum usitatissimum*, *Alsi*, *Katan*, Flaxseed

Introduction
Linum usitatissimum is an annual herb growing up to 60-120 cm height. Its flowers are small and are blue, bluish violet or white in terminal panicles. The fruits are capsular with five cells, each containing 2 seeds [1]. The plant is thought to be one of the oldest cultivated crops with evidence of cultivation dating back thousands of years [2]. It is cultivated mainly for the purpose of oil and fibre. It belongs to the genus Linum and family Linaceae. The botanical name, *Linum usitatissimum* was given by Linnaeus in his book "Species Plantarum" [3, 4]. It is nature's miraculous plant. The plant was useful as a source of fibre for weaving, oil from the seeds and feed from the meal, hence the species name, *usitatissimum* - meaning 'most useful'. Flaxseed has been classified as functional food because it provides numerous health benefits in addition to serving as a source of nutrients [2].
Seeds are oval lenticular 4-6 mm in length. Seed surface is smooth shining and dark brown in colour. They are slightly flattened and have one edge more acute than the other. Indian linseeds are classified into broad types for commercial purposes, namely, yellow and brown [5]. Both the varieties are with almost similar nutritional values [2], but the yellow variety is preferable to brown type, because of higher percentage and lighter colour of oil [1].
In Unani system of medicine Alsi is described as seed of small herb [6] that is usually cultivated with wheat plant. It is about 36 inches high [7]. Its stem, branches and leaves are thin [6]. The flowers are beautiful bluish in colour [8]. Its fruits are about the size of chick peas which is filled with seeds [6, 7]. The seeds are small shiny, smooth, black in colour [8]. They are elongated in both sides and conical at ends [6].

Cultivation
Linseeds are grown predominantly as a rainfed, cold season rabi crops. It grows in almost all types of soil where sufficient moisture is available. In India, it is sown in the month of September-October and harvested in February and March before the capsules are dry. The herb is dried [1]. The ripe seeds are recovered from the capsules by threshing [9].

Occurrence and distribution
Flax plant is a native of Egypt [10, 11]. It is unknown in a wild state and its origin is uncertain. Some consider it to be indigenous to localities between the Persian Gulf and the Caspian and black seas, while others ascribe its origin to India. These two-main geographical groups correspond to the oldest areas of cultivation. Linseed has been cultivated since antiquity the

Mediterranean coastal lands, Asia Minor, Egypt, Algeria, Tunis, Spain, Italy and Greece. In All these area, only fibre-flaxes are cultivated. The second group comprises south-west Asia, including Turkestan, Afghanistan and India; only oil types are grown. In Asia Minor and south Russia, transitional forms are cultivated for both fibre and oil [1].

Linseed is extensively cultivated throughout the plains of India and up to an altitude of 2000 meters above the sea level [5, 12]. States where it is not grown are Kerala, Madras, Delhi, Manipur, Tripura and in Andaman and Nicobar Islands. Uttar Pradesh and Madhya Pradesh both account for nearly two third of the total production [1].

Linseed products

Linseed oil

Linseed produced in India is utilized mainly for the expression of oil. Bullock-driven ghanis and power driven rotary mills, expellers and hydraulic presses are used for this purpose. The yield of oil is 28-30% on the weight of seeds. Linseed oil is refined by tanking for long period. Filtration followed by tanking results in the separation of a part of mucilage. The colour of refined oil is improved by treatment with decolourizing agents [1].

Linseeds cake / meal:

Linseed cake is obtained as a by-product of the oil. The oil content of the cake varies according to efficiency of the equipment employed for expelling the oil [1].

Linseed mucilage:

It is prepared from aqueous extract of seeds (soaking in water for 24 hours) precipitation. It is obtained as a white fibrous mass which becomes friable when completely dry [1].

