Novel Food products Based on Garden Cress seed and Their Health benefits; A review

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Abstract- The edible plant known as garden cress (Lepidium sativum L.) grows quickly and has long been prized for its therapeutic and nutritional qualities. Proteins, essential fatty acids (ω-3 and ω-6), minerals, vitamins, and bioactive phytochemicals like alkaloids, flavonoids, glycosides, tannins, and glucosinolates are all abundant in its seeds, and these substances contribute to a variety of pharmacological effects. Research has shown that garden cress seeds have galactagogue, anti-inflammatory, antioxidant, antibacterial, antifungal, antidiabetic, hypocholesterolemic, anticancer, and diuretic, aperient, and aphrodisiac properties. Their efficacy in fracture healing, wound healing, managing asthma, hypertension, nephroprotection, controlling diarrhea, and regulating menstruation has been demonstrated by experimental study.Their ability to improve pulmonary function in individuals with bronchial asthma, treat iron-deficiency anemia, and increase breast milk supply is supported by clinical evidence. With uses in noodles, instant mixes, health drinks, cookies, traditional sweets (laddu, panjiri, and burfi), baked goods, and fortified health bars, garden cress seeds are becoming more and more recognized as functional foods in the industrial sector. Roasting, bursting, and germination are some of the processing methods that improve their nutritional and sensory qualities. Garden cress seeds have great potential for inclusion in therapeutic diets and nutraceutical formulations targeted at preventing lifestyle disorders like diabetes, cardiovascular disease, osteoporosis, and cancer because of their numerous pharmacological advantages and functional food applications. To confirm their effectiveness, safety, and dosage adjustment, more clinical research is necessary. All things considered, garden cress seeds are an affordable, versatile food item that may help manage chronic illnesses and nutritional deficits.

Keywords- Functional food, Garden cress seed (Lepidium sativum), Health benefits, Nutraceuticals, Pharmacological properties.

INTRODUCTION

Pharmacological Properties

The seeds of GC possess diuretics, aperient and an aphrodisiac property that is useful for treating inflammation, bronchitis, rheumatism and muscular pain (Behrouzian et al. 2014). The seed is effective in the treatment of asthma, dysentery and diarrhea, coughs, skin disease and poultices for sprains (Sharma 2015). Moreover, the seed is effective in the treatment of hypertension and diabetes (Connor 2000), and have antibacterial and antifungal properties (Bansal et al. 2012).

Anti-inflammatory effect

Sativum seeds contain 24 percent oil that is mostly composed of the omega-3 and omega-6 fatty acids, ALA and LA, respectively (12%). The antioxidants and phytosterols in this oil make it resistant to oxidation. The Wistar rats' spleens and lungs showed synergistic effects of L. sativum oil (LSO) suppression of platelet aggregation and thromboxane B2 levels. Other studies have shown that LSO reduces lymphocyte proliferation and inflammatory mediator generation from peritoneal macrophages in rats (Diwakar et al., 2010). Garden cress stems, leaves, and seeds are all good for your health (Jabeen et al., 2017). Tocopherol levels and antioxidant enzyme activity were raised in Wistar rats fed a diet enriched with LSO for 60 days (Jabeen et al., 2017). Phytochemicals present in garden cress seeds have shown antioxidant and anti-inflammatory activity in various studies

Fracture healing effect

Yadav et al. (2011) studied the fracture healing effect of ethanolic extracted GC seeds using X-ray photographs conducted at the second, fourth and

eighth week at a dose of 400mg/kg GC seed in rats, the result indicated a significant increase in callus formation in GC seed administered groups compared to control groups. Similarly, bin Abdullah Juma (2007) reported the fracture healing effect of GC seeds on fracture-induced healing rabbits, in which the study duration lasted 12weeks from by feeding the rabbits with a normal diet and 6 g of GC seed; the study showed rapid recovery, good healing of wounds and fractures in the experimental rabbits than controls. The effectiveness of GC in wound and fracture healing is due to abundant source of glycosides, alkaloids, tannin, flavonoids, fatty acids and amino acids like glutamine, cysteine and glycine including (Yadav et al. 2011), which increase collagen deposition at fracture position (Mali et al. 2007)

