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Levels of Metals and Nutritional Composition of Garden Cress (*Lepidium sativum*) Seed, in Southern Ethiopia

Ashenafi Feleke[1], Mesfin Bibiso[1], Alemu Lelago[1]

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ABSTRACT

Background: Garden cress (*Lepidium sativum*) belongs to the Cruciferae family, a fast-growing edible herbaceous plant. This study aimed to determine the essential and non-essential metals levels and nutritional composition of garden cress seed grown in the Wolaita Zone in southern Ethiopia. The study was carried out by collecting garden cress cultivated in Jage, Wandara, Taba, Hilena, Siyara, Demba Gale, Himbecho, Afama and Gara sites of the Wolaita Zone, Southern Ethiopia.

Methods: 27 triplicate garden cress seed samples were collected from nine selected sites and digested by the wet digestion method. The level of metals in the sample was determined by using FAAS.

Result: The result showed that the average concentration of K, Ca, Mg, Fe, Cu and Zn in the garden cress seed samples in mg/100 g dry weight, were in the range of 1179.76 to 1226.79, 249.52 to 291.62, 314.84 to 341.44, 7.29 to 8.48, 3.72 to 5.44 and 5.80 to 6.68, respectively. The average concentration of non-essential lead metal was not detected in all sample sites. The proximate composition of the garden cress seed sample was in the range of 19.68% to 22.87% for protein, 8.30% to 10.27% for crude fiber, 20.72% to 24.17% for fat, 3.44% to 4.63% for ash, 1.37% to 2.59% for moisture, 40.56% to 43.24% for carbohydrate and 332.96 to 344.19 Kcal/ 100 g for energy. The study confirmed that the garden cress seed was a good source of essential metals and an excellent source of protein, carbohydrate, fiber, energy and fat contents. The concentrations of metals in garden cress were permissible compared with recommended permissible limits of WHO/FAO as well as USDA.

Key words: Essential metals, Garden cress, Non-essential metals, Nutritional composition.

INTRODUCTION

Garden cress (*Lepidium sativumin*) is a member of the family Brassicaceae cultivated throughout many countries in the world (Tiwari *et al*., 2004). Major secondary metabolites in Garden cress's alkaloids, flavonoids, tannins, glucosinolates, sterols, triterpenes, saponins, glycosides, carbohydrates and anthracene proteins phenolics (Manohar *et al*., 2012) which are responsible for its various ethnopharmacological activities. The seeds possess appropriate levels of protein, fat, carbohydrate, dietary fiber, phosphorus, magnesium, calcium, iron and (Mohite *et al*., 2012) but the lee of the is not well reported for specific countries.

In Ethiopia, food insecurity has been a severe problem for decades. A series of production failures have resulted in chronic food insecurity (Kaluski *et al*., 2001). This indicator demonstrates that a large proportion of the population has been undernourished over the last one and half decades. Malnutrition has been a severe obstacle to economic development in Ethiopia. A major cause is lack of access to nitrous food products The Ethiopia Demographic and Healthy survey carried out in 2005 showed that 47% of children under five in Ethiopia were stunted. Similarly, 27% of all women of childbearing age were found to suffer from chronic energy deficiency (FDRE, 2008). To alleviate this problem, the consumption of garden cress seed is among the options.

However, there was no research conducted on levels of metals and nutritional composition of garden cress in the study area. Therefore, the objective of this study was to determine the level of essential and non-essential metals and nutritional composition in garden cress seed grown in Wolaita zone in southern Ethiopia, to ensure that all individuals secure adequate nutritional status in a sustainable manner which is essential for health and productive life.

[1]Natural and Computational Sciences college, Wolaita Sodo University, Wolaita Sodo, Ethiopia.

Corresponding Author: Alemu Lelago, Natural and Computational Sciences college, Wolaita Sodo University, Wolaita Sodo, Ethiopia. Email: lelagoalem@gmail.com

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MATERIALS AND METHODS

Sample collection and preparation

27 triplicate samples were collected from nine selected sites, namely; Jage, Wandara, Taba, Hilena, Siyara, Demba Gale, Himbecho, Afama and Gara Godo of Wolita zone during the dry season in 2021. These collected samples were dried by the use of sunlight to be constant in their weight. The dried samples grind by the use of an electronic blending

device and stored in a plastic bags and freeze below -25°C till digestion (Yu *et al*., 2005).

