



UNLOCKING THE POTENTIAL OF LEGUMES: OVERCOMING NUTRITIONAL BARRIERS AND ANTI-NUTRIENT COMPLEXITIES

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Abstract

Although legumes are essential sources of energy, protein, and bioactive substances, anti-nutritional factors frequently limit their full nutritional value. These include goitrogens, cyanogenic glycosides, protease inhibitors, haemagglutinins, and neurotoxins linked to lathyrism. Protease inhibitors, which are commonly found in kidney beans, peanuts, and soybeans, prevent the digestion of proteins by preventing enzymatic activity. However, they can be successfully rendered inactive by heating them. Despite being heat labile, lectins, or haemagglutinins, decrease food intake and nutritional absorption. Under marginal iodine intake, goitrogenic substances like thiocyanates and isothiocyanates can cause goitre by interfering with iodine uptake. Although most pulses stay within safe bounds, cyanogenic glycosides, which are found in large quantities in select legumes like lima beans, have the potential to release lethal hydrogen cyanide. *Lathyrus sativus* (khesari dhal), consumed in certain Indian regions, contains the neurotoxin β -N-oxalyl-L- α,β -diaminopropionic acid (ODAP), which can cause lathyrism if consumed excessively. Toxin levels are greatly reduced by 80–90% using detoxification techniques such as soaking, boiling, parboiling, and sun drying, making eating safer. Understanding these nutritional challenges and adopting appropriate processing strategies is

essential to maximize the health benefits of legumes while minimizing their risks.

Protease Inhibitors

All over the plant kingdom, but especially in legumes, there exist substances that can prevent the proteolytic action of specific enzymes. The inhibitors prevent the release of amino acids, which prevents animals fed these legumes from growing normally (Leung et al., 2000). Many legumes, such as soybean, peanut, navy bean, lima bean, etc., contain trypsin inhibitors. Proteins known as trypsin inhibitors prevent the stomach enzyme trypsin from doing its job, which hinders the digestion of food proteins and lowers their use. In general, they are heat labile. Nearly all trypsin inhibitors are rendered inactive by autoclaving at 120°C for 15–30 minutes (Choi, 2018). Dhals can readily inactivate trypsin inhibitors, but kidney beans and soybeans require more intense heat treatment to do the same.

Haemagglutinins

These are naturally occurring proteins that are also known as lectins or phytoagglutinins. One of the substances that seems to be present in all legumes is a protein known as phytohaemagglutinins, which has the unusual ability to agglutinate red blood cells. Leguminous seeds contain them in large quantities (Smith and Westwood, 1949). Haemagglutinins cause poor growth by reducing food intake. Heat labile substances are haemagglutinins (Barnard, 2001).

Haemagglutinins interfere with the absorption of amino acids by interacting with intestinal wall lining cells in a manner similar to that of red blood cells.

Goitrogens

These chemicals prevent the thyroid gland from absorbing iodine. Lentils, groundnuts, and soybeans contain thiocyanate, isothiocyanate, and their derivatives (Muzzaffar et al., 2022). Goitre may develop if these substances are consumed in excess when iodine intake from food and water is just moderate.

Cyanogenic Glycoside

When an enzyme found in the diet hydrolyzes cyanogenic glycosides, hydro-cyanic acid is produced (Gana,2023). This disrupts tissue respiration, which results in cyanide poisoning. Hydrogen cyanide is released when the enzyme α -glycosidase hydrolyzes the glycoside. A pulse's cyanide concentration of 10–20 mg/100g is regarded as safe (Airaodion,2019). With the exception of lima beans, many legumes contain cyanide within this range.

Lathyrism

Man is crippled by a nerve condition called lathyrism. This is completely avoidable. It is now understood that consuming too much of the pulse *Lathyrus sativus* (Khesari dhal) causes the illness. Young men between the ages of 15 and 45 are affected (Manna ,1999). Madhya Pradesh, Uttar Pradesh, Bihar, Bengal, Maharashtra, Mysore, and Andhrapradesh are among the arid regions where *Lathyrus sativus* is farmed. The common term for it is "Khesari dhal" throughout the nation. The dehusked seeds look like red or Bengal gram dhal (Khokhar et al.,1996). Thus, khesari dhal is occasionally added to other dhals as an adulterant. *Lathyrus* seeds are a good diet when consumed in little amounts since they contain 28% protein. However, if they provide more than 50% of the energy, a serious spinal

cord illness could develop (Islam et al., 1986). Lathyrism is caused by the neurotoxin B-N-Oxalyl-L -diaminopropionic acid. Steeping or parboiling can be used to eliminate toxins.

The seeds are initially heated to a boil four times their original quantity. For two hours, seeds are steeped in boiling water. It is necessary to drain the water. After being cleaned with cool, fresh water, the seeds are allowed to dry in the sun. This approach removes 80 to 90 percent of the poison. For twelve hours, the seeds are submerged in cold water. For 20 to 30 minutes after that, the seeds are steam-cooked. Once more, seeds are soaked for an hour before being dried. Through this procedure, 80–90% of the toxins are released.

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