For breast milk secretion

Nutritional significance for breastfeeding mothers is well known with the seeds of garden cress. It aids the nursing mother in sustaining the flow and production of breast milk that is rich in protein and iron (Imade, Erinfolami, et al., 2018; Imade, Smith, & Gazal, 2018). Garden cress seeds have several properties, including being a tonic, demulcent, rubefacient, carminative, galactagogue, and emmenagogue. It has been found to help an average of 11 nursing mothers produce more milk throughout the postnatal period. Additionally, it is often recommended for those suffering from diarrhea or dysentery (Prajapati & Dave, 2018). Syphilis and Tenesmus may be treated with the root, which is bitter, caustic, and used as a condiment. Male aphrodisiac effects and an increase in testosterone concentration have been linked to garden cress, whereas female anovulatory and abortifacient effects have been linked to garden cress (Uphof, 1959).

Breast milk is an excellent source of nutrition and immune system support for infants. Graden cress seeds are excellent galactagogues, and their consumption is highly recommended for nursing mothers (Khan, 2018). Iron, protein, tocopherols, carotenoids, ascorbic acid, flavonoids, phytosterols, and amino acids like glutamic and aspartic acid are all abundant in the seeds. They are historically administered postpartum to encourage and boost breast milk secretion in nursing mothers because of these nutrients, which make them a galactagogue (Pattnaik, 2003; Singh *et al.,* 2015).

Its anti-diabetic effect

Garden cress seed extract is effective in the prevention and management of diabetes mellitus and related complications (Mishra et al. 2017). Eddouks et al. (2005) investigated the aqueous extract of GC seed had hypoglycemic effect in both streptozotocin induced diabetic rat and normal rat. Blood glucose levels were reduced in streptozotocin-induced diabetic rats after injecting 20mg/kg body weight of the extract. Since there were no changes observed in basal plasma insulin concentrations, the investigation concluded that the seed extract had a powerful hypoglycemic effect in rats independent of insulin secretion. This effect was attributed to the prevention of renal glucose reabsorption which decreases blood sugar. Shukla et al. (2012) studied the antidiabetic effect of the seed; alkaloid specifically lepidine and semilepidine. The antidiabetic potency of the alkaloids (50, 150 and 250mg/kg) was assessed on alloxan induced diabetic rats after 21days. Alkaloids at a dose of 250mg/kg showed potent hypoglycaemic activity than others. The potential antidiabetic effects of the alkaloids could be via reducing oxidative damage and modulation of the antioxidant enzymes. According to Mali et al. (2007) GC seeds also reduce starch hydrolysis by 41% when tested on type 2 diabetic patients, and the seeds were found significantly reduces glucose response to meals in both normal and diabetics. starch hydrolysis by 41% when tested on type 2 diabetic patients, and the seeds were found significantly reduces glucose response to meals in both normal and diabetics. The seeds of garden cress include antioxidants including tocopherols, carotenoids, and ascorbic acid, as well as alkaloids like glucotropaeolin and lepidine that have anti-diabetic effects. They have a hypoglycemic impact that is independent of insulin secretion, lower blood glucose levels, and help treat diabetes mellitus (Eddouks et al., 2002; Abdullah, 2007; Prajapati and Dave, 2018).

Effect on bronchial asthma/digestive functions

Sore throats, asthma, headaches, and coughing may be alleviated with the use of garden cress seeds. Due to the fact that it has the properties of a bronchodilator, it is recommended for patients with bronchitis (Imade, Erinfolami, et al., 2018; Khan, 2018). A study was conducted on 30 male and female patients aged 15–80 with mild to moderate bronchial asthma, excluding pregnant women. The patients were administered 1 g

of finely powdered seed powder orally, three times a day, for a period of 4 weeks. The spirometer results indicated significant improvements in several pulmonary functions during and after the study period, with no reported adverse effects among the subjects (Doke & Guha, 2014). Table 2 indicates that the ingestion of a large quantity of goiter can lead to hypothyroidism. Bioactive substances such N,N-dibenzylthiourea, leporine, N,N-dibenzyl urea, sinapic acid, and riboflavin are found in garden cress seeds. The seeds' ethanol extract helps prevent asthma by having a bronchoprotective effect against acetylcholine (ACh) (Paranjape and Mehta, 2006; Mali *et al.,* 2008). However, Lepidium sativum L. has demonstrated its effectiveness in treating bronchial asthma, hiccups, coughs with expectoration, and bleeding piles. Several

