

**BIHAR ANIMAL SCIENCES UNIVERSITY**

**BIHAR VETERINARY COLLEGE, PATNA**

**Department of Animal Nutrition**

**ANN-606**

**UNIT-II (NON-RUMINANT NUTRITION)**

**Lecture on**

**Feed additive for Non-ruminants**

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# PG Lecture: 3

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

- **Feed additives**
- **Types of feed additives**
- **Antibiotics**
- **Probiotics**
- **Prebiotics**
- **Enzymes**
- **Hormones**
- **Organic acids**
- **Other growth stimulants etc.**
- **Advantages of feed additives**
- **Limitations of additives in non-ruminant species.**

## Feed Additives

- Feed additives are materials that are administered to the animal to enhance the effectiveness of nutrients and exert their effects in the gut or on the gut wall cells.

### 1. Antibiotics:

- Chemical compounds produced by other microorganisms (e.g. fungi, and are also synthesized in the laboratory) that, when given in small amounts, halt the growth of bacteria.
- They are used at therapeutic levels to treat diseases caused by bacteria.
- In subtherapeutic levels added to the feed/food to enhance the rate of growth.

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- **Various groups of antibiotics act in different ways to reduce the numbers of specific bacteria in the GIT, and increase the efficiency of nutrient utilization by;**
  - **Reduction or elimination of the activity of pathogenic bacteria.**
  - **Allowing the host to achieve production levels closer to their potential.**
  - **Stimulation of growth of microbes that synthesizes unidentified nutrients.**
  - **Reduction of the growth of microorganisms that compete with the host animal.**
  - **Increased absorptive capacity of the small intestine by decrease thickness of intestinal wall.**

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- These effects may be coupled with a reduced turnover of mucosal cells as well as **reduced mucous secretion**.
- Large proportion of the energy & protein required to maintain an animals &
- Any reduction in the mass of the gut & cell turnover will release nutrients for other purposes such as **growth & production**.
- **AGPs used mainly in pig & poultry feeds @20–40 mg/kg**
- **Improvements of 4–16 percent in growth rate & 2–7 percent FCR.**
- **Response is greatest in young animals & consuming diets containing vegetable protein rather than animal protein.**
- **Effect is less in healthy herds and flocks.**
- **Young pre-ruminant calves also respond to AGPs in the same manner as non-ruminants.**

## Modes of action of antibiotics

- Antibiotics halt the growth of bacteria by interfering with their cellular metabolism. There are four groups;
  - i. Interfere with the synthesis of bacterial cell wall & cause the cell to burst:
    - ✓ These are high-molecular-weight (>1200) compounds that act on Gram positive bacteria.
    - ✓ They are poorly absorbed by the host and thus are non-toxic
    - ✓ Leave no detectable residues and have no withdrawal period (i.e. a period of time during which the compound must be removed from the food/body before the animal is slaughtered).
    - ✓ Examples of this type of antibiotics are **Avoparcin & Flavomycin.**

## ii. Inhibitors of bacterial protein synthesis:

- ✓ Primarily active against Gram-positive bacteria & have a medium MW (>500).
- ✓ Absorbed to a greater extent than the higher-molecular-weight compounds, they **do not have a withdrawal period**.
- ✓ Examples- **Tylosin & Virginiamycin**.

## iii. Inhibitors of bacterial DNA synthesis:

- ✓ These can have a broad spectrum of activity, have a low MW (about 250) & **require withdrawal periods**.
- ✓ Examples- **Nitrofurans & Quinoxaline-N-oxides**.

#### **iv. Ionophore antibiotics:**

- ✓ **Interfere with the electrolyte balance (Na/K) of bacterial cell by transporting potassium into the cell, which then requires energy to pump it out.**
- ✓ **Ion pump fails to operate efficiently & potassium accumulates inside the cell.**
- ✓ **Water enters by osmosis & the cell becomes rupture.**
- ✓ **Example- Monensin sodium**



