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Utilization of *Lepidium Sativum* for the Development of Value Added Laddu for Lactating Women

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Abstract—*Lepidium sativum (Brassicaceae) known as Garden Cress or Chandrasura is a native plant of south west Asia. It has peppery, tangy flavor and aroma. The seed coat is of brick red to cream color, the endosperm has yellow color. The seeds of L. sativum are hypoglycemic, aperients, stimulant, diuretic, tonic, carminative, galactogogue and emmenagogue. Objective: 1)To study the changes in the physical and sensory characteristics of laddu upon incorporating lepidium sativum powder. 2)To determine the chemical composition, antioxidant activity, proximate analysis of control and optimized product, and 3)To compare the level of nutritional quality between control and optimized product. Material and Method: Seeds of L. sativum (Garden cress) were collected from local market of Dist. Allahabad of Uttar Pradesh, India. Laddu were made by incorporating the seed. Nutritional analysis was done for moisture, protein, carbohydrate, fat, calcium, iron, phosphorus, ascorbic acid, DPPH, TPC and fiber. Result: 12 variations were subjected to sensory evaluation using nine point hedonic scales out of which T8 (15%) was the most accepted variation and found higher in moisture, energy, fat, fiber, calcium, iron, phosphorus and TPC than control. 100gm of value added laddu contains 362.53 kcal energy, 43.55gm carbohydrate, 18.33gm protein, 18.26gm fat, 9.6gm fiber, 120mg calcium, 31.27mg iron, 161mg phosphorus. Conclusion: The aim of this study is to develop a value added laddu by the incorporation of L.sativum powder for lactating mothers by replacing flaxseed. Garden Cress seed cost is half than the cost of flaxseed so it can be easily consumed by all socio-economic groups.*

Keywords*: Lepidium sativum, Galactogogue, Emmenagogue, Lactating mother.*

1. INTRODUCTION

Lepidium sativum, known as Garden cress or pepper cress or Elrashad, belongs to the family *Brassicaceae (cruciferae)* and it is an erect, annual herb grows up to 50 cm height. The leaves are variously lobed and entire, flowers are white small and found in racemes and fruits are obviate pods, about 5 mm long, with two seeds per pods. The seeds and leaves of the plant contain volatile oils[1]. *L.sativum* plant and seeds are considered one of the popular medicinal herbs used in the community of Saudi Arabia, Sudan and some other Arabic countries as a good mediator for bone fracture healing in the human skeleton. A number of recent studies pointed out the traditional uses of *L.sativum* seeds extract in controlling many clinical problems. They were used as anti-asthmatic antiscorbutic, aperient, diuretic, galactogogue, poultice and stimulant. The leaves are antiscorbutic, diuretic and stimulant[2]. *L. sativum* seeds increase weight gain as they are found to contain 18-24% of fat, 30-40% of the total fatty acids are alpha linolenic acid; and the oil has alpha linoleic acid which could give it nutritional advantages[3]. The primary fatty acids in *L. sativum* oil were oleic (30.6 wt %) and linolenic acids (29.3 wt %) and was found to contain high concentrations of tocopherol. It contains good amount of lignin and antioxidants, which can stabilize the n-3 polyunsaturated fatty acids in its seed oil. The primary phytosterols in *L. sativum* were sitosterol and campesterol, with avenasterol[4].

2. MATERIALS AND METHODS

1. Estimation of Moisture:

Moisture was estimated by Oven drying method. Weighed sample (approx 2 g) (W2) on pre-weighed petriplates (W1) were kept in an oven for drying at 60º C for 5 hrs. The samples were cooled in airtight desiccators to prevent moisture loss or gain from the environment. Drying was considered complete when readings of two consecutive weighing recorded at an interval of an hour did not vary by more than 5 mg. Moisture content was calculated by subtracting the dried weight from the sample weight and was expressed as percentage[5].

$$\%\text{Moisture} = \frac{\text{Loss in weight} \times 100}{\text{Weight of sample}}$$

2. Estimation of Fat:

Fat content in the sample was estimated by Soxhlet extraction method[5]. Moisture free sample was transferred to thimble, which was then fixed into a stand and transferred to a pre-weighed soxhlet beaker. The beaker was filled with petroleum ether. The beaker was then attached to soxhlet apparatus & sample was extracted for 2 hrs at 60ºC. At the same temperature the ether was evaporated for 2 hrs after extraction. At the end of 4 hrs the ether left in the beaker was dried in hot oven at 100º C for 30 min. The beaker was then cooled in desiccators & weighed. It gives the amount of ether soluble fat present in the sample.

