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Studies and extraction of garden cress seed oil by different solvent

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Abstract
Garden cress (*Lepidium sativum* L.) belonging to Brassicaceae family is widely grown in India, Europe and US. It has been used as an important medicinal plant and the Garden cress seed also important and nutritive values was available in that studies determined physicochemical properties of garden cress seed carbohydrate, crude fat, protein, moisture, crude ash, crude fiber. Studies were conducted with the objective of extracting Garden cress seed oil from Garden Cress seed (*Lepidivm sativum*) using two different solvents i.e. petroleum ether and hexane. The extraction time and temperature were varied to determine the optimal conditions for solvent extraction of Garden Cress seed oil by using two different solvents Hexane and Petroleum ether. The peroxide value, free fatty acid, iodine value, saponification value of garden cress seed oil obtained from hexane solvent was higher than the solvent petroleum ether but the saponification value was obtained lower than hexane solvent in petroleum ether solvent The garden cress seed oil has a balanced amount of both polyunsaturated fatty acids and monounsaturated fatty acids and is a good source of linolenic acid. It contains natural antioxidants, viz. tocopherols and carotenoids and eugenol that help in preventing cancer and protect the oil from rancidity. Its seed, oil and powder contain significant amount of protein, fat, minerals, fibers and phytochemicals.

Keywords: Garden cress seed, garden cress seed oil, soxhlet extraction, hexane, petroleum ether

Introduction
Garden cress (*Lepidium sativum* L.) is a fast growing annual herb, native to Egypt and west of Asia and presently it is cultivated all over the world. In local languages garden cress (GC) is also known by Chandrasur and it is considered as an important medicinal crop in India. Garden cress seeds (*Lepidium Sativum*) belong to the family Brassicaceae (Cruciferae), believed to have originated primarily in highland regions It is originated in Egypt and West Asia, is widely cultivated in all parts of the world with hot and temperate climate (Singh, *et al.*, 2017) [13]. Garden cress main character is that it can grow in any type of climate and soil condition and its ability to tolerate slight acidity; it can be grown like white mustard. It's an annual plant of a height of 50 cm that can grow easily using less irrigation, equipment's facilities, and in comparatively weak soil without having special technical knowledge. It's easy cultivation and it's tolerance to different environmental conditions gave it the ability to spread all around the world. Garden cress leaves are consumed raw in salads, also cooked with vegetable curries and used as garnish. Cautions should be taken with storing raw collected cress, with any sign of slime, witting or discoloration it should be avoided. Until they're needed for use, the leaves should be left on stem (Falana, *et al.*, 2014**).** Morphology of garden cress seed are small in size, oval in shape, pointed and triangular at one end, smooth, about 3-4 mm long, 1-2 mm wide, reddish brown in color. A furrow present on both surfaces expending up to two thirds downward, a slight wing like extension present on both the edges of seed. On soaking in water seed coat swells and gets covered with transparent, colorless, mucilage with mucilaginous taste. The seed length and width are 298- 300 µm and 100 -109µm respectively. Garden cress seed have also been used as a popular medicinal herb in Arabian countries (Gaafar *et al*, 2013) [5]. Seeds are also rich source of omega 3- fatty acid, which helps to lower cholesterol in hyper cholesterolemic patients. The nonconventional foodstuff namely garden cress seed was processed and the resultant processed version were analyzed for proximate principles, minerals and antinutrients. The Garden cress is widely used in medicine as well as cooking. The seeds are the major part of the crop, commonly used. They are small, brownish red in color, oval in shape, triangular and pointed at one end and smooth in texture (Singh, *et al.*, 2017) [13]. Garden cress seeds are used in the form of vegetable in Europe and America; the seeds are harvested for food purpose in several parts of India (Gokavi, *et. al.*, 2004) [6]. Garden-cress seeds are used as a medicine in India in the system of "*Ayurveda*". Also it has health promoting properties which can be used as a functional food.

