DISTRIBUTION OF α- AND β-ISOMERS OF N-OXALYL-α, β-DIAMINO PROPIONIC ACID IN SOME INDIAN VARIETIES OF *L. SATIVUS*

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NEUROLATHYRISM, a crippling disease associated with the consumption of *L. sativus* for a prolonged period, is endemic in several villages in Central India where the consumption of the pulse is generally high.[1] A toxic principle, capable of inducing neurological symptoms in young chicks through injections of aqueous ethanol extract of *L. sativus* was identified by Roy, Nagarajan and Gopalan,[2] and later isolated and characterised by Adiga, Rao and Sarma[3] as an unusual amino-acid, β-(N)-oxalyl-α, β-diamino propionic acid or β-(N)-oxalyl amino alanine. The compound was found to be neurotoxic to other species of animals like rat[4] and duckling.[5] Injected intrathecally into monkeys, it could induce paraplegia.[6]

Analysis of a large number of samples of *L. sativus* collected from the endemic area indicated that the concentration of total (N)-oxalyl-α, β-diamino propionic acid (BOAA) in them varied widely, ranging from 0·1 to 2·5%.[7] Bell and O'Donovan[8] showed that the naturally occurring (N)-oxalyl-α, β-diamino propionic acid can exist in two forms as α- and β-isomers, which could be separated by high voltage electrophoresis. A reversible transfer of the oxalyl group between α- and β- amino groups could occur with the establishment of an equilibrium under certain experimental conditions. Under normal conditions, the concentration of the β- form was about 95% of the total compound present in the seeds. It is, however, not established whether the two isomers of the above compound are equally effective as neurotoxic agents.

In the present study, the distribution of α- and β-oxalyl derivatives of diamino propionic acid in some Indian varieties of *L. sativus* seeds, containing high and low concentrations of this compound, was investigated. Since the concentration of the oxalyl derivatives of diamino propionic acid increases during germination of the seeds, the distribution of α- and β-isomers was also estimated in the germinating seeds.

Twelve selected samples of *L. sativus* collected from different districts of Madhya Pradesh were divided into two main groups: (a) six samples of low BOAA-containing varieties in which the BOAA concentration ranged from 0·12 to 0·25%; and (b) six samples with high BOAA content ranging from 2·00 to 2·25% of the toxin.

Two-and-a-half grams of seeds were used for analysis as such, and another identical batch was allowed to germinate under optimum laboratory conditions before being taken up for analysis. A 30% alcohol extract of the seeds prepared according to the procedure of Nagarajan *et al.*[9] was lyophilised at 0·05 mm. and −60° F., to complete dryness. This procedure eliminated any possibility of interconversion of α-, and β-isomers of the oxalyl derivative of diamino propionic acid.

The lyophilised material was dissolved in a known volume of distilled water and subjected to electrophoresis in Beckman Model R paper electrophoresis system with "Durrum" type cell. Ten to twenty μl of the extract was applied on Whatman No. 1 filter-paper strip and the fractionation was carried out in a buffer system containing formic acid, pyridine and water (4·0 : 0·3 : 95·7) at pH 2·2 and 300 V for 4 hours. The relatively fast moving β-isomer and the slow moving α-isomer were identified by staining with ninhydrin and scanned in Beckman "Analytrol" densitometer. Isolated and purified oxalyl derivative of α, β-diamino propionic acid[9] when subjected to electrophoresis under the above conditions also showed two distinct spots corresponding to the above two positions and these two could be distinguished by their colour development with ninhydrin.[8] To obtain the relative concentration of each isomer, the area under the corresponding peak was calculated as percentage of the total area.

It was observed (Table I) that irrespective of the concentration of BOAA in different varieties of *L. sativus*, the proportion of α- and β-isomers of the compound remained

TABLE I

Percentage of α- and β- forms of BOAA in low and high BOAA containing L. sativus seeds and corresponding seedlings

Sample No.*	% BOAA*	In seeds β form as % of total	In seedlings β form as % of total
I. BOAA Low Variety			
247	0·20	95·0	96·1
2	0·12	89·7	96·3
10	0·25	94·3	95·8
32	0·25	93·0	93·6
24	0·25	90·4	97·0
13	0·12	90·0	94·7
Average	0·19	92·06	95·6
β-isomer = 92·06%		β-isomer = 95·6%	
α-isomer = 7·94%		α-isomer = 4·4%	
II. BOAA High Variety			
S-38	2·25	93·8	95·5
S-90	2·13	97·3	94·4
S-13	2·13	95·2	94·3
S-83	2·13	96·1	97·8
S-102	2·00	97·7	98·5
BGT-200	2·00	95·7	97·1
Average	2·10	95·9	96·2
β-isomer = 95·9%		β-isomer = 96·2%	
α-isomer = 4·1%		α-isomer = 3·8%	

* Samples and analytical data were kindly supplied by Dr. V. Nagarajan.

constant. The β-isomer in "high" and "low" BOAA-containing varieties of *L. sativus* ranged between 92 and 96% of the total BOAA, while α-isomer was very low (4-8%) in the samples studied. The process of germination did not alter the relative proportions of α- and β-isomers.

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ON THE FLOW OF A CONDUCTING FLUID IN A ROTATING STRAIGHT PIPE

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CONSIDER a weakly conducting fluid flowing through a straight pipe, walls $z = \pm = L$, under the action of a constant pressure gradient $-\partial\Pi/\partial x$ in the direction of x-axis. H_0 is a uniform magnetic field imposed along z-axis and the walls rotate with an angular velocity Ω about the same axis. Assuming that the motion is laminar, the equations of hydromagnetic motion[1] in a rotating frame of reference (stationary relative to the walls) for an incompressible fluid in terms of the complex velocity field $q(z, t) = u + i\, v$ is

$$\frac{\partial q}{\partial t} + 2i\Omega q = -\frac{1}{\rho}\frac{\partial\Pi}{\partial x} + v\frac{\partial^2 q}{\partial z^2} - mq, \quad (1)$$

where

$$\Pi = p - \frac{1}{2}\rho\Omega^2(x^2 + y^2), \quad m = \frac{\sigma\mu^2 H_0^2}{\rho}. \quad (2)$$

We assume at $t = 0$, $q = 0$. The motion is caused by sudden change of pressure gradient from zero to a constant quantity P at $t = 0$. We represent

$$-\frac{1}{\rho}\frac{\partial\Pi}{\partial x} = \mathrm{P}H(t) \quad \text{at} \quad t = 0, \quad (3)$$

where H is a Heaviside's unit function.

We seek the solution of (1) subject to the conditions for no slip at the walls.

$$q = 0 \quad \text{for} \quad t > 0 \quad \text{at} \quad z = \pm L. \quad (4)$$

Using the Laplace transform technique, we find that the solution $\bar{q}$ of the transformed differential equation satisfies,

$$\bar{q} = -\frac{\mathrm{P}\,ch\,\sqrt{(s + m + 2i\Omega)/v}\;z}{s\,(s + m + 2i\Omega)\,ch\,\sqrt{(s + m + 2i\Omega)/v}\;\mathrm{L}} + \frac{\mathrm{P}}{s\,(s + m + 2i\Omega)}. \quad (5)$$

On inversion and separating real and imaginary parts, we get