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# ROLE OF GRASS PEA (LATHYRUS SATIVUS L.) IN NUTRITION SECURITY AND RISK OF NEUROLATHYRISM

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## ABSTRACT

The objective of this review was to draw attention to the possible role of grass pea(Lathyrus Sativus L.) in food and nutrition security. Grass pea is tolerant to adverse climatic variables and soil nutrient deficiency. This agrological characteristics of the plant are particularly important for the poor farmer living in arid and semi arid areas where the annual rainfall is very low. The plant is a good source of human food and forage for animal production. Despite the good nutritional profile, there are potential anti-nutritional and toxic substances such as phytates, tannins, and β-N-oxalyl-α,β-diaminopropionic acid (β-ODAP) contained in the plant. One of the major limitations of the plant is the irreversible damage of the nerve system (neurolathyrism) if consumed for a long period of time. Both scientific and traditional efforts have been made to avoid the effects of the anti-nutritional factors and toxic substances of the plant. Different food preparation methods like soaking, boiling, roasting, and sousing are being practiced to avoid the risk of neurolathyrism. Different breeding strategies to produce a low level of β-ODAP has been also conducted and grass pea varieties with a low level of β-ODAP are released. Therefore; if the effects of antinutritional factors and the neurotoxin are minimized, the plant can assure nutritional security by direct consumption and supporting animal production.

**Key words**: Grass pea, neurolathyrism, nutritional security

## INTRODUCTION

The prevalence of undernourishment in the world is estimated to be 10.9 percent in 2017. The situation is worsening south America and most regions of Africa (WHO, 2018). There has been the least progress in the sub-Saharan region, where about 23 percent of people remain undernourished – the highest prevalence of any region in the world. Nevertheless, the prevalence of undernourishment in sub-Saharan Africa has declined from 33.2 percent in 1990– 92 to 23.2 percent in 2014–16, although the number of undernourished people has actually increased (FAO et al., 2017). Wasting and stunting of children are common undernourishment problems. Moreover, the prevalence of anemia among women of reproductive age has risen incrementally from 30.3 percent in 2012 to 32.8 percent in 2016 with no region showing a decline. Effort made so far in agriculture is to supply food (ensure food security ) without agricultural diversification to supply the necessary macro and micro nutrients (nutrition security).

Major causes for both food and nutrition insecurity are increasing conflicts, crises, and climate change. Climate change disproportionately affect food unsecured regions jeopardizing both crop & animal productions. Some regions especially arid and semi arid areas are affected by recurrent drought which is characteristic feature of climate change. Therefore selecting crop varieties resistant to drought may be one mitigation strategy to ensure food and nutrition security.

Nutrient-dense food crops with reduced water demands such as Grass pea (Lathyrus sativus L.) are likely to play a key role in alleviating global malnutrition. Grass pea is a crop of immense economic significance, especially in developing nations including India, Bangladesh, Pakistan, Nepal, and Ethiopia (Kumar et al., 2011). The objective of this review is therefore to highlight the role of grass pea in nutrition security, risk of neurolathyrism of using grass pea seeds as food and strategies to avoid the negative effects of this crop.

### Origin and Ecology of Grass pea

The origin of grass pea is not well known. But different authors give different areas of the world as the origin of the crop. Vavilov (1951) described two separate centers of origin of the crop. One was the Central Asiatic Centre which includes northwest India, Afghanistan, the Republics of Tajikistan and Uzbekistan and western Tian-Shan. The second was the Abyssinian Centre. Grass pea (*Lathyrus sativus*) is a common crop in many Asian and African countries as well as in the Mediterranean Basin where it is used either for animal feed or human consumption (Crino *et* *al.*, 2004). The renewed interest in grass pea production is due to the need to reintroduce rational crop rotations in areas overexploited by cereal cultivation, and also to partially satisfy the demand for protein concentrates for animal feed (Crino *et al.*, 2004). In addition, it is interesting agronomicaly that the plant is drought tolerant, resistant to pests of stored grains and adaptable to different types of soil as well as to adverse climatic conditions as described by the same author. Despite its tolerance to drought it is not affected by excessive rainfall and can be grown on land subject to flooding (Rathod, 1989; Campbell *et al*., 1994).