Linseed tea:

It is also known as infusion of linseed. Prepared by adding an ounce of the seed in one pint of water, boiled for ten minutes and strained and made preparation with or without the addition of a little liquorice root and sweetened with sugar [11].

Linseed fibres:

Fibre is extracted from the stalks of plant. Seeds obtained from type grown for fibre are poor in oil content. The colour of raw fibre varies from creamy white to grey. Flax-fibres are valued for its outstanding strength, fineness and durability. It is stronger and more durable than cotton. It is soft, lustrous and flexible and possesses high water absorbency [1].

Ethnobotanical description

Plant: It is an erect annual herb [9, 13], about 0.6-1.2 m high [1, 5, 10].

Stem: It is solitary or few, corymbosely branched. The branches are ascending towards the apex [5, 10, 13]. Stem may be unbranched, erect or ascending curves [9].

Leaves: These are up to 3.8 cm long, linear, lanceolate [5, 10], ovate [13]. It is attenuated at both the ends acute at the apex [5, 10]. It has smooth edge grey green in colour [9].

Flowers: It is usually blue in colour [1, 13] may be bluish violet or white [1].

Fruits: Fruit is an almost globular in shape, 6-8 mm long capsule on an erect or slightly bent stem [9]. They have 5 cells, each containing 2 seeds [1, 14].

Seeds: The seeds are compressed, dark brown [5, 10, 13]. It is 4-6 mm lenticular oval in shape. Surface is smooth shining. They are slightly flattened laterally and have one edge more acute than the other. The hilum lies in a depression close to the more acute edge of the seed. The raphe extending from the hilum to the broader end of the seed is in the form of a yellowish line along the acute edge. The seeds are highly mucilaginous in taste but completely devoid of any odour [5].

Roots: The root is short, fusiform and light yellow in colour [9].

Vernaculars

The plant is known by different vernacular names in different language, areas and traditions: *Bazarul katan*, *Kattan* (Arabic); *Atasi*, *Umaa*, *Masrnaa*, *Nilapushpi*, *Kshuma* (Ayurvedic); *Chikna*, *Tisi* (Bihar); *Tisi* (Bengal); *Alasi, Javas, Javasa* (Bombay); *Linho* (Brazil); *Hou Ma Tse* (Chineese); *Alshi, Javas* (Deccan); Blaebows, common flax, flix, Lin, Line, Lint, Bells, Lint Benels, Lint, Bow, Lyne, Vlix, flax, Linseed (English); *Lin, Lin chaud, Lin commun, Lin cultive* (French); *Lein, Flachs* (German); *Linon* (Greek); *Alshi* (Gujarat); *Alsi, Tisi* (Hindi); *Len* (Hungarian); *Lino* (Italian); *Atashi* (Kannari); *Alish* (Kashmir); *Ali* (Madaras); *Cheruchanavittintevilta* (Malayalam); *Alashi, Javasa* (Marathi); *Bazarug, Kuman, Tukhmekatan, Zaghir, Zaghu* (Persian); *Alis, Tisi* (Punjab); *In* (Roumanian); *Len, Lyon* (Russian); *Atasi, Auma, Chanaka, Devi, Haimvati, Uma* (Sanskrit); *Lino* (Spanish); *Alshi, Ali, Virai, Sirrali* (Tamil); *Madanginjalu, Atasi* (Telugu); *Ziggar* (Turki); *Kattan* (Unani) and *Alasi, Alsi* (Urdu) [5,10,11,15-17].

Different preparation of Linseeds

In Unani system of medicine different preparation of linseed are used. It is used as the principal constituent in Laooq-e-Katan and Qairooti Bazr-e-Katan [7]. Laooq-e-Katan is a single drug preparation for pneumonia, cardiac asthma and bronchitis given to liquefy the phlegm [12]. It is also used in preparation of Sharbat-e-Sadra, Qairooti Aard Jauwali, Zimad-e-Kibreet [6], Habb-e-Sual, Laooq-e-Motadil, Laooq-e-Ribo [8].