Ayurvedic practitioners have recommended the use of L. sativum seeds (Rehman et al., 2012). There are a variety of medical uses for the plant. Patients with bronchial asthma benefit from the diuretic and mildly stimulating properties of the leaves of this plant. L. sativum, on the other hand, has not been studied in terms of its ability to cure bronchial asthma (Chopra et al., 1986).

Antihypertensive, diuretic, nephron-curative and nephron-protective property

Maghrani et al. (2005) investigated the antihypertensive and diuretic effect of aqueous extract of GC seed with daily 20mg/kg oral administration for 3weeks in normotensive and spontaneously hypertensive rats (SHRs). The study report indicated that the extract showed considerable decrease in blood pressure in SHRs from day 7 until treatment completion, while no change was observed in normotensive rats. The study also reported, electrolytes excretion increased in SHR, but no significant change was examined in water excretion. On the other hand, Patel et al. (2009) compared the diuretic effect of aqueous (50mg/kg) and methanolic extracts (100mg/kg) of GC seeds and control group (10mg/kg of oral hydrochlorothiazide (diuretic drug) in orally administered rats. The finding of the experiment showed that urine volume and excretion of sodium was significantly increased in the extract fed groups. Potassium excretion was only increased in the aqueous extracts rats while no significant change recorded in pH of their urine. The diuretic effect of GC seed extract was equally effective with that produced by hydrochlorothiazide treatment. This effect could be due to stimulation of regional blood flow or initial vasodilation, thus, inhibit tubular reabsorption of water and anions to initiate diuresis: rise in sodium and water excretion.Moreover, Halaby et al. (2015) studied the nephroncurative and nephron-protective activity of GC seeds powder at 5 and 10% concentrations against cisplatin (anticancer drug) induced nephrotoxicity in male albino rats. Feeding of a basal diet enriched with the above seeds powder concentrations decreased bad cholesterols and improved good cholesterol level as well as decreased the level of kidney and liver functions tests (serum urea, serum creatinine and serum uric acid) against cisplatin which has renal failure effect. This could be due to an increment in the level of glutathione and reduced lipid peroxidation in both nephron-protective and curative groups. Hence, cisplatin depletes glutathione, raises thiobarbituric acid reactive substances and inhibits the activity of antioxidant enzymes in renal tissue (Yadav et al. 2011).

The antidiarrheal and antispasmodic effect

Manohar et al. (2009) examined the antidiarrheal activity of methanolic extract of GC seed at 50, 100 and 200mg/ kg doses using castor oil induced diarrhea model, charcoal meal test in mice and prostaglandin-E2 induced enteropooling in rats. Castor oil induced model showed a significant dose dependent reduction of cumulative wet fecal mass, whereas prostaglandin-E2 induced enteropooling model inhibited PG-E2 induced secretions and in the charcoal meal test, the movement of charcoal was decreased indicating its antimotility activity. The antidiarrheal effect of the seed extract may be resulted due to the inhibition of PG biosynthesis and/or decreasing the peristaltic movement (Manohar et al. 2009). However, the possible mechanism for the antidiarrheal activity is the combined blockade of both calcium channels and muscarinic receptors (Rehman, Mehmood, et al. 2012).