Percent crude fat was calculated as under:

$$\% \text{ Crude Fat} = \frac{\text{Weight of fat} \times 100}{\text{Weight of sample}}$$

3. Estimation of Protein:

The protein content of samples was determined by Kjeldahl[5]. Two g of sample was digested with 5 g 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 to 100 ml. An aliquot of 10 ml was distilled with 20ml of 30 percent sodium hydroxide and liberated ammonia was collected in 20 ml of 2 percent boric acid containing 2-3 drops of mixed indicator [0.1 % methyl red and 0.1% bromo-cresol green of 95 percent 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:

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

A conversion factor of 5.71 was used to convert nitrogen into protein content.

4. Estimation of Total Ash:

For ash determination two gram of sample taken in a silica crucible was ignited on a heater and later shifted to a muffle furnace until clean ash was obtained. The temperature of furnace was raised to 550º C ± 15º C[5]. The weight of residue was noted and the percent ash was calculated as under:

$$\% \text{ Ash} = \frac{\text{Weight of residue} \times 100}{\text{Weight of sample}}$$

5. Estimation Of Carbohydrate: (By Difference)

The percent carbohydrates were calculated by subtracting the sum of moisture, protein, fat, ash and fiber from 100.

% CHO = 100 - (% Moisture + % Protein + % Fiber + % Ash)

6. Estimation of Total Energy:

Calorific value (Kcal/g) = (% CHO × 4) + (% fat × 9) + (% protein × 4)

7. Total Polyphenol Content[6]

Sample preparation for *lepidium sativum*: Weight 0.02 gm of dried sample and added 5 ml of 70% methanol in it. Took the supernatant in the centrifuge tubes and centrifuged the supernatant for two minutes. Then these supernatants were used as sample.

Dilute Folin-Ciocalteau phenol reagent 10% (volume fraction): Use a pipette, transferred 10 ml of Folin-Ciocalteau reagent to a 100 ml volumetric flask. Diluted up to the mark with distilled water and mixed.

Sodium carbonate solution, 7.5 % (mass concentration): Weight 7.5 gm of anhydrous sodium carbonate (Na_2CO_3) into 100 ml volumetric flask. Added sufficient warm distilled water to half fill the flask. Swirled and dissolved the sodium carbonate, cooled to room temperature, diluted to the mark with distilled water and mixed.

Blank solution:- Similar procedure was adopted for preparation of blank where sample was replaced by distilled water. Taken 1 ml of sample extracted. 5 ml of Folin-Ciocalteau reagent was added. 4 ml of Na_2CO_3 added within 3-8 minutes. The test tubes was covered with the help of brown paper or aluminum foil and allowed to stand for 60 minutes. Absorbance was taken at 765 nm.

Total Polyphenol Content was calculated by following formula: -

$$\text{TPC} = \frac{(\text{Sample OD} - \text{Intercept value}) \times \text{Sample extraction volume} \times 100}{\text{Slope} \times \text{mass in gm of test sample} \times 10{,}000 \times \text{wt. in dry matter}}$$

8. Antioxidant Activity

The percent (%) antioxidant activity of laddu was determined by DPPH method.

Sample preparation for dried laddu sample: -Weighed 10 mg of dried sample and added 10 ml of acidified methanol in each dried sample. Heated it in water bath at 40ºC for 20 minutes. Took the supernatant in a centrifuged tube and centrifuged it for two minutes. Then the supernatant was used as sample.

Preparation of control sample: -Took 150 µl of DPPH solution and added 3 ml of pure methanol in it.

Preparation of DPPH solution: - 4.3 mg of DPPH was dissolved in 3.3 ml of methanol. It was protected from light by covering the test tube.

Blank: - Pure methanol was used as blank solution.

Procedure: - 100 µl of sample extract taken in a test tube**.** Diluted it with 200 µl methanol**.** Made up volume with 2.7 ml methanol again up to 3ml**.** 150 µl DPPH solution was added and covered the test tubes with the help of brown paper or aluminum foil**.** Mixed properly**.** Incubated the solution for 15 minutes at room temperature**.** Took absorbance at 515 nm by spectrophotometer. The free radical scavenging activity (FRSA) (% antioxidant activity) was calculated using the following equation:

$$\% \text{ Antioxidant} = \frac{\text{Control absorbance} - \text{Sample absorbance} \times 100}{\text{Control absorbance}}$$

9. Estimation of Calcium:

Principle: - Calcium is precipitated as calcium oxalate. The precipitate is dissolved in hot diluted H_2SO_4 and titrated against standard potassium permanganate solution.

