Nutritional Significance and Usage of Garden Cress Seeds (*Lepidium sativum L*) - A Review

Vaijayanthi Kanabur1, Sharavathi V1*

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ABSTRACT

Garden cress seeds are traditionally used in some geographic regions as functional food. In some parts of India, it is given to pregnant and lactating mothers as milk-based beverage. It is used in salads, soups and smoothies in western countries. Although garden cress seeds packed with nutrients, comprehensive research on all the nutrients information (both macro and micro nutrients) was needed. Understanding the nutritional benefits can help in development of food products and extending the usage to other geographical areas. The present review tries to explore the nutritional composition of this less familiar food. 100 g of garden cress seeds provide 445.18 kcal of energy, 24.11 g protein, 24.12 g fat, 9.01 g fiber. In addition, Garden cress seeds also provide calcium (320.45 mg/100g), magnesium (353.87 mg/100g), phosphorus (619.82 mg/100g), potassium (1141.67 mg/100g) and iron (11.70 mg/100g). Many food scientists have incorporated the seeds in local recipes and they are found to be acceptable by the sensory panel. Scaling up and commercialization of these products is needed to popularise the usage of these seeds. As garden cress seeds are rich in micronutrients and help in combating micro nutrient deficiency.

Keywords
Cress Seeds, Nutritive Value, Usage, Traditional Dish

INTRODUCTION

Garden cress is an annual, fast-growing edible herbaceous plant that belongs to the Brassicaceae family and hence shares many characteristics with mustard and watercress1. There are 12 different species of garden cress seeds of which *Lepidium sativum L* is commonly used2. Garden cress plant is cultivated in India, North America, parts of Europe and it is native to southwest Asia and Egypt3. Garden cress can be grown and harvested at any time of year, but the months of January, February, and November are the best for sowing in a Mediterranean climate4. Garden cress grows very quickly in the early spring season5. The plants are ready to cut in 15 to 20 days after seeding6. It’s a glabrous, upright, branching plant. Seeds are small, oval-shaped, pointed, triangular at one end, smooth, about 2-3 mm long and 1.5 mm wide, reddish-brown, with an arrow present on both surfaces, reaching up to two-thirds downwards, and slight wing-like extension present on both edges of seed when soaked in water (Fig 1)7. Micropyle and groove in between can be observed in the lateral and dorsal aspects of the seeds8. Seeds display testa, radical, and cotyledon in both transverse and longitudinal sections9. The cotyledon, radical, and superior portion lobes of the cotyledon are visible in the embryo. The crop is mostly grown for seeds10. The methodology used for this study was online search from the secondary sources. Research publications of last 20 years were reviewed for the study.

**Figure 1:** Dry Garden Cress Seeds & Soaked Garden Cress Seeds for 12-hours

**Nutritional Composition of garden cress seeds**

**Macronutrient Composition**

The macronutrient composition of garden cress seeds is presented in Table 1. On an average garden cress seeds provide 445.18 kcal/100g of energy2. The protein content varies from 22 to 25.5 g/100g3. It is also a good source of fat (24.12 g/100g) and dietary fiber (9.01 g/100g)4. The low moisture content is responsible for its stability, quality, and also good shelf life5. Macronutrient composition varies depending upon plant variety, agronomic practices and stage of harvest, climatic and geographical condition of the area from where seeds are collected6.
Table 1: Macro Nutrient Composition of Garden Cress Seeds

