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NOTE

Anti-Nutritive Factors in Some Cultivated Varieties of Leguminous Seeds

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Anti-nutritive factors like cyanogenetic glycosides, tannins, oxalates, trypsin inhibitor activity and haemagglutinin activity were studied on the seeds of *Glycine max* variety NRC-37, *Vigna radiata* variety LGG-460 and *Phaseolus mungo* variety LBG-20.

Key Words: Anti-nutritive factors, Leguminous seeds, *Glycine max* variety NRC-37, *Vigna radiata* variety LGG-460 and *Phaselous mungo* variety LBG-20.

Legumes have a predominant place in an average Indian diet. They are the major and valuable source of proteins, carbohydrates, minerals and vitamins and occupy a very important place in human nutrition in many developing countries. However, their role appears to be limited by several factors, which include low protein digestibility and flatulence[1]. Although numerous toxic compounds are found in raw legumes including polyphenols (tannin), trypsin inhibitor activity, cyanogenetic glycosides, phytic acid saponin, oxalates and haemagglutinin activity. Since the toxic principles associated with the seed under investigation are not known, attempts are made to evaluate them.

Polyphenols decrease the digestibility of protein and carbohydrates, as a result of formation of insoluble enzyme-resisting complex. Other anti-nutritional effects, which have been attributed to these polyphenols, include damage to intestinal tract, lowered feed efficiency and growth depression in animals[2]. Trypsin inhibitor activity also depresses digestion or metabolic utilization of proteins. Another substance, which appears to be universally distributed among the legumes, is a protein which has the unique property of being able to agglutinate red blood cells, the so called phytohaemagglutinins. In 1953 Lienar isolated phytohaemagglutnins from soybeans and demonstrated its ability to inhibit the growth of rats[3].

Oxalates and cyanogenetic glucosides reduce the solubility or interfere with utilization of mineral elements[4]. This anti-nutritional quality reduces the availability of nutrients of the seeds. Thus it is necessary to determine the toxicity of the seeds before the sample is included in the dietary system.

The seeds of *Glycine max* (NRC-37), *Vigna radiata* (LGG-460) and *Phaselous mungo* (LBG-20) were procured from Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur. Cyanide and tannin contents of the seeds were determined by the method of AOAC[5]. Oxalates were determined by using the method of Talpatra *et al.*[5]

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Trypsin inhibitor activity was determined by the method of Kakade *et al.*[7] with certain modifications[8, 9]. Haemagglutinin activity was studied on chicken blood erythrocytes, goat blood erythrocytes and human blood erythrocytes by using the serial dilution method of Liener[10].

TABLE-1
ANTINUTRITIVE FACTORS IN LEGUMINOUS SEEDS UNDER INVESTIGATION

Variety name	Cyanide content (HCN mg/100g)	Tannin content (g/100g)	Oxalate content (g/100g)	Trypsin inhibitor activity (TIU/mg protein)	Haemagglutinating activity		
					Chicken blood erythrocytes	Goat blood erythrocytes	Human blood erythrocytes
Glycine max NRC-37	2.79	0.41	0.03	11.30	–ve	–ve	–ve
Vigna radiata LGG-460	4.05	0.02	0.06	10.23	–ve	–ve	–ve
Phaseolus mungo LBG-20	4.72	0.46	0.05	10.32	–ve	1:5	–ve

TABLE-2
EFFECT OF PROCESSING TREATMENTS ON HAEMAGGLUTININ ACTIVITY IN *PHASEOLUS MUNGO* (LBG-20) WITH HUMAN BLOOD ERYTHROCYTES

Seeds	Treatments			
	Unprocessed seeds	Boiling for 10 min	Soaking for 24 h	Roasting in microwave oven for 5 min
Phaseolus mungo LBG-20	1:5	–ve	–ve	–ve

Cyanide content, tannin content, oxalate content, trypsin inhibitor activity and haemagglutinin activity of the seeds are given in Table-1 and the effect of different processing treatments on haemagglutinin activity in *Phaselous mungo* (LBG-20) with human blood erythrocytes are given in Table-2.

Cyanide content of different varieties of legume seeds (Table-1) ranged from 2.79–4.72 HCN mg/100g. Among these legume seeds *Glycine max* variety NRC-37 contained significantly greater amount (2.7 mg HCN/100g) of cyanide than other varieties of *Glycine max*[4]. Varieties *Vigna radiata* (LGG-460) and *Phaseolus mungo* (LBG-20) contained 4.05 and 4.72 mg HCN/100 g of cyanide content respectively which is in close proximity with other varieties of leguminous seeds[11-15]. The values of cyanide content observed in the present study are comparatively less than the fatal dose[11] (50 mg/kg).

