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RESEARCH ARTICLE

PHOTOCHEMISTRY AND THERAPEUTIC PROPERTIES OF BUNIUM PERSICUM (BOISS.): REVIEW

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Abstract

The seeds of Bunium persicum are commonly known as black cumin, black caraway, shahi zeera, and sayah zeera. In many food systems, these are used not only as flavor enhancers but also as a preservative. The main chemical components in seeds of B. persicum are, alpha-terpinen, limonene, dillapiole, p mentha 1, 4 dien 7 al, gamma terpenene, beta-pinene, phenolic compounds, fatty acids, carboxylic acids, and carbohydrates. B. persicum seeds possess multiple biological activities i.e.acetylcholinesterase inhibitory, antimicrobial, anticancer, antidiabetic, anticonvulsant, anti-inflammatory, analgesic, substances that are antihistamine, antidiarrheal, antispasmodic, antihematoxic, and anti-pancreatic lipase.

Introduction:-

As natural items, herbs and spices differ from person to person in their chemical composition, with uses ranging from energizing decoctions to the usage of herbal extracts in accordance with standard Western medical procedures. The history of traditional medicine is extensive. It encompasses all of the methods used preserve health, including illness prevention, diagnosis, treatment, and enhancement that are grounded in numerous cultures' thoughts, beliefs, and experiences. Although there are some differences Herbal therapy still has to be evaluated for effectiveness using the traditional trial approach in comparison to conventional pharmaceutical therapies. Numerous plant extracts have been shown to be effective for specific health issues. Research in this area has to be stepped up, nevertheless, because the public is frequently misinformed to think that herbal drugs are dangerous and that all-natural remedies are safe. An key unresolved issue in evaluating the numerous purported health effects of herbs and their extracts is the primary topic that has not been adequately addressed, which concerns the triad of absorption, metabolism, and effectiveness. Barkat et al (2011).1

The negative effects of anti-obesity medications can be reduced by using herbal remedies or chemical compounds from these remedies. Several clinical and animal studies were conducted using herbal remedies, and some of them showed a notable improvement in body weight control without any discernible negative effects (Gupta et al., 2012).2 Ayurvedic and Unani medicines have been used for centuries to treat obesity, but many of them have not been tested for safety and efficacy using contemporary scientific methods. Zeera arq is Among the most well-known conventional herbal treatments used to treat obesity. Zeera arq is aqueous decoction of four herbs and among which seeds of. Bunium persicum is one among the four. B. persicum seeds are used to treat digestive and urinary diseases, such as liver function, colic, diarrhea, dyspepsia, hysteria, heartburn, flatulent indigestion, stomatitis stimulant, and dyspeptic headache. Some of its numerous uses include anticonvulsant, anti-diabetic, anti-asthmatic, antispasmodic,

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antiepileptic, anti-obstruction, diuretic, and breast milk flow enhancer. therapeutic applications. (Miraj and Kiani, 2016; Gurpreet, et al .2002]. 3

Bunium persicum is herbaceous perennial geophyte. Bunium persicum (synonym: Carum carvi) are commonly called as Black Cumin, Siyah Jeera, Kala Jeera. It belongs to family Apiaceae or Umbelliferae which consists about 423 genus (Koul et al., 1979).4 The genus Bunium has roughly 166 species. It naturally grows in alpine and sub-alpine environments. Around the world, this plant is known by many distinct names, including " "Persian Cumin," "Zire Kuhn," "Shah zira," "Kala Zeera," "Jira," "Wild caraway," "Black caraway," "Black carvi," "Persian cumin," "Great pignut," and "Wild cumin." It is known as Kala Jira in Punjabi and Krishna ji in Sanskrit. Its name is Shahijirige in Kannada. It is called Kalijira or Himali Jira in Nepali. It is referred to as Kalazira in Urdu. Hassanzad et al., (2018) 5 .B. persicum is a valuable plant herbaceous spice that is one of the treasures of aromatic plants. It is found throughout regions with a Mediterranean climate, such as China, Iran, Turkey, Syria, Pakistan, Tajikistan, Afghanistan, North India (including Kashmir and Pamir), and some regions of Europe, Northern Africa, and South America. (Zahida et al., (2019) 6.