| Sl.no | Macro Nutrient | Per cent of macronutrient composition /100g |
|-------|----------------|------------------------------------------|
|       | Kumar Neeraj et.al. (2016) | Sanchita Sarkar et.al. (2014) | Baswathi Lahiri et.al. (2020) | Tanu Jain et.al. (2016) | Varsha Rani et.al. (2020) | IFCT (NIN 2017) | Average Value |
| 1. | Moisture (%) | 2.88 ± 0.1 | NA | 2.9 | NA | NA | 4.60 | 3.75 |
| 2. | Energy (Kcal) | 428.4 | 454.5 | NA | 454 | 442 | 447 | 445.18 |
| 3. | Carbohydrate (g) | 30.74 ± 1.2 | 33.0 | 30.7 | NA | 33.66 | 33.66 | 32.76 |
| 4. | Protein (g) | 24.19 ± 0.5 | 25.5 | 24.2 | 22-26 | 23.36 | 23.36 | 24.11 |
| 5. | Fat (g) | 23.19 ± 0.2 | 24.5 | NA | 24.5 | 23.74 | 23.74 | 24.12 |
| 6. | Dietary fiber (g) | 11.9 ± 0.4 | 7.6 | 11.9 | NA | 8.27 | 8.27 | 9.01 |

Amino Acid Composition

The amino acid composition of garden cress seeds is presented in Table 2. Both essential and non-essential amino contents per 100g are shown in Table 2. The glutamic acid varies from 19.33 to 24.29g/100g and aspartic acid varies from 9.76 to 12.07g/100g. In addition, studies have shown that it aids in digestion and acts as a fat burner.

Research has shown that the amino acid content was reduced on heating and there was maximum retention of amino acids in the case of soaked garden seeds (Tanu Jain et.al 2016).

Fatty acid composition

Fig 2 shows that garden cress seeds have a good amount of Mono Unsaturated Fatty Acids (27.84 per cent) and Poly Unsaturated Fatty Acids (34.69 per cent).

Table 2: Amino acid Composition of Garden Cress Seeds

| Sl.no | Amino Acid | Per cent of amino acid composition (g/100g) |
|-------|------------|-------------------------------------------|
|       | Kumar Neeraj et.al. (2016) | Baswathi Lahiri et.al. (2020) | Varsha Rani et.al. (2020) | IFCT (NIN 2017) | Average Value |
| 1. | Histidine (g) | 3.87 | 3.87 | NA | 2.62 | 3.45 |
| 2. | Isoleucine (g) | 4.19 | 5.11 | NA | 3.75 | 4.35 |
| 3. | Leucine (g) | 7.03 | NA | NA | 6.58 | 6.81 |
| 4. | Lysine (g) | 5.98 | 6.26 | 6.26 | 3.85 | 5.59 |
| 5. | Methionine (g) | 0.51 | 0.97 | 0.97 | 1.85 | 1.08 |
| 6. | Tryptophan (g) | 0.92 | NA | NA | 1.24 | 1.08 |
| 7. | Phenylalanine (g) | 5.39 | 5.67 | 5.67 | 3.89 | 5.15 |
| 8. | Threonine (g) | 3.76 | 2.66 | NA | 3.15 | 3.19 |
| 10. | Valine (g) | 6.21 | 3.04 | NA | 4.69 | 4.65 |
| 11. | Alanine (g) | 4.59 | 4.83 | NA | 5.33 | 4.92 |
| 12. | Arginine (g) | 3.44 | 4.51 | NA | 10.67 | 6.21 |
| 13. | Aspartic acid (g) | 12.07 | 9.76 | NA | 10.29 | 10.71 |
| 14. | Cystine (g) | 0.21 | NA | NA | 1.23 | 0.72 |
| 15. | Glutamic acid (g) | 24.29 | 19.33 | NA | 21.34 | 21.65 |
| 16. | Glycine (g) | 5.08 | 5.51 | NA | 5.22 | 5.27 |
| 17. | Proline (g) | 4.63 | 5.84 | NA | 4.37 | 4.95 |
| 18. | Serine (g) | 4.18 | 4.96 | NA | 4.99 | 4.71 |
| 19. | Tyrosine (g) | 2.88 | 2.69 | NA | 3.47 | 3.01 |

Figure 2: Fatty acid composition of the garden cress seed oil.

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Vitamin Composition

The Vitamin composition of garden cress seeds is presented in Table 3. It provides B-complex vitamins. On an average the biotin content is 8.66 mg/100g and folate content is 30.92 µg/100g. Riboflavin content varies from 0.51 to 14.3 mg/100g and niacin content varies from 0.61 to 14.3 mg/100g.