***Mizaj* (Temperament)**

Unani physicians described the *Mizaj* of *Alsi* (*Linum sitatissimum* seed) as Hot and Dry in Ist degree [6, 7], while some others categorised in 2nd degree [18]. The *Mizaj* of oil is described as Hot and Wet in Ist degree [6, 7].

***Afaal* (Action)**

In classical Unani literature, various actions of the plant *Linum sitatissimum* have been described such as *muhallil-e-warm*, *musakkin-e-alam* [6-8,19], *mulayyan* [6-8,20], *munzij*, *muqi* [6,7], *mudir-e-bol* [6,7,20], *mudir-e-sheer* [20], *jali* [6-8,20], *mukhrij-e-balgham* [6,7,19], *naffakh* [7], *musakkin-e-gurda wa kamar*, *murakkhi*, *mulayyan-e-salabat*, *munzij-e-warm*, *mughaliz-e-mani* [18], *nafe qurooh* [8,19], *mulattif* [19], *mukhrij-e-sang-e-gurda wa masaana, naf-e-surfa* [20]. The oil of the seed possesses *mohallil, muskkin-e-auja, jali, nafe qurooh* properties [7].

***Istemaal* (Uses)**

Alsi has been described to be useful in various ailments. It is a valuable soothing application to the inflamed surfaces, boils, carbuncles, threatening abscesses. It also decreases pain in these conditions. It also accelerates the maturation of torpid abscesses [6-8].

Its paste is beneficial for superficial inflammation as well as it makes counter-irritant for deep seated inflammation such as

pneumonia, bronchitis, pleurisy, peritonitis and arthritis. This counter-irritant effect of *Alsi* can be increased by smearing its surface by dusting over it a little of mustard powder [7,8].

It is useful for various skin conditions. It has a good result when applied on herpetic lesions, *qurooh-e-shahedia* and *kalaf* [6]. *Alsi* and vinegar are used as tila in cloasma and acne vulgaris [7, 8].

Mucilage obtained from the seed is either dropped in eyes or applied as tila around the eyes to relieve the redness [7, 8, 20].

Decoction of *Alsi* is very beneficial in throat irritation produced by severe cough. *Alsi* is also used in gonorrhoea, inflammatory condition of bladder and kidney. Powdered *Alsi* with honey is prescribed for *surfa-e-balghami* and *zeequn-nafas* (asthma) [7]. Abzan and huqna of *Alsi* is useful in inflammatory condition of uterus and intestine [7, 21].

Alsi cures the diseases of nails when applied over it. The seeds are also used with black pepper and honey to increase libido [21]. Linen cloth and lint are cooling to the body and lessens the perspiration [20, 22]. Barks and leaves resolve thrombosis in brain. Sprinkle of burnt bark stauches haemorrhage and heals wound [20].

Oil obtained from *Alsi* is massaged over inflammed area to relieve pain. It is used in form of tila for skin disease like *kalaf* or *da'ad*. Enema of oil is useful in ulcerative colitis and intestinal obstruction. A cream is formed by mixing equal part of oil and lime water which is a popular remedy for burns [7, 8].

***Muzir* (Adverse effect)**

Alsi weakens digestion and produces adverse effect on stomach [7, 8, 21, 22].

***Musleh* (Corrective)**

Different correctives are used like Kishneez [6, 8], Shahad (honey), Sikanjabeen [8, 20].

Pharmacological action

(As described in ethnobotanical and traditional literature)

The drug *Linum sitatissimum* is described in detail in ethnobotanical and scientific literature and various actions have been reported to possess by it. Some pharmacological actions and therapeutic uses are as follows:

The seeds are tonic [10], aphrodisiac [10, 11], resolvent [5], antitussive, antilipidemic [17], laxative [1, 17], demulcent [1, 11, 13-15, 17], expectorant [1, 5, 11], diuretics [1, 5, 10, 11], emollient [1, 11, 17], galactogogue [5,10], emmenagogue [10].