B. persicum is typically grown from subterranean tubers but occasionally it is also grown from seeds. The plant of B. persicum generally attains a height of 40 to 80 cm. It may or may not have one or more middle-branching stems. The inter-nodal area of the stem is hollow and has secretary conduits for resins and oils B. persicum leaves are filiform, broadly pinnate, and coarsely split (2–3).It features a umbel blossoming, a feature belong to umbelliferae family, with an 8 to 20 flower cluster with a convex or flat top that arises from a single apex. B. persicum flowers are zygomorphic, with five stamens that alternate with petals and five petals that are purple, pink, or white. The plant's fruit is a schizocarp, which is made up of two falciform meri-carps joined by a slender axial centre stalk. The petals are both bifid and free. 5 white, pink, or purple petals and five stamens that rotate with the petals make up the blooms. The fruits, which are more usually but incorrectly referred to as seeds, are brown to dark brown in colour, four to five mm long, and 0.8 to 1 mm in diameter (Bansal et al., 2021).7 The plant is perennial and has branches that can reach heights of 40 - 60 cm. The glandular root has an asymmetrical, spherical form. The leaf have a filiform shape and are freely pinnate and finely divided. The flowers are tiny, white, highly symmetrical, and have little sepals, petals, and stamens. They grow in tight umbel (Baser et al., (1997; Abduganiev et al., 1994; Bansal et al. 2021).8

Fig 1: Bunium persicum Seeds and Flower Bunium persicum Plant (a) (Mandegari et al., 2012)

Penology : Fruiting in September and October; flowering from late June to September. Zahida et al,. (2019).8

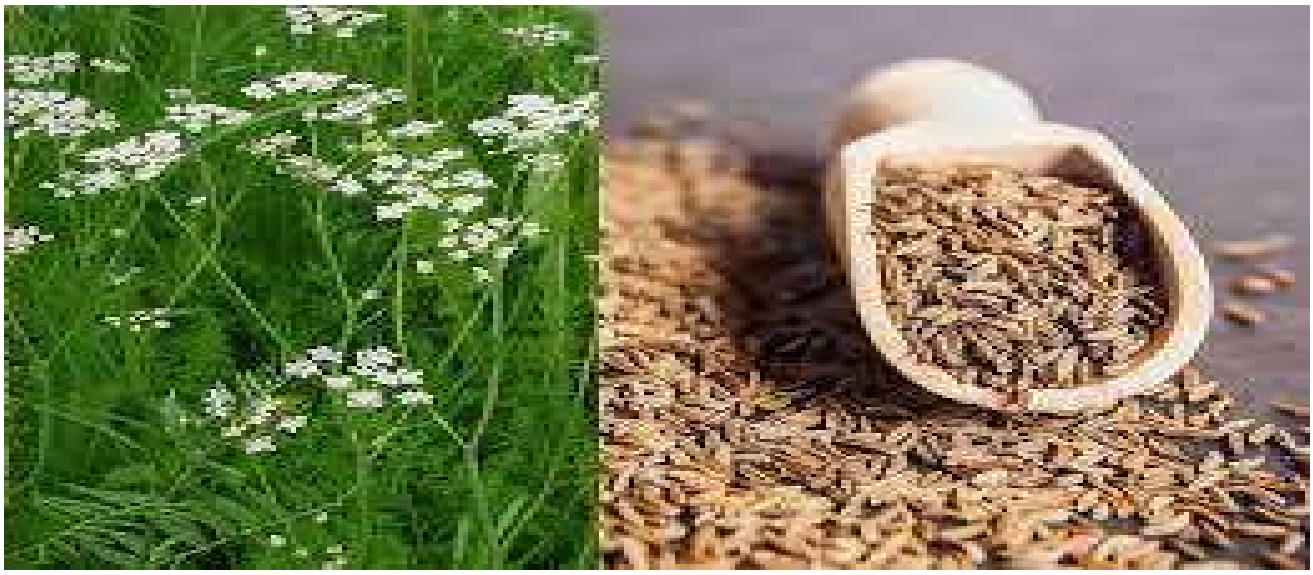

Fig 1 Bunium persicum

Geographical distribution:-

B.P. is a valuable herbaceous spice found in many aromatic plant treasures. It is a perennial herb with a pleasant odor that grows throughout the Mediterranean region, including parts of Europe, North Africa, South America, China, Iran, Turkey, Syria, Pakistan, Tajikistan, s

