

BIHAR ANIMAL SCIENCES UNIVERSITY
Bihar Veterinary College, Patna
Department of Animal Nutrition

Second Professional Year (UNIT-I)

**Harmful Natural Constituents & Common Adulterants
(Lecture-4)**

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Point to be discuss.....

- ✓ Proteins
- ✓ Amino Acids and Amino Acid Derivatives
- ✓ Carbohydrates
- ✓ Lipids
- ✓ Metal binding substances
- ✓ Resins
- ✓ Mycotoxins

3. Proteins:

- Several important inhibitors in plants are proteins.
- In some cases, effect of these are to inhibit the utilization of other proteins by animals.

i. Protease (Trypsin) and Amylase Inhibitor:

- Inhibitors of enzymes, such as trypsin, chymotrypsin, carboxypeptidases, elastase appear in many food products (legumes, cereals, potatoes etc.).
- Adverse effects following short- and long-term ingestion of raw soybean meal (the richest source of dietary trypsin inhibitors) by mammals & birds on protein utilization & growth, attributed to presence of trypsin inhibitors.

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Protease inhibitors fall into 2 main categories:

- 1. Kunitz inhibitor:** MW- 21.5 kilodalton with 2 disulfide bridges and possess specificity mainly against trypsin.
 - 2. Bowman-Birk inhibitor:** MW- 8 kilodalton with a high proportion of disulfide bonds & capability of inhibiting chymotrypsin & trypsin at independent binding sites.
- Levels of trypsin inhibitors (mainly as the Kunitz trypsin inhibitor) in soybeans have been reported to vary from 17-48 mg/g sample or from 37-123 mg/g protein.
 - Protease inhibitors can be inactivated by the heat-processing method, such as extrusion, IR, micronizing, autoclaving, steam processing, or flaking.

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Mode of action of trypsin inhibitors:

- Raw soybean feeding cause an enlargement of the pancreas (hypertrophy), i.e. an increase in the size of acinar cells of pancreas.
- The pancreatic enzymes (trypsin and chymotrypsin) are rich in sulfur-containing amino acids.
- Therefore, hyperactive pancreas would divert these Sulfur AA from the synthesis of body tissue protein to the synthesis of these enzymes, which are subsequently lost in the faeces.
- When the level of active trypsin in the gut is depressed due to the presence of the inhibitor, the pancreas would respond in a compensatory fashion by producing more enzymes.

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- The mediating agent between trypsin & pancreas has been reported to be the hormone cholecystokinin (CCK), is released from jejunal endocrine cells when level of trypsin in small intestine becomes depleted.
- Protein and/or amino acid digestibility have been reported to be negatively affected in animal by high levels of dietary trypsin inhibitors.

ii. Hemagglutinins (lectins):

- Hemagglutinins, are proteins which agglutinate red blood cells.
- Soyabean lectin strongly binds to mannose of RBC & cause agglutination.
- The highest concentrations of lectins are found in seeds but, in the leaves, their concentration is low due to translocation.
- Lectins may bind to the carbohydrate moieties of cells of the intestinal wall & cause a non-specific interference with nutrient absorption.
- Robin, a lectin from *Robinia pseudoacacia*, has been reported to cause symptoms of anorexia, weakness and posterior paralysis in cattle.
- Ricin, castor bean (*Ricinus communis*) seed press cake, and foliage are poisonous and not used as a livestock feed but the oil is non toxic.

iii. Enzymes:

- Thiaminase, found in bracken fern (*Pteridium aquilinum*) and certain fish.
- Enzyme cleaves the thiamine and inactivating it & causes thiamine deficiency (Chastek's paralysis).
- Other enzymes in feeds which produce deleterious effects in livestock includes Lipoxidases in soybean & alfalfa, which degrade fat soluble vitamin.

4. Amino Acids and Amino Acid Derivatives

(a) Mimosine:

- Toxic amino acid
- A non-protein amino acid structurally similar to tyrosine, occurs in *Leucaena leucocephala* forage plant.
- Concentration of mimosine in the leaf is about 2–6%, varies with seasons & maturity.
- In non-ruminant animals, mimosine causes poor growth, alopecia (loss of hair), eye cataracts & reproductive problems.
- Levels of Leucaena meal above 5–10% of the diet for swine, poultry and rabbits result in poor animal performance.

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- MoA of mimosine is not clear but it may act as an amino acid antagonist or may complex with pyridoxal phosphate, leading to disruption of catalytical action of trans-aminases, or may complex with zinc metal.
- Toxicity symptom in ruminants are poor growth, loss of hair & wool, swollen hooves, lameness, mouth & oesophageal lesions, depressed serum thyroxine level & goitre.
- These symptoms may be due to mimosine toxicity & metabolite of mimosine i.e. 3, 4 -dihydroxypyridine (DHP).

(b) Avidin:

- Glycoprotein in egg albumin, which is an antagonist of B vitamin Biotin.
- Raw eggs can be used to induce biotin deficiency in experimental animals.

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5. Carbohydrates:

- Few toxicity problems arises due to carbohydrate
- Xylose (hexose sugar)- cause decrease growth & cataracts in pigs & poultry.
- Raffinose are not digested in small intestine, hence promote bacterial growth in the hind gut (flatulence factors in beans).
- Beta- glucans in barley cause nutritional problems in poultry.

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6. Lipids:

- Several fatty acids are toxic such as;
- Erucic acid in rape seed.
- Cyclopropenoid fatty acid- such as sterculic & malvalic acids in cottonseed, have toxic properties & cause pink albumins to develop in stored eggs.
- Trans fatty acid may have carcinogenic effect in human.

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7. Metal binding substances:

i. Oxalates:

- Chelating agent which chelates Ca very effectively.
- Plants with a high oxalate content may produce acute metabolic Ca deficiency (**hypocalcemia**) in livestock.
- Oxalic acid converted to **Ca-oxalate**.

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ii. Phytates:

- **Phytic acid in cereal grains & soyabean meal causes reduced mineral availability.**
- **Organic P (phytin P) is of low availability to non-ruminant animals.**
- **Phytate is synthesized in plants by successive phosphorylation of inositol.**
- **Breakdown of phytate involves successive dephosphorylation by phytases present in plants, microorganisms & certain animal tissues.**
- **Phytase supplementation improves the availability of minerals & digestibility of proteins and ME.**

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8. Resins:

- Soluble in organic solvents, insoluble in water, and do not contain nitrogen.
- Examples are **cicutoxin**, a poisonous principle of *Cicuta spp.* (water hemlock).
- It is one of the most spectacular known poisons- acting directly on the CNS to produce violent convulsion.

Discussions.....

Questions, if any.....??

THANKS