Table 3: Vitamin Composition of Garden Cress Seeds

| Sl.no | Vitamin          | Kumar Neeraj et.al. (2016) | Sanchita Sarkar et.al. (2014) | Baswathi Lahiri et.al. (2020) | Tanu Jain et.al. (2016) | Varsha Rani et.al. (2020) | IFCT (NIN 2017) | Average Value |
|-------|-------------------|-----------------------------|-------------------------------|-------------------------------|-------------------------|--------------------------|----------------|---------------|
| 1.    | Thiamine B1 (mg)  | NA                          | 0.59                          | NA                            | 0.59                    | NA                       | 0.52           | 0.57          |
| 2.    | Riboflavin B2 (mg)| NA                          | 14.3                          | NA                            | 0.61                    | NA                       | 0.15           | 5.02          |
| 3.    | Niacin B3 (mg)    | 0.61                        | NA                            | 14.3                          | NA                      | 5.67                     | 6.86           |               |
| 4.    | Pantothenic acid B5 (mg)| NA | NA | NA | NA | NA | 8.66 | 8.66 |
| 5.    | Total B6 (mg)     | NA                          | NA                            | NA                            | NA                      | NA                       | 0.05           | 0.05          |
| 6.    | Biotin B9 (mg)    | NA                          | NA                            | NA                            | NA                      | NA                       | 8.66           | 8.66          |
| 7.    | Folate (µg)       | NA                          | NA                            | NA                            | NA                      | NA                       | 30.92          | 30.92         |
| 8.    | Carotene (µg)     | 27                          | NA                            | NA                            | NA                      | NA                       | NA             | 27            |

Mineral Composition

The mineral composition of garden cress seeds is presented in Table 4. The amount of ash content shows that seeds are a good source of minerals. On an average it is evident that garden cress seeds contain a good amount of potassium (1141.67 mg/100g), phosphorous (619.82 mg/100g), magnesium (353.87 mg/100g), and calcium (320.45 mg/100g). The iron content varies from 8.31 to 17.20 mg/100g. The quantities of these minerals vary based on species.

Table 4: Mineral Composition of Garden Cress Seeds

| Sl.no | Mineral          | Kumar Neeraj et.al. (2016) | Sanchita Sarkar et.al. (2014) | Baswathi Lahiri et.al. (2020) | Tanu Jain et.al. (2016) | Varsha Rani et.al. (2020) | IFCT (NIN 2017) | Average Value |
|-------|------------------|-----------------------------|-------------------------------|-------------------------------|-------------------------|--------------------------|----------------|---------------|
| 1.    | Ash              | 7.1 ± 0.1                   | NA                            | 7.1                           | NA                      | 6.37                     | 6.37           | 6.61          |
| 2.    | Calcium (mg)     | 266.35                      | 377                           | 266.35                        | 377                     | 318                      | 318            | 320.45        |
| 3.    | Iron (mg)        | 8.31                        | 12.1                          | 8.31                          | 12.1                    | 12.20                    | 17.20          | 11.70         |
| 4.    | Magnesium (mg)   | 339.23                      | NA                            | 339.23                        | NA                      | 430                      | 307            | 353.87        |
| 5.    | Manganese (mg)   | 2.00                        | NA                            | 2                             | NA                      | 2                        | 2.87           | 2.29          |
| 6.    | Copper (mg)      | 5.73                        | NA                            | 5.73                          | NA                      | NA                       | 0.51           | 3.99          |
| 7.    | Phosphorus (mg)  | 608.63                      | 723                           | 608.63                        | NA                      | NA                       | 539            | 619.82        |
| 8.    | Zinc (mg)        | 6.99                        | NA                            | 6.99                          | NA                      | 4.83                     | 4.83           | 5.91          |
| 9.    | Selenium (mg)    | NA                          | NA                            | NA                            | NA                      | 54.41                    | 54.1           | 54.26         |
| 10.   | Potassium (mg)   | 1236.51                     | 1236.51                       | NA                            | NA                      | 952                      | 952            | 1141.67       |
| 11.   | Sodium (mg)      | 19.65                       | 19.65                         | NA                            | NA                      | 21.84                    | 21.84          | 20.38         |

