# The Mineral Composition Of Grass Pea (*Latyrus sativus*) Seeds Cultivated In Different States Of India

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***Abstract :*** Grass pea is rich in minerals. The seeds have a higher concentration of magnesium and phosphorus followed by calcium**.** The chemical composition of grass pea may vary according to varieties/ genotype, geographical region of their growing and maturity and environmental factors (soil fertility, nitrogen nutrition, temperature, and water stress and soil pH). The grass pea (*Latyrus sativus*) seeds cultivated in different States of India like Andhra Pradesh, Kerala, Odisha, West Bengal, Chattisgarh and Bihar were taken and the seeds were treated using different processing methods of wet roasting, boiling and soaking+boiling and also further mineral analysis for the estimation of Calcium, Iron, Copper, Zinc, and Magnesium were determined using atomic absorption spectrophotometer method. Among all the States of India, the mineral analysis of the seeds of *Lathyrus sativus* showed higher amounts of minerals in Andhra Pradesh. In Andhra Pradesh, the soaked + boiled processed seeds showed a better amount of mineral values compared to raw, wet roasted and boiled processed *Lathyrus sativus* seeds seeds whereas in Bihar, the values were the lowest. The seeds have a higher concentration of magnesium followed by calcium. The trace minerals are also significantly high.

***IndexTerms*** - Grass pea, *Lathyrus sativus*, minerals, β-ODAP, neurolathyrism, processing methods.

## I. INTRODUCTION

Minerals are chemical constituents found in foods. They have important roles to play in many activities in the body (Malhotra, 1998; Eruvbetine, 2003). The macro-minerals include calcium, phosphorus, sodium and chloride, while the micro-elements include iron, copper, cobalt, potassium, magnesium, iodine, zinc, manganese, molybdenum, fluoride, chromium, selenium and sulfur (Eruvbetine, 2003). Grass pea is rich in minerals. The seeds have a higher concentration of magnesium and phosphorus followed by calcium (Urga *et al*., 2005). The chemical composition of grass pea may vary according to varieties/ genotype, geographical region of their growing and maturity and environmental factors (soil fertility, nitrogen nutrition, temperature, and water stress and soil pH).

The mineral content of grass pea determined as ash, constitutes major and minor elements. Calcium, magnesium, phosphorus and iron in the seed samples were generally higher than the corresponding manganese, copper and zinc levels. The levels of calcium ranged from a low 82.01mg/100g to a high 118.97mg/100 g, whereas, magnesium and phosphorus values ranged from a low 98mg/100 g and 242mg/100 g to a high 178 mg/100 g and 432mg/100 g in different cultivation areas. The seeds have a higher concentration of magnesium and phosphorus followed by calcium. The ratio of the content of grass pea of calcium to magnesium ranges from 1:0.53 to 1:1.02 and that of calcium to phosphorus ranges from 1:0.22 to 1: 0.43. Zinc content ranged from 2.74±0.5 mg/100 g to 4.52 mg/100 g with a significant variation. Although not much data are available for contents of minerals in grass pea foods from Ethiopia or other countries, results of different study indicate that the levels of minerals obtained falls within the usual range for most grain legumes (Urga *et al*., 2005).The nutritional composition of *Lathyrus sativus* and *L. cicera* (two closely related species) is similar to that of other feed grain legumes such as field pea (*Pisum sativum)*, faba bean (*Vicia faba*), lupine (*Lupinus angustifolius*) (Hanbury *et al*., 2000; Poland *et al*., 2003; White *et al*., 2001).

The initial connection between Zn and neurolathyrism stemmed from the incidence of the disease in soils low or depleted in plant available Zn (Mannan and Rahim, 1988). It has been suggested that Zinc deficiency in the soil leads to a greater expression of the neurotoxin in the seeds, thus increasing the toxic hazards from consuming this food (Lambein et al., 2001). In addition, evidence showed Zn deficiency in the body to be implicated in motor-neuron disease (De Belleroche 1987; Rao SLN, 2001) and that β-ODAP may be a carrier for Zn (Lambein *et al.,* 1994); even though no physiological role of β-ODAP has been identified. Such medical evidence led (Lambein *et al.* 1994) to hypothesize that Zn deficiency can make an individual who consumes grass pea in considerable quantities more susceptible to the toxic action of β-ODAP or can lower the threshold for β-ODAP toxicity (Rao SLN, 2001). The decrease in β-ODAP with added Zn that we observed may be due to a chelating effect of the Zn on β-ODAP reducing its mobility to the grain. Adequate Zn nutrition for acceptable yields of grass pea, the Zn, either from the soil or applied as a fertilizer, may have the additional benefit of partially reducing β-ODAP levels in grass pea and thus making consumption of the crop safer for humans.