(Kasabe, *et al.*, 2012) [7]. Garden cress seeds are richest source of protein (25-39 per cent) and minerals (6.4 percent) like calcium, iron and phosphorous. Germinated garden cress seeds can be cheap and more effective in improving anemia in anemic adolescent girls. Therefore, some food products were developed by incorporating germinated seeds of *L. sativum*. In recent year efforts are made to develop human diets in such a way that it acts as medicinal foods in order to exploit several health benefits and to prevent increased diversity of diseases (Singh, *et al.*, 2014) [12]. Garden cress seeds are used in South Asia as traditional medicine to treat bronchitis, asthma and cough. It is considered diuretic, expectorant, aphrodisiac, antibacterial, gastrointestinal stimulant, gastro protective, laxative and stomadic (Doke, *et al.*, 2014) [3]. The edible whole seed is known to have health promoting properties as it contains 25-39 per cent of protein. 33% percent carbohydrate, 2.4per cent crude fat, 7.6% crude fiber and 6.4% minerals, iron (100%) (Kaur, *et al.*, 2015) [3]. The major fatty acid present in garden cress seeds are alpha-linolenic acid (34.0%) and also contains monounsaturated fatty acids (37.6%), polyunsaturated fatty acids (46.8%) and antioxidants such as tocopherols and carotenoids (Kaur, et al., 2016). Garden Cress Seeds (*Lepidium Sativum*) are very high in iron and folic acid content. These seeds are used as herbal medicine to treat iron deficiency anaemia because 100 g of Garden Cress Seed provide 100 mg of iron (Sheeba, *et al.*, 2016) [11]. Garden cress oil has Linoleic acid: Linolenic acid (LA: ALA) ratio in the range of 1:4–2:3, which could give it nutritional advantages over the currently available ALA-rich plant oils in altering the n- 6/n-3 ratio in vivo (Yenge, *et al.*, 2017) [14]. Despite its medicinal value and one of the best sources of ALA, garden cress seed oil (GCO) has not received much attention (Diwakar, *et al.*, 2007). The composition and some physicochemical properties of the oil extracted from L. sativum seeds. The seeds contained 26.77% (w/w) crude oil. The LSO also showed very low kinematic viscosity (15.41 mm2/s) compared to that reported for soybean, sunflower, and Jatropha oils, which ranged from 30 to 40 mm2/s at 40 ºC. The LSO contained high percentages of polyunsaturated (42.23%) and monounsaturated (39.62%) fatty acids. the potential to be used as a raw material for biodiesel production Nehdi *et al.*, (2012) [9]. The selection of solvent for oil extraction was done on the basis of soxhlet extraction. The n-hexane was the best solvent than other solvents used like petroleum ether, ethanol and carbon tetrachloride. The maximum yield achieved was 46% of with n-hexane and minimum yield achieved was 41% of with carbon tetrachloride of sesame seed (Chakraborty, *et al.*, 2017) [1]. The comparison between different techniques of oil extraction and solvents used. The results reveal that extraction by Soxhlet method yield oil in the range of 53 to 78%. This value was taken as 100% recovery of oil, while calculating the oil recovery by other methods. Soxhlet extraction is better when compared with other methods, because the process is continuous and there is complete oil recovery (Patel, *et al.*, 2011) [10].

The method that is mostly used for extracting oil from oilseeds is a petroleum distillate that contains a mixture of isomers of hexane (boiling points between 65 to 71°) industrially known as n-hexane. N-hexane can contain from 45 to 70% n-hexanes, as well as methylcyclo-pentane, 3-methylpentane, 2-methylpentane and cyclon-hexane when comparing the yields of cottonseeds solvent extraction using hexane and ethanol at different temperatures, that higher efficiency was obtained using the renewable source ethanol as a solvent at higher temperatures. When performing extraction with two different solvents (ethanol and hexane) and by pressing of physic nut seeds, concluded that extraction with ethanol as a solvent enabled higher yield when compared to pressing and no difference was found in the composition of the oil when using ethanol and hexane as solvents. (Reginaldo, *et al.*, 2013)

Extraction of oil from garden cress seed

Oil was extracted from Garden cress seed 10 g of sample was placed in a thimble and extracted with the extract or hexane or petroleum ether as a solvent. The solvent was taken in the round bottom flask and heated a heating mantle. The temperature was On the boiling point of the solvent 40 ºC – 60 ºC for hexane and 60 ºC -80 ºC for petroleum ether. The vapors of the solvent were condensed and used to extract oil from the sample. The extracted oil was then removed under reduced temperature and pressure and refluxed at 60 ºC to remove excess solvent used in the oil. Extracted oil was stored in ambient temperature for subsequent physicochemical analysis. The process flow chart for extraction of Garden cress seed is shown figure.