Hypocholesterolemic activity

According to a study conducted in hypercholesterolemic rats GC seed powder and its extract have a preventive effect (Kadam et al. 2012). Al Hamedan (2010) investi gated the effects of 5 and 10% of GC seed powder and its extract in hypercholesterolemic rats. Lower level of serum

triglycerides, cholesterol, very low-density lipo protein cholesterol, low-density lipoprotein cholesterol (LDL-c) level, cholesterol ratio to high density lipo protein cholesterol, creatinine, urea and liver cholesterol level were decreased compared to positive control group. The hypocholesterolemic effect of GC seed could be attributed to suppression of cholesterol biosynthe sis via inhibition of 3-hydroxy-3-methyl-glutaryl-CoA reductase, which is the rate-limiting enzyme that medi ates the first step in cholesterol biosynthesis (Mohamed & Safwat 2016). The hypolipidemic effect of GC seed also might be due to inhibition of absorption and enhanced excretion of lipids through the gastrointestinal tract (Chauhan et al. 2012).

Anticancer activity

Recent research suggests that garden cress may be used to combat cancer. This product includes antioxidants, including Vitamin A and Vitamin E, which protect cells from free radical damage. Additionally, it contains a bioactive compound that has been shown to inhibit the synthesis of enzymes that can lead to tumor growth. Studies have demonstrated that the injection of this compound is effective in killing breast cancer cells (Imade, Smith, & Gazal, 2018). Antioxidant, anti-inflammatory, and cancer-protective properties have been found in *L. sativum*'s phytoesterols as well as their metabolites (Singh et al., 2015). Phenolic chemicals, particularly flavonoids, may protect the human body against oxidative stress, which may contribute to cancer, aging, and cardiovascular illnesses. Tocopherols, carotenoids, eugenol, terpenoids, glucosinolates, phenolic compounds, omega-3 and omega-6 fatty acids, and other phytochemicals and antioxidants found in garden cress seeds contribute to the prevention of cancer. Omega fatty acids are particularly helpful in preventing breast cancer, while glucosesinolates function as secondary metabolites that prevent carcinogenesis (Kassie *et al.,* 2002; Gee *et al.,* 2002; Matthaus and Angelini, 2005; Barba *et al.,* 2016; Rajasekaran and Suresh, 2021).

For the treatment of iron-deficiency anemia

Research has shown that vitamic C supplementation helps improve iron absorption. It also boosts the digestive system's ability to absorb iron. Vitamin-C and iron-rich seeds of garden cress may be used to treat anemia or iron insufficiency without the need for additional supplements (Umesha & Naidu, 2015). In the stomach, L-ascorbic acid helps to increase iron absorption by building a chelate with ferric iron at an acidic pH. This makes the iron more soluble at the alkaline pH of the duodenum, where it is more easily absorbed. Improves hemoglobin levels and cures anemia by consuming Garden Cress seeds on a long term basis. Garden cress seeds have a high concentration of iron, which encourages the development of red blood cells (Falana et al., 2014). Garden cress seeds are helpful in raising hemoglobin levels and preventing anemia because they are a rich source of non-heme iron, as well as glutamic acid, aspartic acid, potassium, calcium, phosphorus, manganese, zinc, dietary fiber, and important fatty acids. Blood quality is improved by their hematic property (Monsen, 1988; Paranjape and Mehta, 2006).

Management of menstrual cycle disorders

Maintaining a regular menstrual cycle and having knowledge of the estimated date of conception are crucial for women throughout their lives. It is believed that the ingestion of garden cress seeds may assist in regulating menstrual cycles since the seeds contain estrogen-like chemicals (Diwakar et al., 2010). On the subject of garden cress seed and reproduction, there is a wide range of opinions. It is also missing information on effectiveness, safety and how it works. It is also unknown how it affects LH secretion and reproductive function within the mammalian species studied. Rats (1.6 mg/g BW) given garden cress seed powder for 14 days showed a mammogenic and lactogenic effect. Aside from that, the ovariectomized rats administered a methanolic extract of LS for 21 days showed proceptive and receptive properties when 200 and 400 mg/kg BW were provided orally. A similar effect on prolactin, progesterone, and luteinizing hormone in ovariectomized rats has been observed (Patel et al., 2009). Estrogenic qualities that aid in the appropriate control of the menstrual cycle are provided by flavonoids, glycosides, coumarins, glucosinolates, saponins, sterols, sinapic acid, tannins, triterpenes, uric acid, and volatile oils. Inducing menstruation by increasing blood flow in the uterus and pelvic region, garden cress also has emmenagogue properties (Pattnaik, 2003; Ghante *et al.,* 2011; Singh *et al.,* 2015).