Requirements:- Pipette, measuring cylinder, Whatman No. 42 filter paper, glass rod burette and conical flask.

Reagents:-

1. Ammonium oxalate-saturated solution
2. Methyl red indicator: Dissolved 0.5 gm methyl red in 100 ml 0f 95% alcohol.
3. Dilute acetic acid- (1+4)
4. Dilute ammonium hydroxide-(1+4) Added acid to water slowly and with constant stirring. Cooled and made up the volume.
5. Dilute H_2SO_4-(1+4)
6. 0.1 N $KMnO_4$

Procedure:- Taken an aliquot (20-100ml) of ash solution in a beaker. Added 25-50ml of water, if necessary +10ml of saturated ammonium oxalate +2 drops of methyl red indicator, then made the solution slightly alkaline by the addition of dilute NH_3 and then slightly acid with few drops of acetic acid until colour is faint pink. Heated the solution to the boiling point and left it at room temp. for at least 4 hours. Filtered through Whatman No. 42 paper, then washed with distilled water till filtrate became oxalate free. Broken the point of the filter paper with platinum wire or glass rod. Washed the precipitate first using dilute H_2SO_4 with washed bottle into beaker in which Ca was precipitated. Then washed with hot water, titrated while still hot with 0.01N potassium permanganate to first permanent pink colour and finally added filter paper to solution

Calculation:-

$$\text{Ca (mg/100g)} = \frac{\text{Titre} \times 0.2 \times \text{volume made up of ash solution} \times 100}{\text{Aliquot taken for titration} \times \text{weight of sample taken}}$$

10. Determination of Iron in given food sample by Spectrophotometer:

Principle: - Iron content in food is determined by converting the iron to ferric form using oxidizing agents like potassium persulphate and treated with potassium thiocyanate to form red ferric thiocyanate which is measured at 480 nm.

Requirements:-Pipette, cuvette, tissue paper, measuring cylinder, Whatman NO. 42 filter paper, burette, conical.

Reagents:-

1. Concentrated H_2SO_4
2. Saturated potassium persulphate: Dissolved 7-8 gm of potassium persulphate in water the undissolved excess settled at bottom and filtered it.
3. 3 N Potassium thiocyanate: Dissolved 146 gm KCN in 500 ml water. Filtered and added 20 ml acetone for preservation.
4. Standard iron solution:-Dissolved .351g ferrous ammonium sulphate in 50 ml water. Added 0.25 ml conc. H_2SO_4, warm slightly and added potassium permanganate solution drop by drop until a drop produces a permanganate colour. Made up vol. to 500 ml with distilled water.
5. Ash solution.

Procedure:-The ash solution of sample prepared by dry ashing was used for colour development. Into three separate stoppers measuring cylinder pipettes the solution as given below:-

Regents	Blank (ml)	Standard (ml)	Sample (ml)
Standard iron solution	0.0	1.0	0.0
Sample ash solution	0.0	0.0	5.0
Distilled water	5.0	4.0	0.0
Conc.H_2SO_4	0.5	0.5	0.5
Potassium persulphate	1.0	1.0	1.0
Potassium thiocyanate	2.0	2.0	2.0

Calculation:-

$$\text{Iron (mg/100gm)} = \frac{\text{OD of sample} \times 0.1 \times \text{total vol. made up of ash}}{\text{OD of standard} \times 5 \times \text{weight of sample taken for ashing}}$$

11. Determination of Phosphorus in given food sample By Spectrophotometer:

Principle:- Phosphorus Reacts With Molybdate acid to form phosphomolybdate complex. It is then reduced with aminonapthol-sulphuric acid to complex molybdenum blue, which is measured at 650nm.