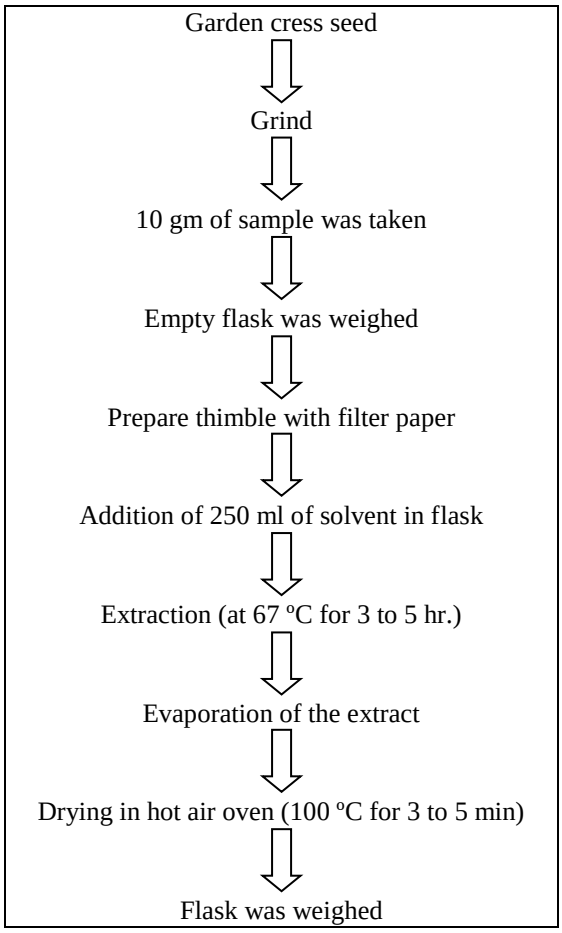

Fig 1: Process flowchart for extraction of garden cress seed oil

Sample was dried in an oven at 60 ºC for 30 min. Then the sample was removed from the oven and cooled in desiccators and weighed. 10 gm sample was weighed accurately and taken on the filter paper and it was completely wrapped up by the paper before put in to the thimble. Extract solution was added in to extraction flask about 250 ml and connected them to the soxhlet apparatus system. Moving the handle up to boiling position and extraction was carried for different time period i.e. 3 and 4 hr. and it was moved down to rinsing

position was done for recovery of solvent for time 30 to 45 min. Extract solution was evaporated and condenser valve was closed. Extraction flask were dried in hot air oven at 100 ºC for 30 min. Removed and cooled in desiccators and weight.

Results And Discussion

Physico-chemical properties of garden cress seed

In order to characterize Garden Cress seeds, the different physico-chemical parameters viz. color, shape, 1000 kernel weight, and the chemical properties of garden cress seed carbohydrate, protein, crude fiber, moisture, crude ash, crude fat, etc. were measured and the data is presented in Table1. The fruits were globs, 1.2 cm across, and purple black with hard ribbed endocarp. The seeds were small, oval-shaped, pointed and triangular at one end, smooth, about 2-3 mm long, 1-1.5 mm wide, reddish brown to almost black (Falana, *et al*., 2014).

Table 1: Physical parameters of Garden Cress seed

Physical parameters	Mean value
Color	Dark brown
Shape	Oval
1000 kernel weight (g)	1.91

*Each value represented the average of three determinations.

Chemical composition generally represents the nutritional quality of the product. It is necessary to observe the chemical properties of Garden cress seed as to judge the effect of the final product after extraction as a novel ingredient. The chemical properties of Garden cress seed was determined and presented in Table 2.

Table 2: Chemical properties of garden cress seed

Properties of Garden cress seed	Value
Carbohydrate	10.4
Crude Fat	24.3
Protein	29.2
Ash	4.5
Moisture Content	3.1
Crude Fiber	14.2

*Each value represented the average of three determinations.