## 2. Probiotics

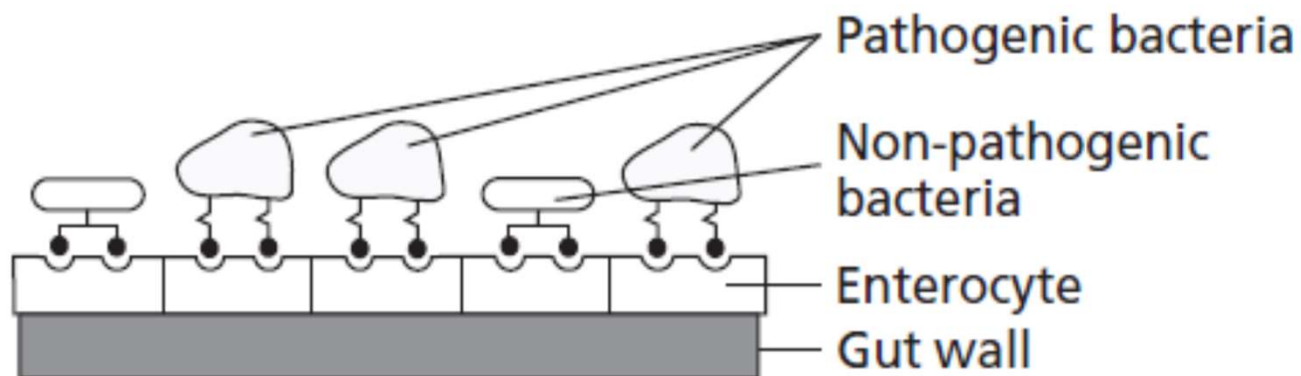
- Probiotic is defined as a live microbial food supplement that beneficially affects the host animal by improving the intestinal microbial balance.
- Beneficial microbes produce enzymes that complement the digestive ability of the host & their presence provides a barrier against invading pathogens.

**Desirable bacteria exert their effects in different ways;**

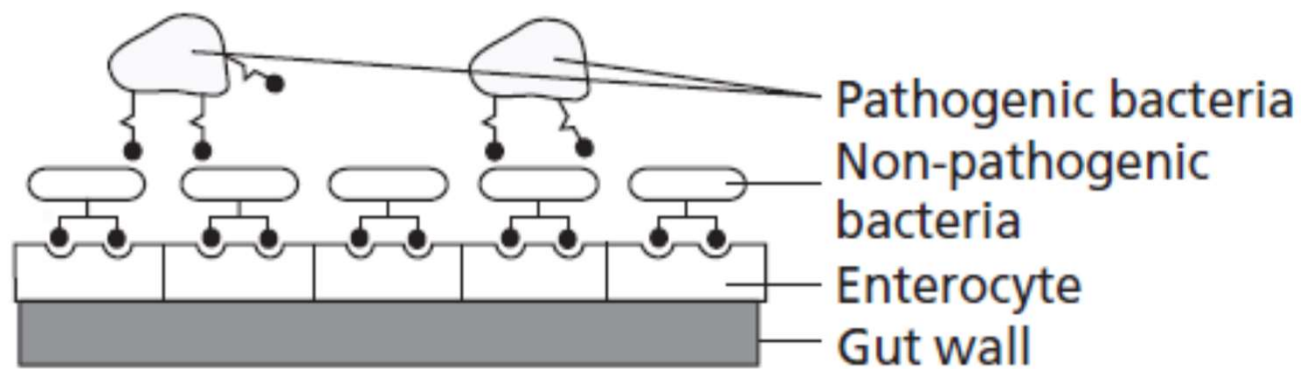
- ✓ Adhesion to the digestive tract wall to prevent colonisation by pathogenic microorganisms:
- **E. coli, need to become attached to the gut wall to exert their harmful effects.**

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- **Attachment is achieved by means of hair like structures on the bacterial surface, called fimbriae.**
  - **Fimbriae are made up of proteins k/a lectins, which recognize & selectively combine with specific oligosaccharide receptor sites on the gut wall.**
  - **Lactobacilli successfully compete for these attachment sites.**
- ✓ **Neutralization of enterotoxins produced by pathogenic bacteria that cause fluid loss:**
- **Live probiotic bacteria can neutralize toxins, but the active substance has not been identified.**



(a)



(b)

✓ **Bactericidal activity:**

- Lactobacilli ferment lactose to lactic acid, thereby reducing the pH to a level that harmful bacteria cannot tolerate.
- Hydrogen peroxide is also produced, which inhibits the growth of Gram-negative bacteria.
- Lactic acid producing bacteria of the **Streptococcus and Lactobacillus** species may produce antibiotics.

✓ **Prevention of amine synthesis:**

- Coliform bacteria, decarboxylate amino acids to produce amines, cause gut irritation, leads to diarrhoea.
- If desirable bacteria prevent the coliforms proliferating, then amine production will also be prevented.