Roasted seeds are astringent [1, 10, 11]. Linseed poultice is emollient [10].

Flowers are cardiac and nervine tonic [10, 13-15, 17].

Therapeutic uses

The whole seed is prescribed as a laxative in the same manner as Ispaghula [1]. It is also used as a relish or chatni [11].

Seeds are given internally in gonorrhoea and strangury; crushed seeds are applied externally to accelerate suppuration of abscesses, boils, and carbuncle and also used in ulcerated and inflamed surfaces, gout and rheumatic swellings [1, 11, 13].

Linseed is used internally for chronic constipation, for colons damaged by abuse of laxatives, irritable bowel syndrome, diverticular disease, symptomatic short term treatment of gastritis and enteritis. It is used externally for painful skin inflammation [9, 17].

Linseed poultice is useful for gouty and rheumatic swelling [1, 10, 14, 15]. It is a counter-irritant for deep seated inflammation [1, 11] such as pneumonia, broncho-pneumonia, pleurisy, pericarditis, peritonitis, arthritis, quinsy, pelvic cellulitis etc. Poultice dilates the local blood vessels, relax the tissue and thereby relieve the tension and pain [11].

Mucilage obtained from seed is dropped in the eye in irritable conditions of conjunctiva [1, 10, 11, 14]. Mucilage along with honey is prescribed in cough and cold [11]. Linseed mucilage is used in cosmetics and pharmaceutical industries [1].

Linseed tea is beneficial in cold, cough, bronchial affection and irritations of the urinary organs, cystitis, gonorrhoea, strangury, diarrhoea and dysentery, also used as injections to the bladder, vagina and rectum [11].

Fumigation with the smoke of the plant is recommended for cold in the head and for hysteria. The tinder is used to staunch haemorrhages [10, 11]. Leaves and barks are efficacious in gonorrhoea [10, 13, 15].

Linseed oil removes biliousness and bad blood, useful for internal wound and ringworms, causes loss of appetite [10]. Equal quantity of linseed oil mixed with limewater known as carron oil is a popular remedy for burnt and scalds [10, 11, 15]. In case of piles it is given in doses of 1 to 2 ounces' morning and evening. One pint of linseed oil makes a good laxative, enemata, in impacted conditions of the rectum and lower colon [11].

Linseeds are also used in veterinary practice [1, 9]. It is used as nutritive food for livestock. It is also used in the manufacture of linoleum and oil cloth, printing and lithographic inks [10]. After oil extraction from the seed the linseed meal/ cake is used as supplement in animal feeds [23]. Linseed oil cake as manure and cattle feed. Oil is also used in industrial purpose in making soaps, varnishes, cosmetics, straw fibre mixed with cotton for stuffing, as laxative to animals [24].

Linseed fibres are suitable for the manufacture of high grade paper pulp. Linseed straw may be applied in the manufacture of building board, cardboard and wrapping and insulating materials. The residues left after extraction of fibre are used as fuel or wall board stock, feed and bedding [1]. Linseed fibres are used in making fabrics, twines etc [24].

Phyto-chemistry

Linseeds contain moisture, 6.6; protein, 20.3; fatty oil, 37.1; carbohydrates, 28.8; fibre, 4.8; mineral matter, 2.4; calcium, 0.17; and phosphorus, 0.37%; iron, 2.7 mg/ 100 gm; the seed also contain carotene, thiamine, riboflavin, niacin, pantothenic acid, choline and vitamin E [1].

Seeds contain about 3-10% of mucilage (in the epidermis) including arabinoxylans, galactans, rhamnogalacturonans [9, 17]. Mucilage is essentially the calcium salt of polysaccharides acid and linseed acid [1].