Reagents:-

1. Molybdate solution: Dissolved 25gm of ammonium molybdate in 400 ml of distilled water then added 500ml of 10 n Sulphuric acid and made up the volume to 1000ml.
2. Aminonapthol-sulphuric acid solution**:** Dissolved 0.5gm of 1amino-2nepthol-4-sulphuric acid in water and 30gm of sodium bisulphate and 6gm sodium sulphate. Made up the volume 250ml and left it for overnight and then filtered.
3. Standard phosphate solution: Dissolved 0.4389g of potassium di-hydrogen phosphate in water and added 10ml of 10 N H_2SO_4 and made up the volume to 1000ml with water.
4. Ash solution:

Procedure :- Taken 5 ml of ash solution obtained by dry ashing. Added 5ml molybdate reagent. Then added 2ml of Aminonapthol-sulphuric acid solution then made up the volume up to 50ml. Prepared similarly blank using distilled water in place of the sample. Leaved it for 10 min and measured the color at 650nm setting blank at 100% transmission

Calculation:-

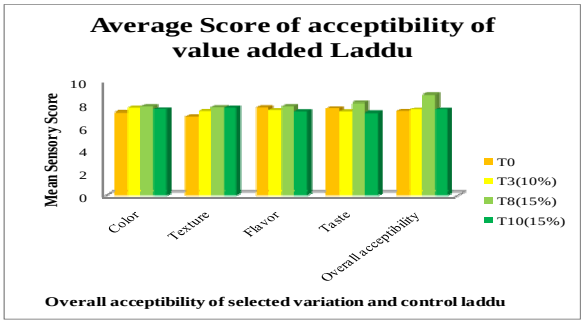
$$\text{Phosphorus} = \frac{\text{OD of sample} \times \text{total vol. of ash solution} \times 0.01}{\text{OD of standard} \times \text{volume of ash solution taken for estimation} \times \text{weight of sample taken for ashing}}$$

Sensory characteristics of Laddu

The organoleptic characteristics of laddu were determined using a taste panel consisting of 10 members drawn from the student/ staff of the Center of Food Technology, University of Allahabad. The panelists were asked to evaluate the various samples for different sensory attributes namely appearance, color, texture, taste, mouth feel and overall acceptability. 9 points hedonic scale was used starting from 9 point for like extremely to 1 for dislike extremely, respectively for sensory evaluation of laddu.

From the anova result in table there was significant difference for each variable of sensory attributes at P<0.05

Overall acceptability of selected variation and control laddu



Overall acceptibility of selected variation and control laddu

3. RESULTS AND DISCUSSION

Table- 1

Proximate composition of Raw (P0), control laddu (T0) and formulated (T8).

Nutrients	Raw (P0)	Control (T0)	Variation (T8)
Moisture	2.8%	19.72%	31.42%
Protein	6.8gm	16.02gm	18.33gm
Fat	3.23gm	22.28gm	14.45gm
Carbohydrate	2.26gm	41.94gm	43.55gm
Energy	21.7Kcal/100gm	324.35Kcal/100gm	362.53Kcal/100gm
Ash solution	.28%	2.04%	2.26%
Calcium	80mg/100gm	93mg/100gm	120mg/100gm
Phosphorus	137.21mg/100gm	176.22mg/100gm	161mg/100gm
Iron	29.34mg/100gm	28.07mg/100gm	31.27mg/100gm
Ascorbic acid	8.96mg/100gm	10.84mg/100gm	11.76mg/100gm
DPPH	62.89%	81.49%	79.67%
TPC	312.423	280.11	340.31
Fiber	6.5g	5.6g	9.6g

In this study of formulated laddu, content of moisture was 31.42%, protein 18.33gm, fat 14.45gm, carbohydrate 43.55gm, energy 362.53Kcal, ash 2.26%, calcium 120mg, phosphorous 161mg, iron 31.27mg, ascorbic acid 11.76mg, DPPH (antiradical activity) 79.67%,TPC 340.31, fiber 9.6gm.

By taken all responses into account it is proved that sample eight (T8) with *L. sativum* 15gm and *jaggery* 44gm have the greatest effect on the sensory properties (color, taste, texture, flavor and mouth feel) of the laddu. The value added *L. sativum* enriched laddu were rich in iron, calcium, folic acid, protein, beta-carotene and ascorbic acid which make them beneficial for people of all age groups.

4. CONCLUSION

Due to its high calcium, phosphorus, iron, fiber and polyphenol content, *L. sativum* enriched laddu may be recommended to meet the specific needs of vulnerable section of the population, who are pregnant and lactating and its cost is half than the cost of flaxseed so it can be easily consumed by all socio-economic groups.

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