Usage of garden cress seeds

Traditionally in parts of South India, it is consumed as a milk-based beverage by pregnant and lactating mothers. Tanu Jain et.al. (2016), Tanu Jain and Kiran Grover (2017), Shekhar Naik R et.al. (2020) have incorporated garden cress seeds in pinni, a Punjabi dessert prepared using wheat flour, green gram flour, and jaggery, panjiri a Punjabi dessert prepared using wheat flour and jaggery, chikki prepared using peanut and jaggery syrup, burfi prepared using Bengal gram flour and sugar syrup, ladoo prepared using wheat flour, Bengal gram flour, and ground sugar, biscuits prepared using wheat flour and butter, burfi prepared using coconut, milk, and jaggery. Snehal Mohite et.al. (2012) have developed a healthy drink prepared using skimmed milk with varying levels of garden cress seed powder (1-5 per cent) concentration. Angel and Vasantha Devi (2015) have developed laddu prepared using rice flakes, bajar, roasted Bengal gram dal, samai, and jaggery and garden cress seeds. Varsha Rani et.al. (2020) have developed muffins by incorporating garden cress seeds. Germinated garden cress seeds incorporated in local side dishes such as a sandwich,
raitha, soup, salad, bhujia were developed by Mamta Sharma (2015) were evaluated by a sensory panel. Mathri, a Rajasthani snack, flaky biscuits prepared using wheat flour, pearl millet flour, and rice flakes were developed by Priyanshu Tripathi et al. (2017) by incorporating 10 to 30 per cent garden cress seeds. The level of incorporation and maximum accepted level of incorporation of garden cress seeds (per cent) in dessert/side dish/snack products are shown in Table 5 and Table 6. The products were found to be acceptable by the sensory evaluation panel.

Table 5: Garden Cress Seeds Incorporated in Traditional Drink/Desserts

| Sl.no | Desserts                                      | Level of incorporation garden cress seeds (Per cent) | Maximum Accepted Level of Incorporation (Per cent) |
|-------|----------------------------------------------|--------------------------------------------------|--------------------------------------------------|
| 1.    | Health drink (SnehalY Mohite et.al. 2012)    | 1-5                                              | 3                                                |
| 2.    | Ladoo (M. Angel and K.P Vasantha Devi 2015)  | 10                                               | 10                                               |
| 3.    | Pinni (Tanu Jain et.al. 2016)                | 5, 10,15                                         | 10                                               |
| 4.    | Panjiri (Tanu Jain et.al. 2016)              | 5, 10,15                                         | 10                                               |
| 5.    | Laddu (Tanu Jain et.al. 2016)                | 5, 10,15                                         | 10                                               |
| 6.    | Burfi (Tanu Jain et.al. 2016)                | 5, 10,15                                         | 10                                               |
| 7.    | Chikki (Tanu Jain et.al. 2016)               | 15, 20,25                                        | 10                                               |
| 8.    | Biscuits (Tanu Jain et.al. 2016)             | 5, 7.5, 10                                       | 25                                               |
| 9.    | Chikki (Tanu Jain and Kiran Grover 2017)     | 25                                               | 7.5                                              |
| 10.   | Burfi (Shekhara Naik R et.al. 2020)          | 5                                                | 25                                               |
| 11.   | Muffins (Varsha Rani et.al. 2020)            | 10,20,30                                         | 5                                                |

Table 6: Garden Cress Seeds Incorporated in Traditional Side dish/Snack Products

| Sl.no | Side dish/Snack Products                          | Level of incorporation garden cress seeds (Per cent) | Maximum Accepted Level of Incorporation (Per cent) |
|-------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|
| 1.    | Sandwiches (Mamta Sharma 2015)                   | 7,10,12                                          | 10                                               |
| 2.    | Soup (Mamta Sharma 2015)                         | 12,15,18                                         | 15                                               |
| 3.    | Salad (Mamta Sharma 2015)                        | 17,20,22                                         | 20                                               |
| 4.    | Bhujia (Mamta Sharma 2015)                       | 20,25,30                                         | 25                                               |
| 5.    | Raita (Mamta Sharma 2015)                        | 8,10,12                                          | 10                                               |
| 6.    | Mathri (Priyanshu Tripathi et.al.2017)           | 10,20,30 (powder)                                | 10                                               |