Phytochemistry:-

Phytochemical compounds from distinct B. persicum sections have been found . The main phytoconstituents found in B. persicum E.O. included Methatriene, p-cymene, limonene, caryophyllene, Crithmene , cuminyl acetate, cuminal , gammaterpene-7-al, trans-3-caren-2-ol, and ethanolic acid. (Zahida et al 2019).10 The dehydrated fruits of different Bunium persicum populations produced an average range. of 1.92-9.1% v/w in volatile oil .pinene , monoterpenes ethers , phenyl propenes, and sesquiterpenes are primary constituents of B. Persicum E.oil. Key components found in volatile oils include terpenoids (0.8–46.1%), cuminal (5.96–40.66%), and terpinene-7-al (0.4–37.2%). Amin et al (2011); Dehkordi et al., (2016). 11 The formic extract of B. persicum contains a variety of phenolic components, comprises flavonoids (kaempferol) and phenolic acids (coumaric acid, caffeic acid, etc).Rakhimov et al., (1984).12

S. no	Compounds	Mass	RT	% area
1.		136	4.65	7.32
2.		136	5.30	**89.82**

3.		136	5.679	75.3
4.		154	6.491	8.75
5.		232	7.141	18.5
6.		154	7.344	11.6
7.		154	7.520	5.68
8.		148	8.373	**81.67**
9.		148	8.400	**85.9**

10.		148	8.470	**96.7**
11.		150	8.910	**51.6**
12.		152	9.160	12.6
13.		166	9.28	7.64
14.		166	9.78	4.75
15.		164	10.70	9.45

16.		152	19.41	4.52
17.		148	19.84	3.49

(Fatma et al 2025.) Bunium persicum fruits have contain calcium oxalate, polysaccharides, volatile and fixed oils, and flavonoids. Khare .et al.,13 This species has a number of isolated compounds that have use in the pharmacopeial and antifungal industries. The goal of this research was to assess the level of variation in the essential oil components of Bunium persicum accessions that came from three different areas. Pulwama, Bandipora, and Kishtwar. The study populations' essential component of B. persicum essential oil were discovered to be γ-terpinene (26–28%) and cumin aldehyde (40–41%). As shown by the Pearson correlation coefficient, there was a highly significant positive association between p-Cymene and cumic aldehyde in the essential oil content of the different samples tested. Based on the essential oil content, the accessions were divided into three main categories. While the Kishtwar population had 81.99% activity with an overall average of 82.94%, the Pulwama and Bandipora populations showed minimal variance in antioxidant properties, ranging from 79.14% to 87.70%. The results of this study can be utilized to develop effective breeding plans for this species.

Lipids: lipids (10.5%) were separated from seeds, the following substances were found: petroselinic acid, both free and esterified; Sterols (0.4), free alcohols (tr.), free fatty acids (5.1), organic compounds (0.2), TAG.(66.0), Grease (0.1), and chlorophyll (0.1%). The roots held scopoleti, phytofluene, β-sitosterol, umbelliferone, and Glyceryl esters of fatty acids, both saturated and unsaturated. (Khan et al., 2016) 14.

Vitamins: Vitamin B6 0.360 mg, total reduce ascorbic acid 21.0 mg, thiaminium 0.3606 mg, vitamin B2 0.379 mg, Nicotinic acid 3.606 mg, folate 10 µg, vitamin A (RAE) 18 µg, v (IU) 363 IU, and tocopherols 2.50 mg Khan et al., 2016).15

Flavonoids: Bunium persicum fruits contain traces like Flavonoids including quercetin, kaempferol, and their glycosides . It has also been discovered that the flavonoids Quercetin 3-ocaffeylglucoside, kaempferol-3-glucoside, iso-quercitrin, and quercetin-3-glucuronides
are present in the roots of Carum carvi (Khan , et al 2016)16

Carbohydrate - The ethanolic extract of kala zeera present variety of carbohydrates, including Pectin compounds, water-soluble polysaccharides, and mono- and oligosaccharides, and hemicellulose. Glucose, fructose, mannitol, sucrose, and raffinose were among the mono- and oligosaccharides.(Rakhimov et al 1984).17

Medicinal uses of Bunium persicum:-

Traditional remedies for menstruation aches, spasms, and flatulence include B. persicum fruits. They are also used as antimicrobials. Kala zeera is used as medicine an antibacterial, stomachic, and carminative. According to a study on information from elderly people in Malakand, Pakistan, where the Unani system of medicine is more common. Low quantities (0.05, 0.1 mg/ml) of aqueous and hydro-alcoholic extracts from B. persicum fruits considerably stimulated the release of insulin from the isolated mouse Langerhans. This impact was similar to how glyburide 1 M and 10 M affected insulin secretion at 2.8 mM and 16.7 mM of glucose, respectively. 1 µM and 10 µM of glyburide had comparable effects on insulin secretion in glucose 2.8 mM and glucose 16.7 mM, respectively. According to a different study, α-amylase activity was significantly inhibited by the methanolic, ethyl acetate, and n-hexane extracts from B. persicum fruits (range of 40–72.3% percent inhibition at 250 µ). According to a different study, B. persicum' methanolic, ethyl acetate, and n-hexane extracts. (Giancarlo et al 2006).18 Natural substances, including medicinal plants, are increasingly being used in food to improve safety and shelf life. (Iacobellis et al., 2005).19 Bunium persicum seeds are well recognized for their Iranian traditional medicine's GIT , anti repertory , anti-convulsive, anthelmintic, anti-dyspnea, and antinociceptive properties. They have also long been used to treat urinary and intestinal diseases. As a carminative, the plant leaves and flower heads are used to cure headaches, stomach colds, joint discomfort, TB, fever, and other ailments can all be treated with fruit decoction in water, according to Zaman. et al., 2013; 20 Majidi et al., 2020.21 B.