The food processing methods including soaking, germination, decortications, fermentation and cooking greatly influence the nutritive values of legumes. Of these, cooking and germination plays an important role as it influences the bioavailability and utilization of nutrients and improves palatability, which incidentally may result in enhancing the digestibility and nutritive value (Ramakrishna *et al*., 2006).

## II. MATERIALS AND METHODS

**Samples:**

Samples of *Lathyrus sativus* seeds are denoted as LS. The samples of LS- Andhra Pradesh, LS-Odisha, LS- Kerala, LS-West Bengal, LS- Chhattisgarh and LS- Bihar were denoted as LS-AP, LS-KE, LS-OD, LS-WB, LS-CH and LS-BI respectively.

**Chemicals:**

Reagents used for analysis were purchased from Sigma Aldrich Company. All chemicals and reagents used were analytical reagent grade except H2O2, which was laboratory reagent grade.

**Sample Preparations**

The seeds were cleaned manually to remove foreign matters, immature and damaged seeds. Different traditional processing methods (Teklehaimanot et al., 1993):

**Raw**

The cleaned seeds (1Kg) were washed with tap water, rinsed with distilled water and immediately dried in drying oven at 55 °C for 12 h, under air circulation, and then grind by grinder to pass through a 0.425 mm sieve, packed in air tight bottle and stored at room temperature (in the shelf) until analysis.

**Wet roasting**

Whole cleaned seeds (1Kg) were washed with tap water, rinsed with distilled water, soaked with distilled water (1:2 w/v seed to water) for 3 hr., decant the soaking water and washed with another distilled water, placed in 2L of distilled boiling water at 96 °C and cooked for 60 min. (until soft) and immediately dried in drying oven at 55 °C for under air circulation, and then grind by grinder to pass through a 0.425 mm sieve, packed in air tight bottle and stored at room temperature (in the shelf) until required for analysis.

**Boiling**

Whole cleaned seeds (1Kg) were washed with tap water, rinsed with distilled water, soaked with distilled water(1:5 w/v seed to water) at 28 $^0$C ( using water bath) for 20 h and then roasted at 200 °C for 40 min in baking oven placed in a baking try and turning with a fork, and then grind by grinder to pass through a 0.425 mm sieve, packed in air tight bottle and stored at room temperature (in the shelf ) until required for analysis.

**Soaking + Boiling**

100 g sample soaked overnight (8-9 hrs.) in water under room temperature and then boiled in sufficient water until the pulse seed is easily pressed soft by hand/spoon/ladle.

**Mineral analysis**

**Preparation of sample**

Sample (0.5 g) was digested by the wet digestion method. It was first digested with 10 ml HNO3 at gentle temperature (60-70°C) for 20 min. Then the sample was digested with HClO4, at high temperature (190°C) till the solution became clear. The digested sample was transferred to 250 ml volumetric flask and volume was made with distilled water and then filtered (Duhan *et al*., 2002).

**Estimation of mineral contents**

The filtered sample solution was loaded to the atomic absorption spectrophotometer. Calcium, iron, copper, zinc, and magnesium were determined using atomic absorption spectrophotometer method of Osborne and Voogt (1978). The ash obtained after dry ashing at 550 $^0$C was treated with 5 ml of 6N HCl to wet it completely and carefully dried on a low temperature hot plate. 7 ml of 3N HCl was added and the dish was heated on the hot plate until the solution just boils. Then, it has been cooled and filtered through a filter paper in to a 50ml volumetric flask. Again 7 ml of 3N HCl was added to the dish and heated until the solution just boils. Finally, cooled and filtered into the volumetric flask. For the determination of calcium, lanthanum chloride (1% w/v) was added to both standards and samples to suppress interference from phosphorus. The standard curve for each mineral was prepared by running samples of known strength. The mineral contents of the samples were estimated by using the respective standard curve prepared for each element (AACC, 2000). Using atomic absorption spectrophotometer, a calibration curve was prepared by plotting the absorption or emission values against the metal concentration in mg/100g. Reading was taken from the graph, which depicted the metal concentrations that correspond to the absorption or emission values of the samples and the blank. The metal contents were calculated by using the formula:

$$Metal\ content\left(\frac{mg}{100g}\right) = \frac{[(A-B)XV]}{10w}$$

*Where*, $W$ = weight of samples (g)