Fatty oil content is about 30-40% in linseeds [9]. The oil contains unsaturated fatty acids like α-linolenic acid (ω-3 fatty acids) 35-77%, oleic acid 12-30% and linoleic acid 8-29% [25].

Flaxseeds are with the richest ω-3 fatty acids content [2]. It also contains stearic acid, palmitic acid, headecenoic acid. Oil also contains small quantity of crystalline wax and water soluble resinous matter [1].

The protein content of linseed varies from 16 to 31%. The principal proteins of linseed are the globulins. Two globulins have been isolated, linin and colinin. It also contains glutelin but albumin appears to be absent. The non-protein nitrogen in the seed forms 21.7% of the total nitrogen [1].

The essential amino acids present in the total proteins of linseed are (expressed as g/16g.N) arginine, 8.4; histidine, 1.5; lysine, 2.5; tryptophan, 1.5; phenylalanine, 5.6; methionine, 2.3; threonine, 5.1; leucine, 7.0; isoleucine, 4.7; and valin, 7.0 [1].

The carbohydrates present in linseed are mostly sugars

(sucrose and raffinose), cellulose and mucilage. Reducing sugar and starch do not occur in ripe but are present in appreciable amount before maturation [1].

Total ash value of linseed is 6.846%, in which acid insoluble ash is about 3.76% and water solubule as is about 0.413% (5). The ash contains sulphats and chlorides of potassium, calcium and magnesium [11].

Linseeds contain a cyanogenic glucoside (0.05-0.1%) linamarin [1], linustatin, neolinustatin in small amount [9]. Besides cyanogenic glucoside, linseed also contains two other glucosides, crystalline and non-crystalline [16]. Linamarin is also obtained from leaves, stem, flowers and roots [12, 16].

Other constituents reported to be present in linseed are phytin, lecithin, wax, resin, pigments, malic acid, acetic acid and the enzymes lipase, protease and diastase, β carotenes [1]. Some phytochemicals such as phenolic acids, cinnamic acids, flavonoids and lignins are also present [2].

Linseeds contain both soluble and insoluble dietary fibres. The main soluble fibre is mucilage gum [2].

Linseed is the richest source of lignans which are both antioxidants and phytoestrogens [2, 26]. Secoisolariciresinol-diglucoside is the main lignan [9]. Other lignans isolariciresinol, pinoresinol, mataresinol and other derivatives of ferulic acid are also present [2, 26].

Pharmacological Studies

A number of studies have been carried out on *Linum usitatissimum* in recent years showing that it possesses diverse pharmacological effects. Some of the important pharmacological effects are as follows:

Analgesic

Analgesic effect of linseed fixed oil was evaluated using tail immersion and acetic acid induced writhing response methods. In tail immersion method linseed oil showed some analgesic effect but it was significantly lower than morphine. Acetic acid induced writhing response method showed that the analgesic activity of the oil is peripherally mediated and not centrally mediated [25].

Anticancer

A study shows that flaxseeds eaten in a quantity of 40 gm every day may have a metabolic impact which could reduce estrogen excess. This impact may be considered as favourable in the prevention and slowing down the evolution of breast cancer with positive hormonal receptors [27].

Omega-3 fatty acid i.e. fats with natural or enriched higher concentration from flaxseed oil, plays a significant role in inhibiting development of chemically induced tumours in laboratory animals thus reducing chances of colon cancer initiation [28].

Flaxseed cotyledons based diet feed to tumour induced mice (82g/kg) for a period of 8 weeks significantly lowers the cell proliferation process and reduces tumour growth area [29].

In other study it was reported that a 10 mg/kg dose of enterolactone of linseed, by subcutaneous injection 3 times per week, reduced the expression of colon 201 human colon cancer cells in athymic mice. Using various testing protocols, it is concluded that the tumor suppression was due to apoptosis and decreased cell proliferation [30].