persicum demonstrates anti-diabetic efficacy by drastically lowering total Triglycerides, low-density lipoproteins, and cholesterol in an aqueous ethanolic extract.with regard, it exhibits antimicrobial activity. Additionally, Aspergillus spp., S. cerevisiae, C. albicans, P. chrysogenum, and A. mali have been documented to exhibit antifungal activity. Using the DPPH assay, -carotene bleaching, and ammonium thiocyanate. Anopheles stephensi, the malaria vector, was tested for larvicidal efficacy against essential oil, extract and fractions of B. persicum. The essential oil, whole extract, petroleum ether fraction, and methanol fraction all demonstrated exceptional effectiveness against Anopheles stephensi larvae. The maximum inhibitory concentration (IC50) of B. persicum's methanolic extract was found to be around 45.7 g/ml when antioxidant activity was evaluated. (Sharifi-far et al 2010).22 In the Unani system of medicine (USM), the popular culinary spice kala zeera is an important therapeutic plant. , Hazim (digestive), Muqawli-e-Meda (stomachic), Kasir-i-Riyah (carminative), Qabiz (astringent), Muqawli-i-Jigar (hepatotonic), etc. are some of the pharmacological effects of Zeera siyah in USM . (Naquibuddin et al., 2021).23 It has been employed as a medicinal substance to treat a variety of illnesses. Due to its strong medicinal and antioxidant qualities, this plant has a lot of potential for usage in the food and medical industries. A thorough evaluation of the literature was carried out by looking for research in all pertinent, reliable scientific databases. B. persicum,Persian cumin, Zire kuhi, Shah zira, Kala Zeera, Jira, wild cumin, and wild caraway were all searched for in databases without restriction up to 10 November 2017. Based on the study to investigations, this plant and its derivatives are important substances with analgesic, antibacterial, anti-inflammatory, anti-diabetic, anti-hyperlipid, and antioxidant properties. High quantities of oxygenated monoterpenes with potent antibacterial and antioxidant qualities, such as limonene, γ-terpinene, cuminaldehyde, and ρ-cymene,are found in B.P.essential oil. The harmful consequences of Bunium persicum are not a serious issue because the plant is frequently utilized as a flavoring ingredient in people's diets. Hassanzadazar et al (2018). 24.Numerous isolated compounds from this species have potential use in the pharmaceutical sector and as antifungals. (Kareshk et al., 2015).25

Antihitamine activity - The antihistamine action was assessed using the Accumulative Accumulative log concentration-response curves of histamine of aqueous and macerated extracts and essential oil at 20 nM chlorpheniramine and saline. caused the solitary guinea pigs' tracheal chains to constrict. There has been an improvement in both maximal reaction and EC50 (effective histamine concentration causing 50% of maximum response). The results demonstrated that B. persicum exhibited a competitive antagonistic impact on histamine H1 receptors, an inhibitory effect on muscarinic receptors, and an activation of β-adrenergic receptors. (Boskabady 2004) 26

Anti-parasitic effects -The ethanolic extract of BP may have antiparasitic qualities, according to research. The results imply that BP could have significant antitoxoplasmosis properties. BP oil can be given orally as natural toxoplasmosis preventative treatment, according to a study done on mice with acute toxoplasmosis. (Kareshk et al.,2015 Results of Mahmoudvand et al. (2016) 27.

Anticancerous property - One of the most prevalent cancers worldwide is colon cancer. Diets rich in cumin have been shown to lower the histopathologic lesions brought on by 1,2-dimethylhydrazine and prevent colon cancer in rats. Alkaline phosphatase activity, neutral sterols, fecal bile acid, and aberrant crypt foci growth are also decreased.

