

**BIHAR ANIMAL SCIENCES UNIVERSITY**

**Bihar Veterinary College, Patna**

**Department of Animal Nutrition**

**Second Professional Year (UNIT-I)**

**Harmful Natural Constituents & Common Adulterants**  
**(Lecture-3)**

**Dr. Kaushalendra Kumar**

**Assistant Professor, Bihar Veterinary College, BASU, Patna**

**e-mail: [drkaushalbvc@gmail.com](mailto:drkaushalbvc@gmail.com)**

## **Point to be discuss.....**

- **Anti-nutritional factors**
- **Classification of Harmful Natural Toxicants by chemical structure**
  - ✓ **Alkaloids**
  - ✓ **Glycosides**
  - ✓ **Proteins**
  - ✓ **Amino Acids and Amino Acid Derivatives**
  - ✓ **Carbohydrates**
  - ✓ **Lipids**
  - ✓ **Metal binding substances**
  - ✓ **Resins**
  - ✓ **Mycotoxins**
  - ✓ **Phenolic compounds**
  - ✓ **Other toxins**
- **Classification of natural toxicants by their occurrence in feeds**
- **Management of Toxicosis**
- **Common adulterants in feed and fodder**

## **Anti Nutritional Factors (ANFs)**

- **ANFs may be defined as those substances generated in natural feed stuffs during normal metabolism & by different mechanisms exert effects contrary to optimum nutrition.**
- **Harmful natural constituent is a substance which under practical circumstances can impairs animal metabolism & produce adverse biological or economic effects in animal production.**

# Classification of Harmful Natural Toxicants by Chemical Structure

## 1. Alkaloids :

- Alkaloids (alkali-like) are compounds that contain nitrogen, usually in a heterocyclic ring.
- They are usually bitter and toxic in nature.

Name	Source
Nicotine	Tobacco
Ricinine	Castor plant seeds
Atropine	Deadly nightshade
Cocaine	Leaves of coca plant
Jacobine	Ragwort
Strychnine	Seeds of <i>Nuxvomica</i>
Morphine	Dried latex of opium poppy
Solanine	Unripe potatoes and potato sprouts

## 2. Glycosides:

- It contains glycan (carbohydrate moiety) & a non-carbohydrate moiety (aglycone) joined with an ether bond.
- It is usually bitter substances.
- They are classified on the basis of structure & properties of the aglycone.

### *i. Cyanogenic glycosides:*

- They yield **hydrocyanic acid (prussic acid)** when hydrolysed.
- It is hydrolysed by **Beta-glycosidases** to release **HCN, glucose** and **benzaldehyde**.
- However, glycosides occur in **vacuoles** in plant cell and enzymes are found in the **cytosol**. So, damage to the plant results in the enzymes and glycoside coming together and producing HCN.

Cont.....

- The hydrolytic reaction can take place in the rumen by microbial activity, hence, **ruminants are more susceptible to cyanogen toxicity than non-ruminants.**
- The HCN is absorbed and is rapidly detoxified in the liver by the enzyme **rhodanase** which converts CN to thiocyanate (SCN).
- Excess cyanide ion **inhibits the cytochrome oxidase** and **stops ATP formation**, tissues suffer energy deprivation and death follows rapidly.
- Drying of cyanogenic leaves may **reduce the risk of cyanide toxicity.**
- **Cattle are more susceptible to HCN poisoning than sheep, horse and pig.**
- **Immature green Jowar, sudan fodder and linseed may cause HCN toxicity.**

Cont.....

- **Immediate treatment of cyanide poisoning:** Injecting i/v 3 g sodium nitrate & 15 g sodium thiosulphate in 200 ml distilled water for cattle & for sheep 1 g sodium nitrate & 2.5 g sodium thiosulphate in 50 ml H<sub>2</sub>O.
- Some glycosides such as Amygdaline (Almond), Dhurrin (Jowar and, Dhatura, immature grasses), Linamarin (Linseed, cassava, pulses).