Analysis of metal

Metals of K, Ca, Mg, Fe, Cu, Pb and Zn were determined by FAAS equipped with the air-acetylene flame system using an external calibration curve from the digested sample (Demirel *et al*., 2008). All the experimental works are conducted in the laboratory of Arba Minch University, Ethiopia.

Analysis of proximate composition

Estimation of moisture content

Two grams of the powdered samples of seeds and aerial parts of garden cress are taken in three replications and dried initially at 80-90°C. Weights of dried samples were noted until constant weights were obtained. The percentage of moisture content was calculated per (AOAC, 2000).

Estimation of fat

The crude fat (%) contents are calculated using the following formula (AOAC, 2005):

$$\text{Fat content (\%)} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \times 100 \quad \text{....(1)}$$

Estimation of ash

The ash contents (%) were calculated using the following formula (AOAC, 2005):

$$\text{Ash content (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100 \quad \text{....(2)}$$

Estimation of protein

Nitrogen and crude protein content in the powdered samples of garden cress was estimated by following the conventional micro Kjeldahl·s method. The protein content of samples was determined by the Kjeldahl method as follows. Two gram of sample was digested with 5 gram of digestion mixture (10 parts potassium sulphate and 1 part copper sulphate) and 20 ml of concentrated sulphuric acid in Kjeldahl flask until the contents were carbon free. The digested sample was made up of 100 ml. An aliquot of 10 ml was distilled with 20 ml of 30 per cent sodium hydroxide and liberated ammonia was collected in 20 ml of 2 per cent boric acid containing 2-3 drops of mixed indicator [0.1% methyl red and 0.1% bromo-cresol green of 95 per cent ethyl alcohol separately and mixed in the ratio of 1:5 respectively]. The entrapped ammonia was titrated against 0.1N hydrochloric acid.

The nitrogen content in the sample was calculated by the following expression:

$$\% \text{ Nitrogen} = \frac{14 \times \text{N of HCl} \times \text{Titre value (ml)} \times \text{Dilution factor} \times 100}{\text{Weight of sample (g)} \times 1000} \quad \text{...(3)}$$

Protein content (%) in sample =

Nitrogen content in sample × 6.25.

Estimation of total carbohydrates

The per cent carbohydrates were calculated by subtracting the sum of moisture, protein, fat, ash and fiber from 100. Total carbohydrates content is calculated by difference as follows (AOAC, 2005).

Total carbohydrates content (%) = 100- [Moisture (%) + Fat (%) + Ash (%) + Protein (%) + Crude fiber (%)] ...(4)

Pure carbohydrate in food was evaluated as the difference between total carbohydrates and the amount of total crude fiber (USDA, 2017).

Estimation of total energy

The energy value in kilocalories (kcal) was calculated by the sum of four times the value of total carbohydrate and protein content and nine times fat content according to (AOAC, 2000):

Calorific value (kcal/g) =

(4 × % Protein) + (9 × %Fat) + (4 × % carbohydrates) ....(5)

Statistical analysis

The determined data were analyzed by one-way ANOVA (analysis of variance) to determine whether there is a significant concentration difference within Garden Cress or not. Mean separation between sample categories was computed using least significant difference (LSD) at a 95% confidence interval.

RESULTS AND DISCUSSION

The concentration of essential and non-essential metals in garden cress seed

Statistical analysis results showed that there is a significant difference at ($p<0.05$) confidence level in the mean concentration of K metal in all sample sites except, the sites of Jage, Wandara, Taba, Hilena and Siyara. As recorded in Table 1, the concentration of K in garden cress seed range from 1179 to 1226.79 mg/100 g. The highest level of K was observed at the Jage site and the least value was observed at Afama site. The source of this significant difference between K concentrations may be the difference in mineral composition of soil or pH of the soil which predicts the degree of mineral absorption by plants. According to USDA national nutrient database, the reported level of K was 1246 mg/100 g (USDA, 2001) which is higher than the K level present study indicating a lower level of K in the edible plant.

Also, the concentration of Ca in garden cress seed range from 249.52 to 291.62 mg/100 g. The highest level of Ca was observed at Taba this could be due to the highest amount of Ca in soil which results from the nature of the parent material and the least value was observed at Afama. The result of this study showed that the mean concentration of Ca was statistically significantly different between sites. The source of this significant difference between sample means may be the difference in mineral composition of soil or pH of the soil which predicts the degree of mineral absorption by plants. According to USDA national nutrient database, the reported level of Ca was 132 mg/100 g (USDA, 2001) which is higher than the present study.