$V$ = volume of extract (ml)

$A$ = concentration of sample solution (µg/ml)

$B$ = concentration of blank solution (µg/ml)

## III. RESULTS AND DISCUSSION

**Table 1: The mineral composition of *Lathyrus sativus* seeds from Andhra Pradesh in India (LS-AP)**

| Parameters (%) | Raw seeds | Wet roasted | Boiled | Soaked+boiled |
|---|---|---|---|---|
| **Calcium** | 98.2±0.16 | 102±0.23 | 110±0.56 | 113±0.66 |
| **Iron** | 5.66±0.13 | 5.89±0.30 | 6.15±0.19 | 6.98±0.09 |
| **Copper** | 0.82±0.02 | 0.86±0.01 | 0.89±0.03 | 0.94±0.02 |
| **Zinc** | 4.31±0.02 | 4.44±0.02 | 4.52±0.01 | 4.68±0.03 |
| **Magnesium** | 126.56±1.26 | 132.15±1.95 | 151.23±1.33 | 170.23±2.13 |

**Table 2: The mineral composition of *Lathyrus sativus* seeds from Kerala in India (LS-KE):**

| Parameters (%) | Raw seeds | Wet roasted | Boiled | Soaked+boiled |
|---|---|---|---|---|
| **Calcium** | 97.46±0.15 | 98.02±0.13 | 99.23±0.10 | 100±0.09 |
| **Iron** | 5.51±0.10 | 5.76±0.16 | 6.09±0.12 | 6.13±0.11 |
| **Copper** | 0.80±0.01 | 0.83±0.03 | 0.87±0.06 | 0.90±0.05 |
| **Zinc** | 4.26±0.02 | 4.40±0.01 | 4.47±0.04 | 4.51±0.05 |
| **Magnesium** | 120.56±1.26 | 127.15±1.41 | 150.23±1.32 | 161.23±0.06 |

**Table 3: The mineral composition of *Lathyrus sativus* seeds from Odisha in India (LS-OD):**

| Parameters (%) | Raw seeds | Wet roasted | Boiled | Soaked+boiled |
|---|---|---|---|---|
| **Calcium** | 95.23±0.13 | 96.14±0.11 | 97.14±0.16 | 99.02±0.12 |
| **Iron** | 5.44±0.15 | 5.67±0.13 | 6.01±0.12 | 6.10±0.14 |
| **Copper** | 0.77±0.02 | 0.80±0.06 | 0.82±0.03 | 0.87±0.08 |
| **Zinc** | 4.30±0.03 | 4.38±0.06 | 4.42±0.05 | 4.48±0.06 |
| **Magnesium** | 119.56±1.31 | 132.15±1.26 | 149.23±1.41 | 158.62±1.33 |

**Table 4: The mineral composition of *Lathyrus sativus* seeds from West Bengal in India (LS-WB):**

| Parameters (%) | Raw seeds | Wet roasted | Boiled | Soaked+boiled |
|---|---|---|---|---|
| **Calcium** | 94.13±0.15 | 95.21±0.16 | 96.35±0.13 | 98.26±0.11 |
| **Iron** | 5.34±0.11 | 5.63±0.13 | 5.98±0.15 | 6.08±0.12 |
| **Copper** | 0.75±0.01 | 0.78±0.06 | 0.81±0.03 | 0.89±0.04 |
| **Zinc** | 4.35±0.04 | 4.36±0.01 | 4.41±0.06 | 4.46±0.05 |
| **Magnesium** | 117.23±1.46 | 138.15±1.38 | 144.23±1.58 | 158.23±1.69 |

**Table 5: The mineral composition of *Lathyrus sativus* seeds from Chattisgarh in India (LS-CH):**

| Parameters (%) | Raw seeds | Wet roasted | Boiled | Soaked+boiled |
|---|---|---|---|---|
| **Calcium** | 93.26±0.13 | 95.01±0.16 | 97.10±0.13 | 97.13±0.11 |
| **Iron** | 5.31±0.14 | 5.49±0.15 | 5.46±0.12 | 5.82±0.13 |
| **Copper** | 0.70±0.06 | 0.72±0.05 | 0.79±0.03 | 0.85±0.04 |
| **Zinc** | 4.39±0.02 | 4.19±0.04 | 4.47±0.06 | 4.59±0.07 |
| **Magnesium** | 116.26±1.59 | 137.16±1.46 | 145.93±1.39 | 153.29±1.66 |