## *ii. Goitrogenic glycosides:*

- It decreases production of the thyroid hormones (Thyroxine, T<sub>4</sub> & Tri-iodothyronine, T<sub>3</sub>) by inhibiting their synthesis by thyroid gland.
- As a result, the thyroid enlarges to compensate for reduced thyroxin output, producing goitre.

Cont.....

- **Goitrogenic glycosides** are commonly found in Brassica spp. such as cabbage, turnip, kale, rapeseed, mustard green etc.
- Glucosinolates are formerly called thioglucosides.
- **Myrosinase** is released from plant tissue by crushing (mastication) & it also produced by rumen microorganisms.
- Glucosinolates are always accompanied by the enzyme **myrosinase** (thioglucosidase) which are capable of **hydrolyzing them to thiocynates and isothiocynates to venyloxazolidinethione** which is potently goitrogenic causes **depressed iodine uptake and liver damage**.
- **Ruminants are less susceptible than pig and poultry.**



## Brassica anaemia factor:

- Two types of sulphur containing compounds that limit the feeding value of brassica crops such as **glucosinolates** and **S- methylcysteine sulfoxide** (an amino acids) .
- In the brassica it may **occur at levels as high as 4-6% of the dry matter.**
- The **SMCO** is a fairly rare amino acid, found only in brassica, garlic, and onion.
- It leads to **RBC hemolysis** and **cause anaemia.**
- **However, SMCO is probably not the primary haemolytic agent.**

Cont.....

- **It is metabolized in the rumen, producing dimethyl disulfide.**
- **Dimethyl disulphide attacks the red cell membrane.**
- **It is inactivated by reacting with reduced glutathione (GSH), producing methylmercaptan.**
- **The toxic principle in onions is n-propyl disulfide and S-MCO, cause RBC hemolysis and Heinz-Ehrlich bodies & reduced by the glutathione peroxidase system.**
- **Garlic contains S-allylcysteine sulfoxide, which is metabolized to allyl disulfide oxide.**
- **The cholesterol lowering properties of garlic may be due to reaction of disulfide group with sulfydryl group of CoA, leads to inhibition of lipid synthesis.**

### *iii. Coumarin glycosides:*

- Found in **sweet clover** (*Melilotus* spp.) as melilotoside.
- Coumarin is **converted by mould growth to dicoumarol** an **antagonist of vitamin K**.
- Sweet clover poisoning, caused by **feeding mouldy sweet clover hay**, is therefore an induced vitamin K deficiency.

### *iv. Steroid and Triterpenoid glycosides:*

#### **a) Cardiac glycosides:**

- Best known CG is **digitonin**, contained in foxgloves (*digitalis* spp.).
- Physiologically, they are **potent stimulators of heart rate & are used medicinally**.

## b) Saponin:

- Saponins are **glycosides** containing a polycyclic aglycone moiety of either C27 steroid or C30 triterpenoid (collectively termed as sapogenins) attached to a carbohydrate.
- They are **widely distributed in the plant kingdom**.
- Saponins are characterised by a **bitter taste** and **foaming properties**.
- **Erythrocytes lyses** in saponin solution and so, these compounds are toxic when injected intravenously.
- **In non-ruminants (chicks and pigs), retardation of growth rate, reduction in feed intake occurs & in ruminants, implicated in causing bloat**.
- The adverse effects of saponins can be overcome by repeated washing with water which makes the feed more palatable by reducing the bitterness.

**v. Vicine:**

- Vicine is a glycoside in **Fava beans (*Vicia faba*)**.
- It causes **haemolytic anaemia (favism)** in people who have a genetic **deficiency of glucose-6-PO4-dehydrogenase activity in their RBC**.
- Fava beans are being utilized as a protein supplement for livestock.

**vi. Isoflavones:**

- Which are called **phytoestrogens**, contain a flavones nucleus (ex- **genistein, formononetin & coumestrol**).
- It cause **reproduction problems** in ruminant especially sheep.

**Discussions.....**

**Questions, if any.....??**

**THANKS**