The concentration of Mg in garden cress seed varied between 314.84 and 341.44 mg/100 g. The highest level of Mg was observed at Jage and the least value was observed at Himbecho which may be due to different levels of Mg-containing minerals in the soil of the study area. As shown in Table 1, one can see that there is a significant difference at ($p<0.05$) confidence level in the mean concentration of Mg metal in all sample sites except, it was not significantly different at Jage, Taba and Demba Gale. The source of this significant difference between sample means may be the difference in mineral composition of soil or pH of the soil which predicts the degree of mineral absorption by plants. According to USDA national nutrient database, the critical level of Mg is 189 mg/100 g (USDA, 2001) which is lower than the concentration of Mg in the study crop.

As indicated in Table 2, the concentration of Fe in garden cress seed range from 7.29 to 8.48 mg/100 g. The highest level of Fe was observed at Afama and the least value was observed at Jage. According to USDA national nutrient database, the reported level of Fe was 6.74 mg/ 100 g (USDA, 2001), which was higher than the present study. The permissible limit of Fe set by WHO/FAO in edible plants was 425.5 mg/kg (FAO/WHO, 2001). The comparison of Fe level with the present study was lower than the permissible level of Fe in an edible plant.

As the recorded value of the concentration of Cu in garden cress seed range from 3.72 to 5.44 mg/100 g. The highest level of Cu was observed at Himbecho and least value observed at Hilena. As shown in Table 2, there is a significant difference at ($p<0.05$) in the mean concentration of Cu metal in Taba, Hilena and Himbecho sample sites.

Also, the concentration of Zn in garden cress seed range from 5.80 to 6.68 mg/100 g. The highest level of Zn was observed at Wandara and the least value observed at Siyara. According to USDA national nutrient database, the reported level of Zn was 2.68 mg/100 g (USDA, 2001), which was higher than it in the present study. The permissible limit of Zn set by WHO/FAO for the edible plant was 99.4 mg/kg (FAO/WHO, 2001) indicating the Zn level in the present study was higher than the permissible level of Zn in an edible plant.

Table 1: Major essential metal concentration of each metal in each site in (mg/100 gm).

	Metals in (mg/100 g)		
Sample site	K	Ca	Mg
Jage	1226.79^{a} ±1.86	279.28^{bc} ±1.00	341.44^{a}±1.00
Wandara	1216.17^{a}±2.52	282.37^{b}±2.52	334.13^{bc}±3.51
Taba	1225.62^{a}±4.00	291.62^{a}±2.65	338.02^{ab}±1.00
Hilena	194.04^{b}±4.00	282.91^{b}±3.06	332.73^{c}±2.52
Siyara	1215.67^{a}±5.03	275.37^{bc}±4.51	334.42^{bc}±0.00
Demba gale	1181.01^{b}±15.28	273.84^{c}±2.00	$336.56b^{ac}$±2.52
Himbecho	1186.91^{b}±5.51	262.18^{d}±2.65	314.84^{e}±3.00
Afama	1179.76^{b}±20.00	249.52^{e}±10.00	316.97^{de}±2.08
Gara Godo	1183.50^{b}±10.00	255.84^{de}±4.48	321.27^{d}±5.77
CV	0.80	1.62	0.87
LSD	16.48	7.57	4.91

Significantly different at p (0.05) and p (0.01). Means with the same letter in the same column are not significantly different. CV- Coefficient of variance; LSD- List significant difference.

Table 2: The minor essential and non-essential metal concentration of each metal in (mg/100 gm).

	Metals in (mg/100 g)			
Sample site	Fe	Cu	Zn	Pb
Jage	7.29^{d}±0.33	4.50^{bc}±0.25	6.56^{a}±0.33	ND
Wandara	7.60^{cd}±0.20	4.50^{bc}±0.36	6.68^{a}±0.30	ND
Taba	7.66^{bcd}±0.10	3.81^{d}±0.10	6.46^{ab}±0.45	ND
Hilena	7.56^{cd}±0.45	3.72^{d}±0.20	5.87^{bc}±0.26	ND
Siyara	7.98^{abc}±0.00	3.97^{cd}±0.00	5.80^{c} ±0.17	ND
Demba gale	7.54^{cd}±0.46	4.40^{bc}±0.40	6.44^{abc}±0.45	ND
Himbecho	8.24^{ab}±0.32	5.44^{a}±0.46	6.52^{a}±0.44	ND
Afama	8.48^{a}±0.38	4.58^{b}±0.31	6.51^{a}±0.45	ND
Gara Godo	8.30^{a}±0.52	4.60^{b}±0.52	6.34^{abc} ±0.40	ND
CV	4.43	7.50	5.89	ND
LSD	0.60	0.57	0.64	ND

Significantly different at p(0.05) and p(0.01). Means with the same letter in the same column are not significantly different. CV- Coefficient of variance; LSD- List significant difference.