(Deeptha et al., 2006; Kamaleeswari and Nalini, 2006)28 Monoterpenes with anticarcinogenic properties, including limonene, carvone, and anethofuran, are found in cumin essential oil. (Agrahari and Singh, 2014). 28 of Mahmoudvand et al. (2016) 29.

Anti-hyperglycaemic Activity –The extract of B. perscium may cause hypoglycaemia in insulin in type 1 diabetes in individuals because they either prevent glucose from being produced or promote its use in peripheral organs, particularly Both muscle and fat, these plants may have a hypoglycaemic impact. (Eddouks et al., 2003)30 Study based on diabetic rats, extracts of BP seed at different dosages significantly lowered insulin and glucose levels in comparison to animals in good condition. Oral administration of cumin extract significantly decrease blood glucose levels in diabetic rats without influencing plasma insulin levels, suggesting that its mechanism of action is not dependent on insulin production. (Eddouks et al., 2004) 31. The components of Strong antioxidant activity and protection against diabetes and its consequences are provided by black zeera, particularly flavonoids and carvone when taken as an aqueous extract. It has been discovered that BP water extract shields rats against kidney damage brought on by diabetes. (Sadiq et al., 2010).32

Gastrointestinal problems - Ninety-three patients with breast cancer underwent high emetogenic therapy participated in a randomized, double-blind, crossover clinical investigation. and experienced nausea and vomiting that was resistant to chemotherapy. Persumac, a combination of Rhus Coriaria and semi-ground zeera fruits, was given to the patients for seven days .They found that Persumac dramatically reduced the frequency and severity of nausea and vomiting. (Nazari et al 2017) 33

Toxicity -Various applications for B. persicum fruits and essential oil, and there have been no reports of any adverse effects from this plant. On the other hand, the literature on traditional medicine has linked long-term fruit intake to skin discoloration and weight loss. pregnant women should be cautious of B. persicum emmenagogue effects. The volatile oil of kala zeera has a substantial margin of safeness. Based on a study on poisoning that is acute. The harmful effects of BP essential oil and extract on mice was evaluated using intraperitoneal (I.P) injections of 0.75, 1, 1.25, and 1.75 ml/kg and 4 and 5 g/kg, respectively. Mortality and morbidity were determined after 24 hours. The results revealed that While the EO had no mortality up to 2.5 ml/kg, the extract had no mortality at a dosage of 4 g/kg but 16% at a dose of 5 g/kg.(Showraki et al., 2016).34

Cytotoxicity assay:-

The effect of ethanolic extract of B.persicum seeds on L6 myc cell lines was evaluated by MTT (3-(4, 5-dimethylthiazol-2-yl)-2, 5- diphenyl tetrazolium bromide) assay. L6 myc cells were seeded at 1×10^4 cells/well in a 96-well culture plate and allowed to get confluence. Cells were treated with different concentrations i.e. 10 µg/ml, 25 µg/ml, and 50µg/ml of plant extract (Black cumin), and incubated at 37°C for 24 h. after incubation, 10 µl of MTT solution (5 mg/mL in PBS) was added into each well, covered with aluminum foil, and incubated at 37°C for 4 h. Culture medium was aspired and 100µl DMSO was added to each well and incubated to dissolve the formazan crystals. The absorbance was measured at 570 nm using an ELISA plate reader. presents the effect of ethanolic extract of B. persicum seeds on L6 myc cell lines. The cytotoxic effect was monitored by uptake of MTT by L6 myc cells. . The cells were incubated for 24 hours with various concentrations of ethanolic extract i.e. 10 µg/ml, 25 µg/ml, and 50 µg/ml in the wells . As evident from the figure 1 that treatment of the ethanolic extract of B.persicum seeds at the concentrations ranging from 10 µg/ml to 50 µg/ml did not show any adverse effect on the viability of L6 myc cell and considered to be safe 50 ug concentrations. (Fatma et .al. 2025)

Conclusion:-

The phytoconstituents present in Cuminaldehyde, α -pinene beta myrcen, 3-carene, benzenemethaneamine, dl-limonene,1,8-cineole,gamma–terpinene,alpha-thujone, camphene, alpha terpinene, and 1,3,3-trimethylbicyclo(2.2.1) –heptan-2-ol,p-menth-2-en-1-ol. i.e. that, in addition to being affordable and free of adverse consequences, it can assist alleviate chronic diseases such as diabetes, cancer,gastrointestinal and autoimmune disorder , etc. The use of phytomedicine has attracted enormous scientific interest. In order to develop Bunium persicum as a potential herbal therapeutic candidate, additional research is required to identify the precise phytoconstituents that will target the particular Chronic condition**.**

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