Processing Methods

The common methods of household processing in case of garden cress seeds include soaking, boiling, and roasting (Table 7). Gurpreet Kaur et al. (2016) studied the influence of processing on nutritive value. They found that soaking increased protein content, while it was reduced by boiling and roasting. Boiling and roasting raised the fat content but soaking reduced fat content. Boiling increased fiber content followed by soaking, and roasting decreased the fiber content. Soaking increased the ash content, while roasting and boiling reduced it. When garden cress seeds were roasted and boiled, the calcium content was increased, but when the seeds were soaked the calcium content was decreased.

Roasting increased the iron content of garden cress seeds followed by soaking and boiling. The processing methods such as roasting and germination was shown in Table 8. Rajashri and Haripriya (2018) found that nutrient profile and development of muffins by germinated garden cress seed powder were better accepted compared to roasted seeds.

Different processing methods such as soaking, germination, boiling, and roasting have been used in preparing garden cress seed-based products such as burfi. Shekhara Naik R et al. (2020) found that soaking and germination of the seeds were more acceptable compared to boiling and roasting.

Table 7: Effect of Processing Methods for Garden Cress Seeds

| Garden Cress Seeds (Gurpreet Kaur et.al. 2016) | Per cent of amino acid composition (g/100g) |
|-----------------------------------------------|---------------------------------------------|
|                                               | Energy (kcal)      | Protein (g) | Fat (g) | Carbohydrate (g) | Iron (mg) | Calcium (mg) |
| Soaking                                       | 459.28            | 23.29       | 23.13   | 39.49            | 31.25     | 356.37       |
| Boiling                                       | 458.28            | 22.07       | 23.79   | 40.90            | 30.38     | 368.89       |
| Roasting                                      | 460.40            | 22.37       | 23.59   | 41.61            | 31.67     | 372.03       |

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Table 8: Effect of Processing Methods for Garden Cress Seed Powder

| Garden Cress Seed Powder (Rajashri VS and Haripriya A 2018) | Per cent of amino acid composition (g/100g) |
|-------------------------------------------------------------|---------------------------------------------|
|                                                             | Energy (kcal) | Protein (g) | Fat (g) | Carbohydrate (g) | Fiber (mg) | Iron (mg) | Vitamin C (mg) |
| Roasting                                                    | 460           | 25.0         | 16.31   | 53.25         | 2.06       | 21.41     | 77.22         |
| Germination                                                | 404.5         | 25.42        | 5.57    | 60.47         | 3.00       | 33.55     | 137.0         |

Table 9: Nutritive Value of Maximum Accepted Garden Cress Seeds Incorporated Traditional Products