Proximate composition determined in garden cress sample

Table 2, show that the average protein content ranged between 19.68 and 22.87%. The observed variation in protein content of linseed could be a result of the differences in environment and the type of soil in which it grows. The higher protein percentage was recorded at Siyara and least at Damot Gale. It can see that there is a significant difference at ($p<0.05$) confidence level in the mean concentration of protein in most sites. But it was not significantly different at Jage, Demba Gale and Afama sample sites. The recorded protein percentage in the garden cress seed sample was related to the value of protein reported by other researchers e in garden cress seed (Gokavi *et al.*, 2004) which was about 24.2% and 22.4, respectively.

The average fat content ranged between 20.7 to 24.17% in garden cress seed in this study. The higher fat percentages were recorded at Jage and least at Hilena sites. The mean concentration of fat was significantly different at all sites except Jage.

The data of crude fiber in Table 3, showed that the average fiber content range between 7.6to 10.27%. The higher fiber percentage was recorded at Hilena and least at Gara. The mean concentration of fat was significantly different at Wandera, Taba, Hilena, Siyara and Gara. And it was not significantly different at Jage, Demba Gale, Himbecho and Afama. The recorded fiber percentage in the garden cress seed sample was related to the researcher

Table 3: Proximate composition values of garden cress seed in each site.

	Nutritional parameters (%)			
Sample site	Protein	Crude fiber	Fat	Moisture
Jage	20.45^{d}±0.58	8.61^{d}±0.30	24.17^{a}±0.70	1.37^{c}±0.35
Wandara	19.68^{c}±0.53	9.36^{c}±0.55	22.33^{bc}±1.29	1.70^{c}±0.17
Taba	21.72^{b}±0.17	10.22^{ab}±0.35	22.20^{bc}±0.17	1.75^{c}±0.06
Hilena	21.63^{bc}±0.52	10.27^{a}±0.17	20.72^{d}±0.46	1.79^{bc}±0.35
Siyara	22.87^{a}±0.58	9.60^{bc}±0.29	21.29^{cd}±0.58	1.71^{c}±0.12
Demba Gale	20.94^{cd}±0.58	8.62^{d}±0.54	21.69^{bc}±0.58	2.31^{a}±0.52
Himbecho	22.06^{b}±0.06	8.30^{d}±0.17	21.02^{d}±0.58	2.53^{a}±0.17
Afama	20.84^{d}±0.17	8.49^{d}±0.35	23.86^{a}±0.00	2.59^{a}±0.23
Gara Godo	21.83^{b}±0.00	7.63^{e}±0.52	22.45^{b}±0.06	2.23^{ab}±0.17
CV	1.98	4.28	2.79	13.69
LSD	0.73	0.66	1.06	0.47

Table 4: Proximate composition values of garden cress seed in each site.

	Nutritional parameters (%)		
Sample site	Ash	CHO	Energy (kcal/100 g)
Jage	3.56^{c}±0.46	43.24^{a}±1.53	344.19^{a}±6.81
Wandara	3.44^{c}±0.35	41.33^{b}±1.00	332.96^{d}±5.29
Taba	3.87^{bc}±0.06	40.63^{b}±0.35	337.4^{bcd}±1.00
Hilena	4.22^{ab}±0.35	40.77^{b}±0.12	335.0^{cd}±1.73
Siyara	3.51^{c}±0.40	40.56^{b}±0.58	340.79^{ab}±1.05
Demba gale	3.60^{c}±0.46	41.89^{ab}±1.15	340.85^{ab}±0.13
Himbecho	4.49^{a}±0.12	41.50^{b}±1.15	338.47^{bc}±2.31
Afama	4.63^{a}±0.17	40.93^{b}±1.15	338.11^{bc}±2.31
Gara Godo	4.21^{ab}±0.12	41.08^{b}±0.58	341.89^{ab}±0.58
CV	7.97	2.30	0.94
LSD	0.54	1.63	5.44

Means with the same letter in the same column are not significantly different. CV- Coefficient of variance; LSD- List significant difference.

value of protein percentage in garden cress seed (Gokavi *et al.*, 2004) which was about 7.01 and 11.9% respectively.