INDUSTRIAL APPLICATIONS

Garden cress seeds acts as functional foods and act as medicine for fighting several health benefits and to prevent increasing state of diseases over the time. It has been sentenced that Garden cress seeds is used as traditional medicine since ancient times in our country (Mali *et al,.*2007). Stems, leaves and seeds of the garden cress are palatable and can be used in culinary purposes. These seeds fall under the category of functional foods that promote overall health and while keeping diseases at bay, apart from providing nutrition. In market, garden cress seeds are segmented into organic and conventional. The garden cress comes under food, pharmaceutical and cosmetic industry and therefore has wider scope if its market potential is explored. Its seeds have large application in food mainly used in salads, sandwich, can also be added in dishes for flavour. New products are developed by the fortification technique. (Singh and Paswan 2017). Stems, leaves and seeds of the garden cress are palatable and can be used in culinary purposes. Being functional food which is highly nutritious, their seeds can be incorporate into various recipes to improve nutritional status of population. Garden cress play a role in the medical field which provide various health benefits such as cardiovascular benefit, prevents osteoporosis, protects nervous system, antioxidant activity, chemoprotective effects and can act as a tonic against diarrhoea, dyspepsia, eye disease, leucorrhoea, scurvy, asthma, cough, cold and seminal weakness. (Singh & Paswan, 2017). Several awareness and promotional programs should be carried out among its target segment since the penetration of the product is comparatively very low. Its critical functions and properties of garden cress seeds are driving the demand for the product in the global market.

The approaches for researching the production of garden cress seeds products have been going on. In the market place garden cress seeds are displayed in the form of organic seeds or in conventional form. As rising demand of this seeds and continuous researches, they might introduce ready to eat food supply or seeds incorporated food products in the market which will be helpful for human health as well as innovation for food industry.

GARDEN CRESS SEED - BASED FOOD PRODUCTS

Various researchers have developed and examined a number of culinary products based on garden cress seeds. Hanan, Al Sayed, Zidan, and Abedelaleem (2019) reported on noodles reinforced with garden cress seed. Yadav, Singh, Sharma, Bhatt, and Govila worked with garden cress seeds to create instant mixes, cookies, and other convenience goods (2018). Lahiri and Rani (2020) investigated health drinks enhanced with garden cress seed. Bansal (2013) developed traditional items like pinni and burfi, whereas Nagi and Mann (2003) made panjiri using garden cress seed. Similarly, Chetana and Sukireddy (2011) standardized chikki, while Richa et al. (2017) developed laddu. Garden cress seeds were used to make contemporary baked goods including pizza, cupcakes, and biscuits. According to Sahloul et.al., (2023). Spreads, muffins, energy bars, and khakhra—the latter of which was the subject of a study by Solanke et.al. (2020)—are further possible uses.

CONCLUSION

With exceptional nutritional and medicinal potential, garden cress seeds (Lepidium sativum L.) are an underappreciated but extremely valuable functional food. Packed with proteins, minerals, vital fatty acids, and a variety of phytochemicals, they have a number of pharmacological actions, such as galactagogue, anti-inflammatory, anti-cancer, antibacterial, and antioxidant properties. Modern scientific research is increasingly supporting traditional purposes like enhancing lung health, mending fractures, and encouraging lactation. Additionally, adding them to high-value foods like laddus, cookies, noodles, and health bars improves consumer appeal and nutritional intake. Clinical trials on dose, bioavailability, and long-term safety are still scarce despite their many advantages, and further investigation is required to develop evidence-based dietary recommendations. Garden cress seeds have great potential as a sustainable food element for addressing nutritional deficiencies and preventing lifestyle-related illnesses because of its accessibility, affordability, and multipurpose qualities. Improving public health and nutrition security may be facilitated by raising knowledge of their use and developing creative products.

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