✓ **Enhanced immune competence:**

- **Oral inoculation of Lactobacilli can elevated serum protein & WBC.**
- **Aids immune system development by stimulation of the production of antibodies and increased phagocytic activity.**

✓ **Other postulated effects include:**

- **Beneficial interaction with bile salts,**
- **Increased digestive enzyme production,**
- **More efficient absorption of nutrients &**
- **Greater vitamin production**

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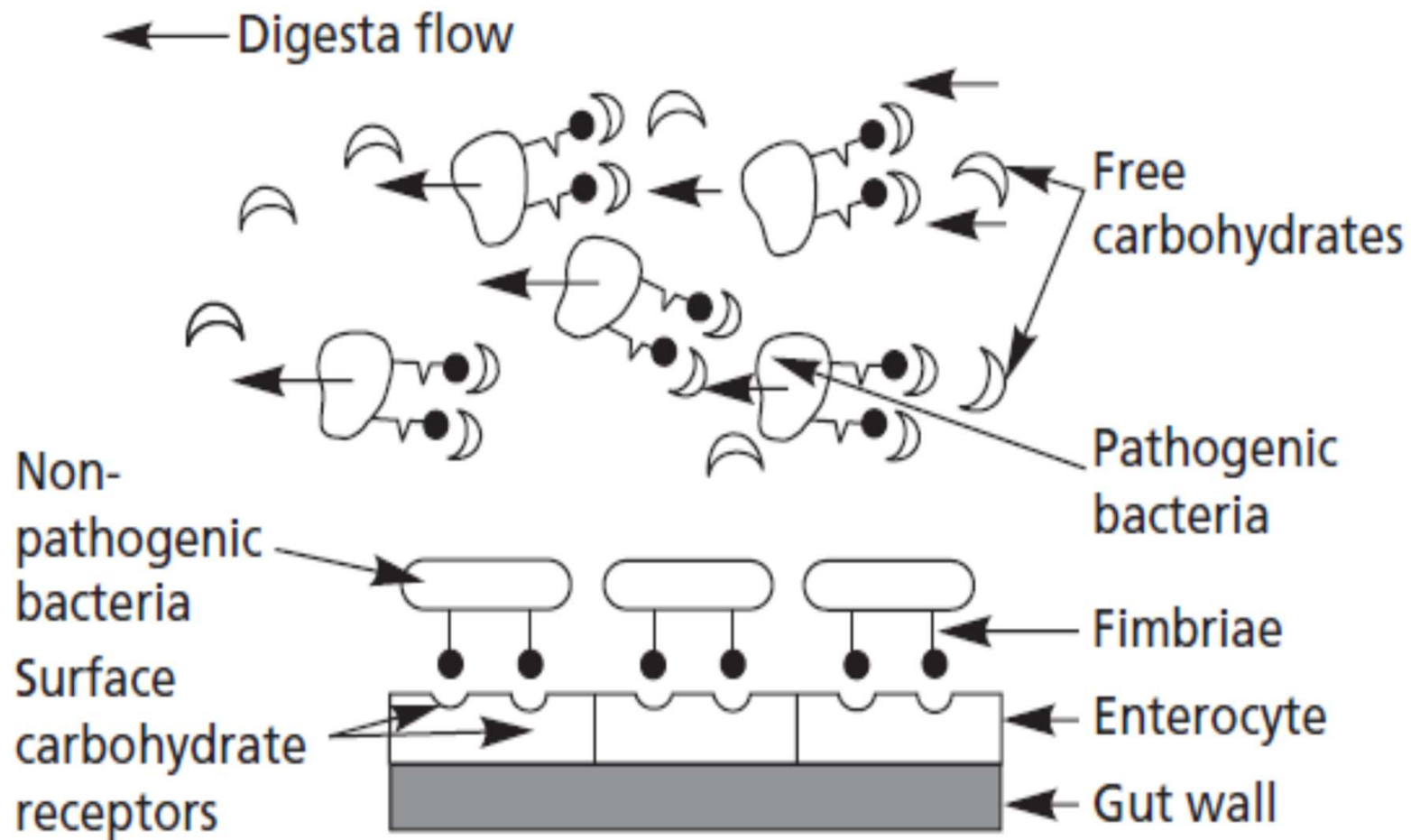
- In monogastric, strains of **Lactobacilli, Bacillus subtilis & Streptococci** have been used as probiotics.
- Metabolites of dead & live yeast cells (B vitamins, BCFA, amino acids & peptides) stimulate the growth of the bacterial species *Megasphaera elsdenii*.
- This utilizes the lactic acid produced from the rapid fermentation of starch & sugars associated with high-concentrate diets.
- Also live yeasts ferment sugars derived from the degradation of starch, thus **competing with the lactic-acid-producing bacteria & thereby stabilize rumen pH & reduce the risk of acidosis.**

### **3. Prebiotics:**

- ✓ **Defined as compounds other than dietary nutrients that modify the balance of the microflora population by promoting the growth of beneficial bacteria & thereby provide a healthier intestinal environment.**