The result of this study showed that the average moisture content range from 1.37% to 2.59%. The higher moisture content was recorded at Afama and least at Jane. The mean concentration of fat was not significantly different at Jage, Wandara, Taba, Hilena, Siyara and Gara. And it was very different at Demba Gale, Himbecho, Gara and Afama. The recorded moisture percentage in the garden cress seed sample was related to the researcher's value of moisture percentage in garden cress seed (Gokavi *et al.*, 2004) which was about 2.9%.

Table 4 showed that the average ash content ranged between 3.44 and 4.63%. The higher ash percentage was recorded at Afama and least at Wandara. The mean concentration of ash was significantly different at Hilena, Himbecho and Gara. The recorded ash percentage in the garden cress seed sample was related to the value of protein percentage reported in garden cress seed by Abd-El salam *et al*. (2019) which was about 4.8% and 4.65%' respectively.

The average carbohydrate content ranged between 40.56 and 43.24%. The higher carbohydrate percentage was recorded in Jage district and least at Siyara. The mean concentration of carbohydrates was significantly different at Jage and Demba Gale.

The energy values showed that the average energy content ranged from 332.96 to 344.19%. The higher energy percentage was recorded in Jage district and least at Wandara. The recorded energy in the garden cress seed sample was related to the researcher's value of protein percentage in garden cress seed (Abd-El salam *et al*,2019; Gokavi *et al*, 2004).

Garden cress seed contained (1.37-2.59)% of moisture, (19.68-22.87)% of crude protein, (20.72-24.17)% of crude fat, (40.46-43.24)% of carbohydrate, (8.3-10.27)% crude fiber, (3.44-4.63)% ash and (332.96-344.19) of energy in Kcal/100 g. These results show that the macronutrients are considerably high and suitable for human nutrition.

CONCLUSION

From this study, it can be concluded that the Garden cress seeds grown in the study area were rich in proteins, fats, crude fiber and carbohydrates. Also, essential metals in it were found at a sufficient level and there was no risk of toxic metals.

Conflict of interest: None.

REFERENCES

Abd El-Salam, K.H, Toliba, A.O, Gehan A, El-Shourbagy and Nemrsh, E. (2019). Chemical and functional properties of Garden cress (*Lepidium sativun*) seeds powder. Zagazig Journal of Agriculture Research. 46: 5.

AOAC, (2000). Official Methods of Analysis of Association of Official Analytical Chemists, Virginia, USA. 1: 23-84.

AOAC, (2005). Official Methods of Analysis of Association of Official Analytical Chemists. 18th Ed.

Demirel, Akinyele I.O, Shokumbi O.S. (2008). Comparative analysis of dry ashing and wet digestion methods for the determination of trace and heavy metals in food sample. National Library of Medicine. 173: 682-684.

FDRE (Federal Democratic Republic of Ethiopia). (2008). Estimation of Nutritional Composition in Ethiopian Children.

Food and Agriculture Organization of the United Nations and World Health Organization. (2001). FAO/WHO Expert Consultation on Human Vitamin and Mineral Requirements, Bangkok, Thailand.

Gokavi, S.S., Malleshi, N.G., Guo, M. (2004). Chemical composition of garden cress (*L. sativum*) seeds and its fractions and use os bran as a functional ingreidient. Plant Food for Human Nutrition. 59(3): 105-111.

Kaluski, D.N., Ophir, E., Amede, T. (2001). Food Security and Nutrition Ethiopian Case for Action Public Healthy Nutrion. 5(3): 373-381.

Manohar, D., Viswanatha, G.L., Nagesh, S., Jain, V. and Shivaprasad, H.N. (2012). Ethnopharmacology of *Lepidium sativum* linn (Brassicaceae): A review. International Journal of Phytotherapy Research. 2(1): 1-7.

Mohite, S.Y., Gharal, D.B., Ranveer, R.C., Sahoo, A.K. and Ghosh, J.S. (2012). Development of health drink enriched with processed Garden cress (*Lapidium sativum* L.) seeds. Ame. J. Food Technol. 7(9): 571-576.

Tiwari, P.N., Kulmi, G.S. (2004). Performance of Chandra Sur (*Lepidium sativum*) under different levels of nitrogen and phosphorus. Journals of Medicinal and Aromatic Plant Science. 26: 479-617.

USDA, (2011). Food Safety and Inspection Service.

USDA, (2017). Food Safety and Inspection Service.

Yu, J., Ahmedna, M. and Goktepel (2005). Effects of processing methods and extraction solvents on concentration and antioxidant activity of peanut skin phenolics. Food Chem. 90: 199-206.