**Nutritional Value of Grass pea**

As a nutrient-dense food/feed crop and its high drought tolerance with minimal input requirements for its cultivation, grass pea provides food and nutrition security to many low-income communities. Grass pea can serve as animal feed and fodder, and also as human food. The leaves are utilized in animal feeding. Grass pea contains 18–34% and 17% of protein content in seeds and mature leaves respectively (Razvi et al. 2016). Rahman *et al*. (1974) also reported the following values for *L. sativus*: energy 362.3 kcal/kg; protein 31.6%; fat 2.7%; nitrogen-free extract 51.8%; crude fiber 1.1% and ash 2.2%.



Grass pea is rich in lysine which low in most cereals. But, it is deficient in methionine and cysteine, sulfur-containing essential amino acids (Mahler-Slasky and Kislev, 2010). Moreover; in common with other orphan legumes, grass pea contains compounds used in the disease treatment of humans. For instance it is the unique dietary source of the amino acid l-homoarginine which is important in cardiovascular disease treatments (Van Wyk et al. 2016) and in overcoming the development of cancer tumor due to hypoxia at the tissue level (Jammulamadaka et al. 2011).

**Grass Pea as Human Food**

Legumes have an important place in human and animal nutrition. Nutrition security accounts supplying all the essential nutrients whether it be macro or micro nutrient. Grass pea effectively withstands unfavorable conditions including excessive moisture at sowing, which is often followed by moisture stress at advanced growth stages (Dixit et al. 2016) . This nature of the plant is a good opportunity to introduce the plant to arid and semi arid areas for food and nutrition security. Not only the agro ecological adaptation, but also the nutritional profile of the plant seed makes it potential for food and nutritional security. Different grass pea varieties contain retinol, β-carotene, thiamine, riboflavin, niacin, pantothene, pyridoxine, folic acid and ascorbic acid ranged from 25.6 to 44.1 μg/kg; 240.8 to 410.1 μg/ kg, 3.74 to 5.44; 1.86 to 2.76; 12.37 to 20.25; 14.43 to 22.41; 4.92 to 6.62; 4.04 to 6.77 and 33.4 to 58.2 mg/kg, respectively (Arslan, 2017). Grass pea contains excellent source of protein and other macro and micro nutrients. Phosphorus content of grass pea germplasms ranging from 380.4-511.6 mg/100g and calcium 131.6-200.1 mg/100g (Urga, et al. 1995) which can easily meet the daily recommended intake of 800mg/day of calcium and 500mg/day of phosphorus for children with in 4-8 years old (Yates, et al. 1998).

**Grass pea as animal feed/Fodder**

The use of legumes as source of protein content for the animal feed industry is expected to increase further in the near future. For many years there has been an emphasis on local production of legumes for animal feed in order to supply some of this protein demand (Gatel,1994). But, Poor productivity of both animal and crop is a challenge for farmers in moisture stressed arid and semi arid areas of the world. This might be due to changes in precipitation and temperature may lead to changes in runoff and water availability, which, in turn, could affect crop productivity (Bates et al., 2008). Drought tolerant forage and food crops are likely appropriate for food and nutrition security in these areas.

Grass pea, which seed and leaves can be used as an animal feed is tolerant for both high moisture (Sinha, 1980) and drought (Jiang et al., 2013). The crop can produce fodder and seed for animal feeding. Well fed animals can perform well in producing different products; milk, meat, egg and other byproducts than can ensure nutrition security of the community living in arid and semi arid areas. Research results reported by Assefa and Animut, (2013) indicated improved daily body weight gain, hot carcass weight and dressing percentage on empty body weight basis of sheep supplemented with heat treated grass pea.