**Oligosaccharides occur naturally in foods such as;**

- ✓ **Soya bean meal, rapeseed meal & legumes contain alfa-galactooligosaccharides (GOS);**
- ✓ **Cereals contain fructo-oligosaccharides (FOS);**
- ✓ **Milk products have trans-galactooligosaccharides (TOS);**
- ✓ **Yeast cell walls contain mannan-oligosaccharides (MOS).**
- ✓ **They are also produced commercially.**





- Pathogenic bacterial cells have surface compounds called **lectins** that recognise these carbohydrates & by which they attach to the gut cells.
- **Lectin**–carbohydrate combination is specific to a particular organism.
- Salmonella & E. coli have a mannose-specific lectin that binds to mannose residues on the gut mucosal surface.
- However, if the same carbohydrate (oligosaccharide) is provided in the diet, harmful bacteria can be encouraged to attach to these &
- They do not adhere to the gut wall but are excreted without producing toxins.

#### **4. Arsenicals:**

- Arsenic compounds, namely **arsanilic acid, sodium arsanilate & 3 -nitro-hydroxyphenyl arsenic acid** are also used as growth inhibitors for pathogenic organism & to restore conditions of recovering animals.
- The amount of arsenic retained in the tissues is very low.
- It is desirable to discontinue arsenicals from the diet at least 5 days before slaughter.
- Arsenicals recommended to add @ 50-70 g/tone of feed.

## 5. Buffering Compound:

- **Buffers** are **mixtures of weak acids and their conjugate bases**.
- A more appropriate term is **neutralizing or alkalinizing agents**.
- When present in aqueous solution, buffers should **resist changes in pH** upon addition of acid or base.

## 6. Antioxidants:

- Antioxidants are chemical compounds which have the capacity of **preventing oxidation of substance** by taking up oxygen.
- High fat vegetable products (oils/fat), tallow, lard, fish meal & poultry by product meal are more prone to oxidative rancidity.
- Cause off-flavours which reduces voluntary feed intake & bioavailability of amino acids & fat soluble vitamins like vitamin A & vitamin E.
- Ex- butylated hydroxyl anisole (BHA), butylated hydroxy toluene (BHT) & ethoxyquin & natural antioxidants include vitamin E, vitamin C & rosemary.
- Added to feed ingredients & vit. premix @125 to 200g/tonne of feed.
- Synthetic antioxidants are comparatively cheaper and long lasting.

## **7. Enzymes:**

- **Fibrolytic enzymes such as cellulase, Phytase, xylanase & beta-glucanase increase nutrient utilization efficiency, eliminate toxic effects of feed in non-ruminant.**
- **It is apparent that enzymes substantially improve feed digestibility and animal performance.**

## **8. Hormones:**

- **Hormones are substances produced by **endocrine glands** that activate specifically the target organs to produce the desired result.**
- **Synthesized compounds also have similar response as naturally produced hormones & can be used as feed additive to promote animal growth.**
- **They are used to bring desirable changes in rate of metabolism for efficient productivity.**
- **They can be grouped into **anabolic and catabolic hormones**.**

Cont.....

- **Anabolics are growth hormone & thyroxine**, used for increasing animal productivity either through **growth or egg production**.
- ✓ **Ex- Iodinated casein** – for increase egg production
- **Catabolics are estrogen & glucocorticoids**, **increase muscle & bone formation** at the expense of fat deposition.
- But the use of hormones has much public concern due to the **residue present in animal products**.
- **Several countries banned the use of these hormonal preparations**.

## **9. Adsorbents:**

- **Compounds that are not absorbed from the GIT & have the ability to bind physically with toxic substances** thus preventing their absorption.
- **The use of adsorbents such as activated charcoal & silicates** are commonly used in livestock exposed to dietary **aflatoxins**.
- **Activated charcoal administered @ 20-120 mg/kg** to domestic animals.
- **Several substances like alumino-silicates, bentonite, silicon, zeolites etc.** found beneficial in minimizing the toxic effects of mycotoxins.



## 10. Organic acids:

- Some organic acids specially **malic acid & fumaric acid** are potent agent.
- Malate stimulates lactate utilization by *Selenomonas ruminantium*.
- Malate was more effective in lactate utilization than fumarate or aspartate
- Fumarate was also found to be beneficial for fibre rich diets.
- Other ex- **citrate, formic acid** etc.

## 11. Flavoring agent & Pigments:

- Flavoring agents are used to **enhance the palatability of feeds** especially, fish meal & other vegetable protein meals in the diet of (flavor sensitive) pet animals.
- Pigmentation compounds are used to **satisfy consumer preference**.
- Xanthophylls present in yellow maize and Lucerne meal are used to produce **deep yellow pigmentation in body & egg yolk**.

**Discussions.....**

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

**THANKS**