

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, carboxpeptidases, 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**.**

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.

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 in the 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.**

5. Carbohydrates:

- **Few toxicity problems arise 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.**

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.

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**.**

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.**

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