Tannin content in the leguminous seeds varied from 0.02–0.46 g/100g. Tannin content of variety NRC-37 (*Glycine max*) was significantly less (0.41 g/100 g) than other varieties of *Glycine max* reported by Harsha *et al.*[4], while for *Vigna radiata* (LGG-460) and *Phaseolus mungo* (LBG-20) it was determined as 0.02 g/100 g and 0.46 g/100 g seeds respectively. Thus the values reported for tannin content lie well below the fatal dose[11] (6000 mg/kg).

The oxalate content (in terms of oxalic acid) in the different varieties of leguminous seeds ranged from 0.03–0.06 g/100 g. It was found to be 0.03 g/100 in case of *Glycine max* (NRC-37), while 0.06 and 0.05 g/100 g of seeds for *Vigna radiata* (LGG-460) and *Phaseolus mungo* (LBG-20) respectively.

The observed values for oxalates in the present study are in conformity with the

data of other Indian varieties of leguminous seeds[4, 15]. All values of oxalates were found to be less than the fatal dose[11] (10 g/100 g).

The trypsin inhibitor activity of the seeds varied from 10.23–11.30 TIU/mg protein. Varieties NRC-37 (*Glycine max*), LGG-460 (*Vigna radiata*) and LBG-20 (*Phaseolus mungo*) exhibited 11.3, 10.23 and 10.32 TIU/mg protein of trypsin inhibitor activity respectively, which is found to be less than the other varieties of leguminous seeds[1, 13, 16].

From the perusal of the data (Table-1) it appears that the seeds of *Glycine max* (NRC-37) and *Vigna radiata* (LGG-460) were found to have no haemagglutinin activity with chicken blood erythrocytes and human blood erythrocytes, while *Phaseolus mungo* variety LBG-20 exhibited agglutination against the erythrocytes of goat blood up to the titre value 1 : 5. No haemagglutinin activity was reported above this dilution.

It was observed from the data (Table-2) that unprocessed (raw) seeds of *Phaseolus mungo* exhibited haemagglutinin activity up to the titre value 1 : 5. Available information (Table-2) shows that the haemagglutinin activity could be destroyed by various domestic processing treatments such as boiling, soaking and roasting in microwave oven. All types of processing treatments employed at domestic levels were effective in reducing the contents of different anti-nutritional factors. However, processing treatments involving high temperature reduce the haemagglutinin activity. Among the various heat treatments boiling was the most effective as it destroyed up to 90% of haemagglutinin activity whereas soaking reduced up to 25–40% haemagglutinin activity. On the other hand, germination, boiling, soking and roasting were found more effective in reducing the amount of other remaining antinutritional factors.

REFERENCES

1. N. Rani and C.K. Hira, *J. Food Sci.Tech.* **35**, 540 (1998).
2. S. Paramjyothi and V.H. Mulimani, *J. Food. Sci. Tech.*, **33**, 259 (1996).
3. I.E. Liener, *Ind. J. Nutr. Dietet.*, **10**, 303 (1953).
4. Harsha, P. Saxena and S.K. Shrivastava, *Bull. Pure Appl. Sci.*, **19C**, 101 (1996).
5. AOAC, Official Method of Analysis, Washington D.C., p. 439 (1970).
6. S.K. Talpatra, S.C. Roy and K.C. Sen., *Ind. J. Vetry. Sci. Anim. Husb.*, **18**, 99 (1948).
7. M.L. Kakade, N.R. Simsons and I.E. Liener, *Cereal Chem.*, **46**, 8518 (1975).
8. A.K. Gupta and A.D. Deodhar, *Ind. J. Nutr. Dietet.*, **12**, 81 (1975).
9. G.E. Haemerstand, L.T. Black and J.D. Glover, *Cereal Chem.*, **58**, 42 (1981).
10. I.E. Liener, *Arch. Biochem. Biophys.*, **54**, 223 (1955).
11. Sarjekar, P. Saxena and S.K. Shrivastava, *Ann. Plant. Physiol.*, **8**, 198 (1994).
12. A.K. Sharma., *Legume Res.*, **14**, 197 (1991).
13. C.K. Hira and N. Chopra., *J. Food Sci. Technol.*, **32**, 501 (1995).
14. O.P. Gupta, L.P.S. Rajput and S.P. Tripathi, *Jawaharlal Nehru Krishi Vishvavidyalaya Res. J.*, **35**, 75 (2001).
15. P. Saxena, P. Saxena and S.K. Shrivastava, *Ultra Sci.*, **12**, 396 (2000).
16. S. Saxena, G. Singh and B.K. Mittal, *J. Food Sci. Tech.*, **31**, 145 (1994).

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