



BOAA: A Toxic Compound with Agricultural and Health Implications

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BOAA, or β -N-Oxalyl-L- α,β -diaminopropionic acid, is a naturally occurring non-protein amino acid with neurotoxic traits. It is found mostly in the seeds of *Lathyrus sativus* (also known as grass pea or khesari dal), a legume produced in South Asia and Sub-Saharan Africa. While this crop is cheaper and drought-resistant, long-term consumption can result in a hazardous neurological condition known as lathyrism.

Chemical nature and structure

BOAA is structurally similar to glutamic acid, the primary excitatory neurotransmitter in the human neurological system. Its chemical structure is similar to excitatory amino acids, and it acts primarily as an agonist of AMPA-type glutamate receptors, resulting in excitotoxicity.

Natural occurrences

BOAA is mostly found in *Lathyrus sativus*, a crop grown in India, Bangladesh, Ethiopia, and Nepal for its protein-rich seeds and capacity to thrive under extreme environmental conditions. However, BOAA concentrations in the seeds might range from 0.5-2.5% of dry weight.

Toxicity and health effects

Health Effects: Neurolathyrism Long term ingestion of *Lathyrus sativus* with high BOAA levels can result in neurolathyrism, a neurodegenerative condition characterized by:

- Spastic paralysis of the lower limb
- Legs that are weak and stiff
- Irreversible injury to motor neurons

This syndrome primarily affects young adult males who take high amounts of grass pea over several months. Epidemiological evidence from impacted areas, including India and Ethiopia, has proven the association between BOAA exposure and neurolathyrism outbreaks.

Mechanism of toxicity

BOAA crosses the blood-brain barrier and functions as a glutamate receptor agonist, notably at AMPA receptors. Excessive activation of these receptors causes calcium ion influx, oxidative stress, and, eventually, motor neuron apoptosis (programmed cell death).

Reduction of BOAA content

Several technological and genetic methods are being used to lower BOAA levels. BOAA is water-soluble and can be removed by soaking and boiling repeatedly. Traditional procedures, such as natural fermentation, considerably lower BOAA content. Indian agricultural research

organizations such as IIPR and ICAR have generated Lathyrus cultivars with less than 0.1% BOAA. Genetic manipulation to disable BOAA production pathways is being investigated.

Conclusion

BOAA is a powerful neurotoxin that poses both a threat and an opportunity. While Lathyrus sativus provides food security in harsh situations, the presence of BOAA restricts its safe use. Breeding low-BOAA cultivars, educating the public, and conducting ongoing investigations are essential to minimizing dangers and maximizing the crop's potential.

References

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