**Table 6: The mineral composition of *Lathyrus sativus* seeds from Bihar in India (LS-BI):**

| Parameters (%) | Raw seeds | Wet roasted | Boiled | Soaked+boiled |
|---|---|---|---|---|
| **Calcium** | 94.10±0.19 | 95.59±0.16 | 97.00±0.12 | 97.95±0.14 |
| **Iron** | 5.29±0.14 | 5.51±0.16 | 5.62±0.13 | 5.90±0.15 |
| **Copper** | 0.68±0.04 | 0.70±0.02 | 0.74±0.03 | 0.84±0.06 |
| **Zinc** | 4.29±0.03 | 4.30±0.01 | 4.32±0.03 | 4.41±0.02 |
| **Magnesium** | 111.11±1.60 | 133.00±1.46 | 142.23±1.51 | 156.62±1.57 |

Table 1 denotes the mineral analysis of *Lathyrus sativus* seeds from the State of Andhra Pradesh in India (LS-AP). The calcium levels are 98.2±0.16, 102±0.23, 110±0.56, and113±0.66 for raw, wet roasted, boiled and soaked seeds respectively. The iron and copper levels are 5.66±0.13, 5.89±0.30, 6.15±0.19, 6.98±0.09 and 0.82±0.02, 0.86±0.01, 0.89±0.03, 0.94±0.02 in raw, wet roasted, boiled, soaked seeds respectively. The zinc levels are 4.31±0.02, 4.44±0.02, 4.52±0.01 and 4.68±0.03 in raw, wet roasted, boiled and soaked seeds respectively. And, the values for magnesium were 126.56±1.26, 132.15±1.95, 151.23±1.33 and 170.23±2.13 in raw, wet roasted, boiled and soaked seeds respectively.

Table 2 denotes the mineral analysis of *Lathyrus sativus* seeds from the State of Kerala in India (LS-KE). The calcium levels are 97.46±0.15, 98.02±0.13, 99.23±0.10 and 100±0.09 for raw, wet roasted, boiled and soaked seeds respectively. The iron and copper levels are 5.51±0.10, 5.76±0.16, 6.09±0.12, 6.13±0.11 and 0.80±0.01, 0.83±0.03, 0.87±0.06, 0.90±0.05 in raw, wet roasted, boiled, soaked seeds respectively. The zinc levels are 4.26±0.02, 4.40±0.01, 4.47±0.04 and 4.51±0.05 in raw, wet roasted, boiled and soaked seeds respectively. And, the values for magnesium were 120.56±1.26, 127.15±1.41, 150.23±1.32 and 161.23±0.06 in raw, wet roasted, boiled and soaked seeds respectively.

Table 3 denotes the mineral analysis of *Lathyrus sativus* seeds from the State of Odisha in India (LS-OD). The calcium levels are 95.23±0.13, 96.14±0.11, 97.14±0.16 and 99.02±0.12 for raw, wet roasted, boiled and soaked seeds respectively. The iron and copper levels are 5.44±0.15, 5.67±0.13, 6.01±0.12, 6.10±0.14 and 0.77±0.02, 0.80±0.06, 0.82±0.03, 0.87±0.08 in raw, wet roasted, boiled, soaked seeds respectively. The zinc levels are 4.30±0.03, 4.38±0.06, 4.42±0.05 and 4.48±0.06 in raw, wet roasted, boiled and soaked seeds respectively. And, the values for magnesium were 119.56±1.31, 132.15±1.26, 149.23±1.41 and 158.62±1.33 in raw, wet roasted, boiled and soaked seeds respectively.

Table 4 denotes the mineral analysis of *Lathyrus sativus* seeds from the State of West Bengal in India (LS-WB). The calcium levels are 94.13±0.15, 95.21±0.16, 96.35±0.13 and 98.26±0.11 for raw, wet roasted, boiled and soaked seeds respectively. The iron and copper levels are 5.34±0.11, 5.63±0.13, 5.98±0.15, 6.08±0.12 and 0.75±0.01, 0.78±0.06, 0.81±0.03, 0.89±0.04 in raw, wet roasted, boiled, soaked seeds respectively. The zinc levels are 4.35±0.04, 4.36±0.01, 4.41±0.06 and 4.46±0.05 in raw, wet roasted, boiled and soaked seeds respectively. And, the values for magnesium were 117.23±1.46, 138.15±1.38, 144.23±1.58 and 158.23±1.69 in raw, wet roasted, boiled and soaked seeds respectively.