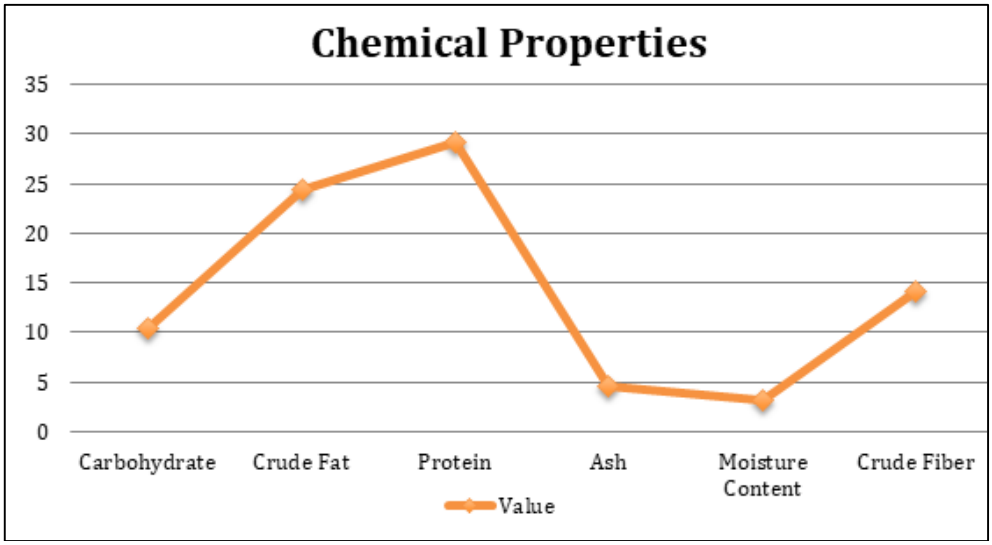

Fig 1: Chemical Properties

The result shows that the carbohydrate, crude fat, protein, moisture, crude ash, crude fiber of Garden Cress seed was determined.

This value was compare to the moisture content of Garden Cress seeds was found as 3.2 per cent on dry basis while protein and fat content were recorded 25.3 and 24.5 per cent respectively. The fiber and mineral content was estimated at 7.6 and 6.4 per cent respectively whereas total carbohydrate by difference was calculated as 33 per cent. The composition and some physicochemical properties of the oil extracted from *L. sativum* seeds. The seeds contained 26.77% (w/w) crude oil (Nehdi *et al*., 2012) [9].

Physical properties of garden cress seed oil

The extracted Garden Cress seed oil was tasted for various physical properties with different solvents. The data describing physical parameters by using hexane and petroleum ether solvent are presented in table 3.

Table 3: Physical Properties of Garden Cress seed oil by hexane and Petroleum ether solvent

Properties	Value (Hexane solvent)	Value (Petroleum Ether Solvent)
Viscosity	52.9	50.1
Specific Gravity	0.90	1.01
Refractive Index	1.25	1.3
Color	Dirty Yellow	Dark Yellow

*Each value represented the average of three determinations.

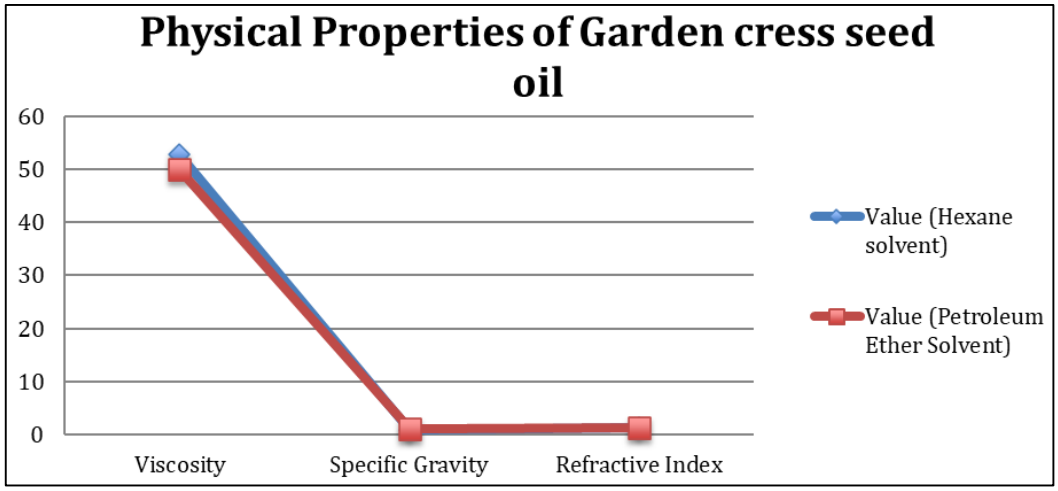

Fig 2: Physical Properties of Garden cress seed oil

Physical properties like viscosity, specific gravity, refractive index, color, are important during the development of food products, because these properties may affect the different quality parameters of the developed products. The color obtained by solvent hexane and petroleum ether was dirty yellow and dark yellow respectively. The color of the garden cress oil is dirty yellow, which is mainly due to the presence of some pigments like chlorophyll and carotenoids, unintentionally co-extracted during the oil extraction process (Singh *et, al* 2014) [12].