The proximate composition of grass pea seed shows a very good nutrient digestibility, low fat and ADF contents and high starch (44.2) and protein (27%) contents ( Larbi et al., 2010). The Crude Protein (CP), Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) values of grass pea hay was analysed to be 232.4, 397 and 300.6 (g kg-1 DM) respectively in a research conducted in Iran (Vahdani et al. 2014).

## Antinutritional factors and Risk of Neurolathrism

Containing enough amount of nutrients in a certain doesn't guarantee its potential to be used in nutrition security. This is due to the fact that some of the plants may contain compounds that affect the digestibility of nutrients so that the nutrient contained will lower bioavailability (Davies and Nightingale, 1975). The neurotoxin β-N-oxalyl-α,β-diaminopropionic acid (β-ODAP) present in grass pea seeds is the main antinutritional factor limiting the wide use of the grain. The neurotoxin, non-protein amino acid causes irreversible spastic paralysis of the legs known as neurolathyrism, when it is consumed as a major portion of the diet over a three-to-four month period (Urga *et al.* 2006). The disease is characterized by symmetrical axonal degeneration of crossed and uncrossed pyramidal tracts in the thoracic, lumbar and sacral spinal cord (Streifler et al.1977) and loss of pyramidal cells in the area of the cortex controlling the leg (Haimanot et al. 1990). The mechanism of its action has not been yet conclusively explained. But; it is indicated that β-ODAP forms chelates with bivalent cations such as zinc, manganese, copper and iron that are essential for the activity of superoxide dismutase and peroxidase. These enzymes protect against the abrasive effects of reactive oxygen species (ROS) that play a role in oxidative stress (Getahun et al., 2005).



Neurolathyrism epidemics mainly occur during times of food shortages as in drought and flood related famine as grass pea is resistant to both water shortage and flooding (Getahun et al., 2005). There are evidences of neurolathyrism outbreak in Ethiopia in 1997 (Getahun et al. 2002). The highest β-ODAP content of the grain was found from grass pea accessions of *Kok-Egir* and *Shanko* with values of 0.35% and 0.45%, respectively in Ethiopia (Denekew and Tsega, 2009). Apart from this there have been also several reports of levels as low as 0.01% from Canada and Ethiopia (Campbell, 1997).

## Efforts Made to Minimize Risk of Neurolathyrism

Great efforts has been done to reduce the β-ODAP content in grass pea plant varieties by different breeding system (Rahman et al., 1995 ;Talukdar, 2009). For example, grass pea lines with <0.1% ODAP concentration have been identified at ICARDA and one of them with high yield (1.67 ton $ha^{-1}$) and low ODAP (0.08%) has been released in Ethiopia (Kumar et al., 2011). Deactivating and removing β-ODAP from the seed harvested from grass pea varieties with high β-ODAP content through different processing methods has been also conducted (Srivastava and

Khokhar, 1996). Grass pea can be treated with different processing methods to overcome the risk of neurolathyrism as well as increase the bioavailability of nutrients contained in grass pea seed. Research reports indicated that dry heat treatment greatly lowers the level of ODAP content (75%) of grass peas (Kebede et al., 1995) and Grass pea seeds soaked for three days in different soaking media reduced 52-82% of β-ODAP contents (Urga and Gebretsadik, 1993). Steeping grass pea in excess water leaches out 30% of the β-ODAP. Lower levels of β-ODAP were found in boiled snacks (*nifro*) and the flour form (*shiro*) in the Ethiopian food preparation to consume grass pea(Tekle-Haimanot et al., 1993). Grass pea bread (*kitta*) and roasted seeds (*kollo*) showed elevated levels of β-ODAP compared to the seeds used in the preparation of these foods.

**CONCLUSION**

Grass pea, tolerant to adverse climatic variables grows in the agro ecologies most likely are extremities (moisture stress vs flood or water lodged areas in the rainy season). This agro ecological adaptation of the plant makes it preferable plant for food and nutrition security especially in the areas where very few types of food crops are grown.

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