Table 5 denotes the mineral analysis of *Lathyrus sativus* seeds from the State of Chattisgarh in India (LS-CH). The calcium levels are 93.26±0.13, 95.01±0.16, 97.10±0.13 and 97.13±0.11 for raw, wet roasted, boiled and soaked seeds respectively. The iron and copper levels are 5.31±0.14, 5.49±0.15, 5.46±0.12, 5.82±0.13 and 0.70±0.06, 0.72±0.05, 0.79±0.03, 0.85±0.04 in raw, wet roasted, boiled, soaked seeds respectively. The zinc levels are 4.39±0.02, 4.19±0.04, 4.47±0.06 and 4.59±0.07 in raw, wet roasted, boiled and soaked seeds respectively. And, the values for magnesium were 116.26±1.59, 137.16±1.46, 145.93±1.39 and 153.29±1.66 in raw, wet roasted, boiled and soaked seeds respectively.

Table 6 denotes the mineral analysis of *Lathyrus sativus* seeds from the State of Bihar in India (LS-BI). The calcium levels are 94.10±0.19, 95.59±0.16, 97.00±0.12 and 97.95±0.14 for raw, wet roasted, boiled and soaked seeds respectively. The iron and copper levels are 5.29±0.14, 5.51±0.16, 5.62±0.13 5.90±0.15 and 0.68±0.04, 0.70±0.02, 0.74±0.03, 0.84±0.06 in raw, wet roasted, boiled, soaked seeds respectively. The zinc levels are 4.29±0.03, 4.30±0.01, 4.32±0.03 and 4.41±0.02 in raw, wet roasted, boiled and soaked seeds respectively. And, the values for magnesium were 111.11±1.60, 133.00±1.46, 142.23±1.51 and 156.62±1.57 in raw, wet roasted, boiled and soaked seeds respectively.

## IV. DISCUSSION

The mineral analysis of calcium, iron, copper, zinc and magnesium in processed samples of *Lathyrus sativus* from different states of India was determined by using atomic absorption spectophotometry. Among all the States of India, the mineral analysis of the seeds of *Lathyrus sativus* showed higher amounts of minerals in Andhra Pradesh. In Andhra Pradesh, the soaked + boiled processed seeds showed a better amount of mineral values compared to raw, wet roasted and boiled processed *Lathyrus sativus* seeds seeds whereas in Bihar, the values were the lowest. The seeds have a higher concentration of magnesium followed by calcium. The trace minerals are also significantly high.

Loss in calcium content might be due to dehulling as minerals are more concentrated in the testa rather than in the cotyledon (Agbede and Aletor, 2005). It might be due to the presence of varying amount of toxic ODAP levels in different States of India. The processing method of soaking+boiling was found to slightly elevate the free mineral content in the samples.

**Table 7: Comparison of mineral analysis in soaked + boiled seeds of *Lathyrus sativus* from different states of India**

| Parameters (%) | LS-AP | LS-KE | LS-OD | LS-WB | LS-CH | LS-BI |
|---|---|---|---|---|---|---|
| **Calcium** | 113±0.66 | 100±0.09 | 99.02±0.12 | 98.26±0.11 | 97.13±0.11 | 97.95±0.14 |
| **Iron** | 6.98±0.09 | 6.13±0.11 | 6.10±0.14 | 6.08±0.12 | 5.82±0.13 | 5.90±0.15 |
| **Copper** | 0.94±0.02 | 0.90±0.05 | 0.87±0.08 | 0.89±0.04 | 0.85±0.04 | 0.84±0.06 |
| **Zinc** | 4.68±0.03 | 4.51±0.05 | 4.48±0.06 | 4.46±0.05 | 4.59±0.07 | 4.41±0.02 |
| **Magnesium** | 170.23±2.13 | 161.23±0.06 | 158.62±1.33 | 158.23±1.69 | 153.29±1.66 | 156.62±1.57 |

## CONCLUSION

In addition to being important source of protein and calories, grass pea is rich in minerals. The results revealed that the calcium, iron, copper, zinc and magnesium levels in samples from LS-AP were found to be slightly more than other States and LS-BI was found to have the least values. The processing method of soaking+boiling was found to slightly elevate the free mineral content in the samples.

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