The viscosity, specific gravity, refractive index of garden cress seed oil by hexane and petroleum ether solvent presented in table 3. As compare Viscosity of the GCSO ranges from 53.8 to 64.3, High refractive index value (1.47±0.03) is indication of substantial unsaturation and presence of unusual components such as hydroxyl groups in GCSO, Specific gravity of garden cress seeds (0.91) resembles with the specific gravity value of milk (Singh *et, al* 2014) [12].

Chemical properties of garden cress seed oil

Chemical properties help in determining the stability of the GCSO and the developed blended products. It also helps in determining the shelf life of the food products. The analyzed properties of garden cress seed oil are peroxide value, free fatty acid, iodine value, saponification value and saponification value obtained by solvent hexane and petroleum ether was presented in table 4.

Table 4: Chemical Properties of Garden Cress seed oil by hexane and Petroleum ether solvent

Properties	Value (Hexane solvent)	Value (Petroleum Ether Solvent)
Peroxide value	4.03	3.9
Free Fatty Acid	0.41	0.37
Iodine value	125	122
Saponification value	182.5	170.2
Unsaponification Value	1.41	1.71

*Each value represented the average of three determinations.

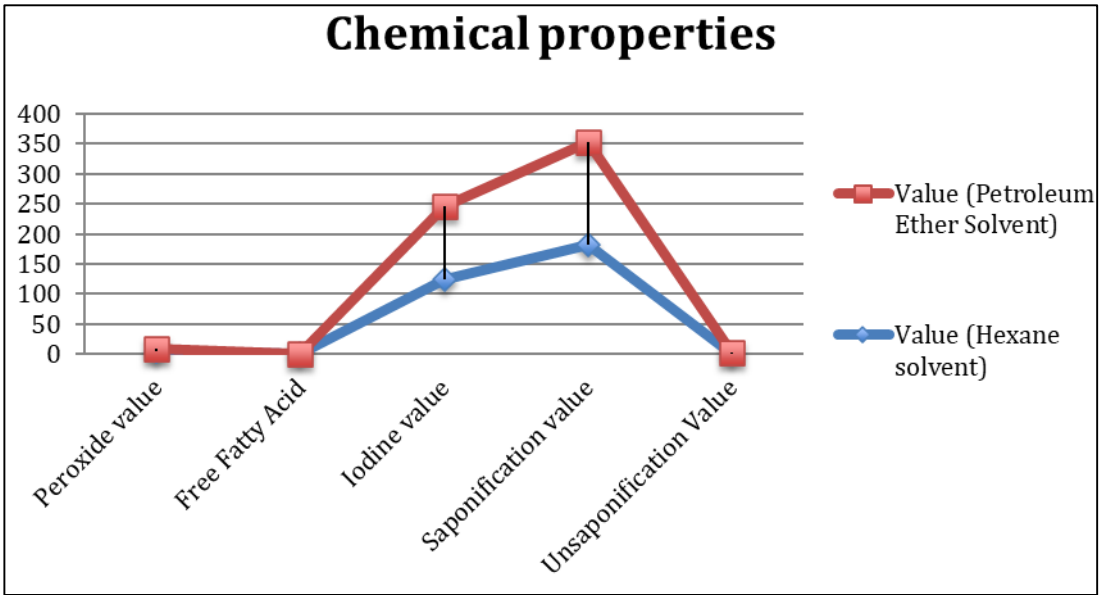

Fig 3: Chemical properties

The peroxide value, free fatty acid, iodine value, saponification value of garden cress seed oil obtained from hexane solvent was higher than the solvent petroleum ether but the saponification value was obtained lower than hexane solvent in petroleum ether solvent in table 4. Soxhlet extracted oil showed lower FFA values. The acid value of GCSO is in range with the specifications of edible oils (0.1–6.0 % of oleic acid). The high PV in soxhlet-extracted oil could be due to the exposure of the oil to high temperature (60–80 ºC) during extraction.

Conclusion

The content of biologically active compounds, as well as the antioxidant capacity of *L. sativum* L. has been investigated by several researchers and their findings indicated that seeds of garden cress plants are good source of carbohydrate, crude fat, protein, moisture, crude ash, crude fiber and have the ability to act as *in vivo* as well as *in vitro* antioxidants due to their high content of phenolic compounds. The Garden cress seed are the higher percent of alpha-linolenic acid, and more percent of iron. So concluded that the consumption for iron defiency dieses like asthma, anemia etc.

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