Antidepressant

A study has been conducted to evaluate the antidepressant activity of extracts of linseed in wistar albino rats by locomotor activity, forced swimming test and tail suspension test. Linseeds have been found to have less significant antidepressant activity in comparison to standard fluoxetine, chlorpromazine and imipramine [31].

Antidiabetic

The effect of ethanolic extract of linseed was evaluated in hyperglycemia associated oxygen reactive species production in peripheral blood mononuclear cells and pancreatic cells and pancreatic antioxidant enzymes in alloxan induced diabetic rats. The result showed the serum glucose level was significantly reduced in both acute and sub-acute study [32].

Antiinflammatory

The anti-inflammatory activity of linseed fixed oil was evaluated against the carrageenan and prostaglandin E2 (PGE2) induced paw edema in rats following administration of oil by oral, intramuscular and intraperitoneal routs. In carrageenan-induced paw edema model significant inhibition of paw oedema was observed after oral administration of oil but the extent of edema inhibition was inferior to that observed with intramuscular and intraperitoneal administration. Similarly in prostaglandin induced oedema model oral administration of the oil inhibition was much smaller than the oedema inhibition obtained with intramuscular and intraperitoneal administration [25].

Antimicrobial

An experimental study was carried out to evaluate the antimicrobial activity of ethanol and chloroform extracts of flaxseeds against five microorganisms i.e. *Salmonella typhii*, Enterococcus, *Escherichia coli*, *Bacillus subtilis* and *Staphylococcus aureus*. The result reveals that chloroform extract is more effective than ethanol extract against microorganisms. Chloroform extracts showed antimicrobial activity against all the five microorganisms. While ethanol extract did not show any antimicrobial activity against *Eshericia coli* [2].

Antioxidant

A study was carried out to evaluate the antioxidant activity of secoisolariciresinol diglucoside (SDG), a plant lignan isolated from linseed. It is platelet activating receptor antagonists that would inhibit the production of oxygen radicals by polymorph nuclear leucocytes (36). The anti-oxidant activity of ethanolic extract of *Linum usitatissimum* EE-LU (100, 200, 300, 400 and 500 µg/ml) in an *In vitro* model has been evaluated. The result indicated significant dose dependent inhibition against DPPH radical, reducing power, superoxide anion radical scavenging, hydroxyl radical scavenging, metal chelating and hydrogen peroxide scavenging by EE-LU and α-tocopherol [33].

Antipyretic

The antipyretic activity of linseed oil was evaluated by testing against typhoid-paratyphoid A/B vaccine induced pyrexia in rats. It was observed that the oil had a definite antipyretic property, when given intraperitoneally at a dose of 1 ml/kg and above. Appreciable reduction in the temperature was noted within the 2nd and 4th hour of oil administration. Antipyretic activity of fixed oil at 3ml/kg dose was comparable to aspirin [25].

Anti-ulcer

In a study flaxseed oil and flaxseed mucilage was found to have significant protective activity against ethanol induced

gastric ulcers. The result showed that pre-treatment of rats with flaxseeds oil and flaxseed mucilage significantly reduced the number and length of gastric ulcers induced by ethanol [34].

Laxative
Linseeds are used as laxative due to its dietary fibre content. These effects are attributed to the bulk materials and in particular to the mucilage that binds with water and swells to form a demulcent gel in the intestine. Water is held back in the intestine due to the swelling of the mucilage. Faeces become softer. The volume of the intestinal content increases and causes a stretch stimulus, which results in a decrease in transit time. The swollen mass of mucilage forms a lubrication layer facilitating the transit of intestinal content [27].

Bone Development
Flaxseed, in particular lignans could influence bone development. In a study rats exposed to 88 or 177.3 mg SDG/kg of body weight/day had higher bone strength than the basal diet at 50 days post-natal. However, by post-natal day 132, no differences in bone strength, bone mineral density were observed. Exposure to SDG did not have negative effect on bone strength [35].