| Sl.no | Name of the Product | Macronutrient (Per 100g) | Micronutrient (Per 100g) |
|-------|---------------------|--------------------------|--------------------------|
|       |                     | Energy (kcal) | Carbohydrate (g) | Protein (g) | Fat (g) | Iron (mg) | Calcium (mg) |
| 1.    | Health drink (Snehal Y Mohite et.al. 2012) | 65.63 | 10.30 | 3.44 | NA | 2.90 | 127.20 |
| 2.    | Ladoo:              |             |           |     |     |       |             |
| a)    | Prepared using wheat flour, bengal gram flour, and ground sugar (10 per cent) (M. Angel and K.P Vasantha Devi 2015) | 376.0 | NA | 12.80 | NA | 10.0 | 96.0 |
| b)    | Prepared using rice flakes, bajra, roasted Bengal gram dal, samai, and jaggery (10 per cent) (Tanu Jain et.al. 2016) | 483.46 | 64.94 | 6.55 | 21.93 | 3.46 | 37.60 |
| 3.    | Pinni (Tanu Jain et.al. 2016) | 488.75 | 56.74 | 8.56 | 25.23 | 4.06 | 63.25 |
| 4.    | Panjiri (Tanu Jain et.al. 2016) | 474.04 | 64.30 | 5.46 | 21.56 | 4.97 | 64.30 |
| 5.    | Burfi:              |             |           |     |     |       |             |
| a)    | 10 per cent (Tanu Jain et.al. 2016) | 569.89 | 48.46 | 8.06 | 38.19 | 4.08 | 34.57 |
| b)    | 5 per cent (Shekhara Naik et.al. 2020) | 481.8 | 45.64 | 2.81 | 32 | 16.5 | 251.10 |
| 6.    | Chikki:             |             |           |     |     |       |             |
| a)    | 25 per cent (Tanu Jain et.al. 2016) | 470.7 | 58.68 | 14.14 | 19.73 | 6.43 | 117.27 |
| b)    | 25 per cent (roasted) (Tanu Jain and Kiran Grover 2017) | 482.03 | 57.13 | 14.47 | 21.0 | NA | NA |
| 7.    | Biscuits (Tanu Jain et.al. 2016) | 456.44 | 58.4 | 6.46 | 21.88 | 3.33 | 36.08 |
| 8.    | Muffin (Varsha Rani et.al. 2020) | 410.57 | 43.13 | 13.23 | 20.37 | 4.83 | 91.32 |
| 9.    | Sandwiches (Mamta Sharma 2015) | 276 | 36.1 | 7.7 | 11 | 11 | 65.7 |
| 10.   | Soup (Mamta Sharma 2015) | 230.3 | 21.48 | 5.4 | 13.7 | 15.52 | 33.74 |
| 11.   | Salad (Mamta Sharma 2015) | 114.8 | 11.43 | 5.8 | 5.02 | 26.6 | 93.3 |
| 12.   | Bhujia (Mamta Sharma 2015) | 300.5 | 29.3 | 8 | 16.2 | 25.4 | 105.2 |
| 13.   | Raita (Mamta Sharma 2015) | 99.4 | 6 | 5.29 | 6.05 | 10.18 | 145.2 |
| 14.   | Mathri (Varsha Rani et.al. 2020) | 356.04 | NA | 12.43 | 4.35 | 17.24 | NA |

Nutritive value of Garden Cress Seeds incorporated products

Nutritive value of maximum accepted garden cress seeds incorporated traditional products shown in Table 9. The energy content varies from 65.63 to 569.89g/100g and protein content varies from 2.81 to 14.47g/100g. Garden cress seeds are a good source of iron and calcium.
Effect of Garden Cress Seeds
A study was conducted by Angel and Vasantha Devi (2015) on the effect of supplementation of garden cress seed incorporated product on moderate anaemic adolescent girls (12-15 years)\(^1\). Ladoo a traditional Indian sweet prepared using rice flakes, bajra, roasted bengal gram dal, samai, and jaggery with 10 per cent garden cress seed was used along with Vitamin C-rich gooseberry\(^2\). The duration of supplementation was 6 months\(^3\). After the supplementation, there was an improvement in hemoglobin level from 8.67 to 12.47 g/dl\(^4\).

CONCLUSION
Garden cress seed is an annual herb grown as a culinary seed in Asia and Europe. These seeds are loaded with a good amount of macro and micro nutrients such as energy (445.18 kcal/100g), protein (24.11g/100g), fat (24.12g/100g), carbohydrate (32.70g/100g), calcium (320.45mg/100g), phosphorous (619.82mg/100g), potassium (1141.67mg/100g), magnesium (353.87mg/100g), iron (11.70mg/100g), and it is also a good source of fiber (9.01g/100g) and iron (11.70mg/100g). Different products have been developed by incorporating garden cress seeds in traditional local recipes. 10-25 per cent level of incorporation has been found to be acceptable by the sensory panel. These products are yet to be commercialized.

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