

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 ruptured.
- ✓ Example- **Monensin sodium**

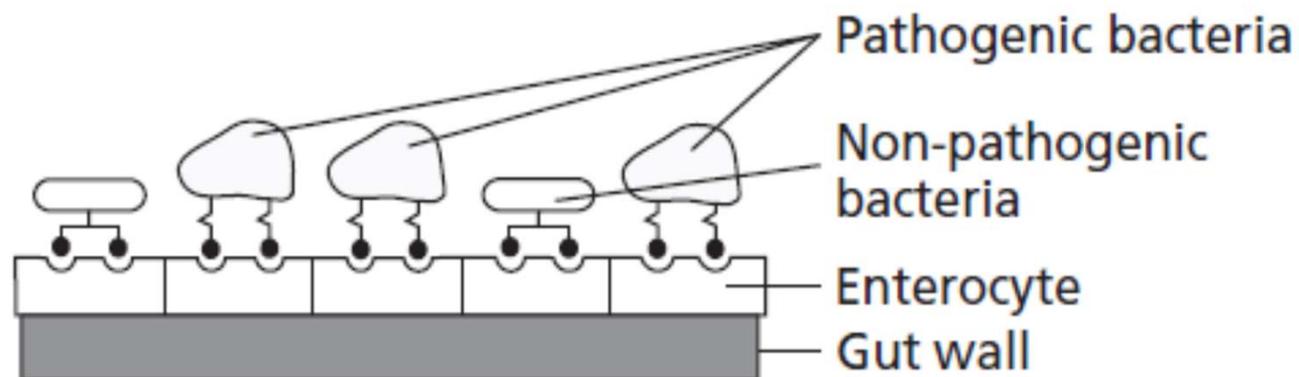
2. Probiotics

- **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.**

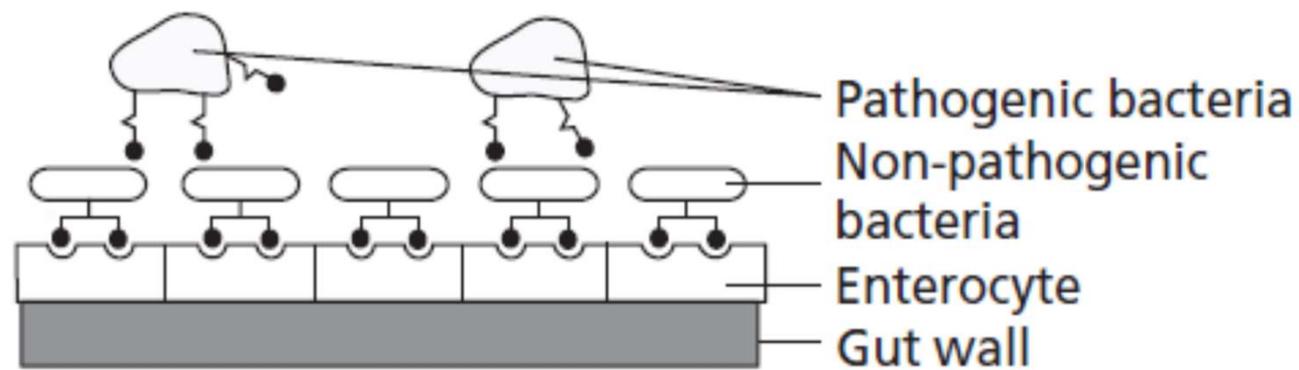
Desirable bacteria exert their effects in different ways;

- ✓ **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.**

- **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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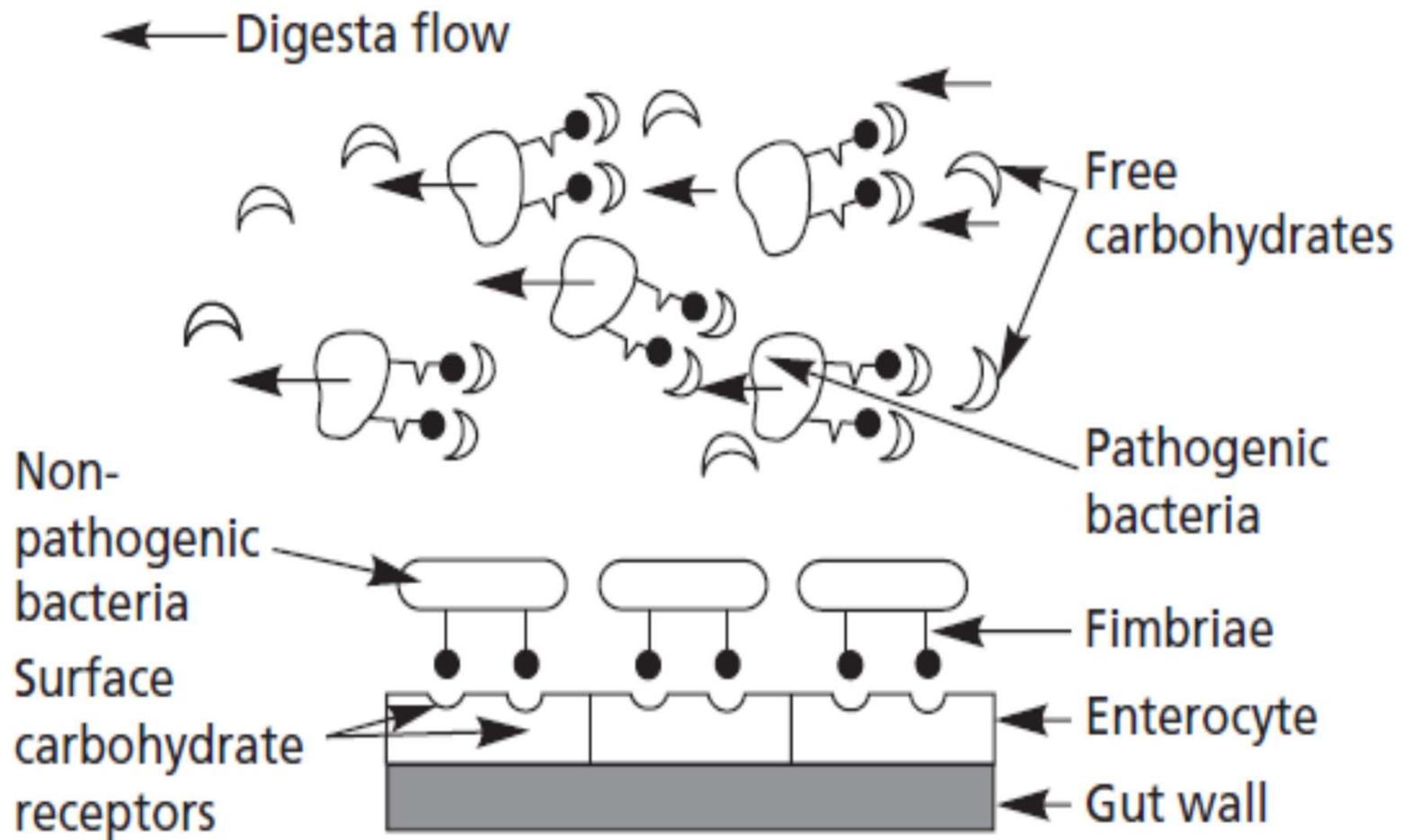
- In monogastric, strains of **Lactobacilli, Bacillus subtilis & Streptococci** have been used as probiotics.
- Metabolites of dead & live yeast cells (B vitamins, BCFA, amino acids & peptides) stimulate the growth of the bacterial species *Megasphaera elsdenii*.
- This utilizes the lactic acid produced 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