Hair Growth
A study has shown that linseeds increases hair length (+26%) with a slight positive effect on hair diameter. Linseed ingestion has a positive effect on hair density [23].

Atherosclerosis
The result of a study shows that linseed SDG is effective in reducing Hypercholesterolemic atherosclerosis by reducing oxidative stress and lowering serum levels of HDL-C in the early stage. SDG therefore may be useful in preventing Hypercholesterolemic atherosclerosis and lowering the relative risk of coronary artery disease [36].

Polycystic Ovarian Syndrome
In a prospective, open label, interventional study, linseed supplementation has resulted in significant reduction in ovarian volume and number of follicles in polycystic ovaries, improvement in frequency of menstrual cycles and has no effect on body weight, blood sugar and hirsutism. The positive effect of flaxseed powder (FSP) could be due to reduction in testosterone, oestrogen, LH and insulin levels contributing to follicular maturation and the anti-inflammatory actions to the reduction in ovarian volume. Considering the improvement in ovarian function and menstrual cycle, flaxseeds appear to be an alternative source of future drug development for PCOS [37].

Memory
Loss in spatial memory is very much associated with accumulation of lipid peroxide in the hippocampus. Higher levels of flaxseed nutritional as well as non-nutritional components like antioxidants in the form N-3 fatty acids most often referred as ω-3 fatty acids i.e. ALA, docosahexaenoic acid (DHA) and dietary fibers i.e. lignans, in addition to reduction of body mass reduces levels of lipid peroxide in the hippocampus. Studies on flax feed dam suggest that improvement in hippocampus ALA and DHA concentration results in reduction of spatial memory inhibitors thus increases learning ability of flaxseed feed dams [38].

Cardiovascular Diseases
Eicosanoides derived from omega-3-fatty acids, present in flaxseed primarily improves heart function by reducing blood cholesterol. A proportionate effect on blood cholesterol concentration and low-density lipoprotein fraction has been linked with higher concentrations of flaxseeds in the diets indicating greater reduction in LDL protein, serum and liver cholesterol [39, 40].

Blood Pressure
ω-3 fatty acids present in flaxseed have been found to regulate transcription and expression of genes, thereby altering enzyme synthesis and modifying several risk factors for coronary heart diseases, including reducing serum triglycerides and blood pressure [41-43].

Breast Cancer
The structure of flaxseed lignans, are similar to that of endogenous sex steroid hormones thus, it acts *In vivo* to alter hormone metabolism and reduce subsequent cancer risk in postmenopausal women [44].
In human objects, the influence of flaxseed and its lignans on breast health in postmenopausal women was examined. The study found that higher blood concentrations of SDG resulted in significant reduction in breast cancer risk [45-46].
In another study, the animals were given a flaxseed supplement along with a carcinogen and a high fat diet. The result was a highly significant reduction in size and number of breast tumors [45].

Prostate Cancer
There are numerous reports on the potential tumour suppressive influence of lignans. Beside estrogenic activity, flaxseed can interfere with steroid metabolism and bioavailability, and also inhibit enzymes, such as tyrosine kinase and topoisomerase, which are crucial to cellular proliferation and hence may contribute to lower incidences of prostate cancer [47].

Conclusion
The seeds of *Linum usitatissimum* Linn (*Alsi*) have been in use since times immemorial to treat wide range of indications. It has been subjected to quite extensive phytochemical, experimental and clinical investigations. Experimental studies have demonstrated its analgesic, anti-atherosclerosis, anticancer, antidepressant, antidiabetic, anti-inflammatory, antimicrobial, antioxidant, antipyretic, anti-ulcer, laxative, memory enhancer and effect in bone development, hair growth, polycystic ovarian syndrome, cardiovascular diseases, blood pressure, breast cancer, prostate cancer. The scientific studies have proved most of the claims of traditional

medicines. However, further, detailed clinical research appears worthwhile to explore the full therapeutic potential of this plant in order to establish it as a standard drug.

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