CONCEPT OF FEED ADDITIVES IN LIVESTOCK

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What is an Additive?

An additive is a substance that is added to a basic feed, usually in small quantities, for the purpose of fortifying it with certain nutrients, stimulants or medicines other than as a direct source of nutrient.
• In general, the term “feed additive” refers to a non-nutritive product that affects utilisation of the feed or productive performance of the animal. Feed additives and implants can be classed according to their mode of action.

Classification

• Types of Feed additives
o Additives that influence feed stability, feed manufacturing and properties of feeds
  Antifungals
  Antioxidants
  Pellet binders
o Additives that modify animal growth, feed efficiency, metabolism and performance
  Feed flavours
  Digestion modifiers
  Enzymes
  Prebiotics
  Buffers
  Acidifiers
  Ionophores
  Antibloat compound
  Isoacids
  Salivation inducers
  Probiotics
  Defaunating agents
  Metabolism modifiers
  Hormones
  Beta-adrenergic agents (repartitioning agents)
  Growth promotants
  Antibiotics
  Chemotherapeutic agents
o Additives that modify animal health
  Drugs
  Immunomodulators
o Additives that modify consumer acceptance
  Xanthophylls

ADDITIVES THAT ENHANCE FEED INTAKE

Antioxidants

• Antioxidants are compounds that prevent oxidative rancidity of polyunsaturated fats. Rancidity once develops, may cause destruction of vitamins A, D and E and several of the B complex vitamins.
• Breakdown products of rancidity may react with lysine and thus affects the protein value of the ration.

Ethoxyquin or BHT

(butylated hydroxytoluene) can serve as antioxidant in feed.
Flavouring Agent

• Flavouring agents are feed additives that are supposed to increase palatability and feed intake.
• There is need for flavouring agents that will help to keep up feed intake
o When highly unpalatable medicants are being mixed
o During attacks of diseases
o When animals are under stress, and
o When a less palatable feedstuffs is being fed either as such or being incorporated in the ration.
• Ruminants prefer sweet compounds. Additionally cattle and goats respond positively to salts of volatile fatty acids.
• Horses will often refuse musty feed when there is so little mould that the owner fails to detect it.

ADDITIVES THAT ENHANCE THE COLOUR

Additives that enhance the colour or quality of the marketed product
• Poultry man will often enhance the yellow colour by incorporating xanthophylls into broiler feed.
• Among various additives, arsanilic acid, sodium arsanilate and roxarsone are added for the purpose.

ADDITIVES THAT FACILITATE DIGESTION AND ABSORPTION

Grit

• Poultry do not have teeth to grind any hard grain, most grinding takes place in the thick musculated gizzard.
• The more thoroughly feed is ground, the more surface area is created for digestion and subsequent absorption. Hence, when hard, coarse or fibrous feeds are fed to poultry, grit is sometimes added to supply additional surface for grinding within gizzard.
• When mash or finely ground feeds are fed, the value of grit become less. Oyster shells, coquina shells and limestone are used as grit.
Buffers and Neutralisers
• During maximum production stage ruminants are given high doses of concentrate feeds for meeting demands for extra energy and protein requirement of the animal.
• The condition on the other hand lowers the pH of the rumen. Since many of the rumen microbes cannot tolerate low pH environment, the normally heterogeneous balanced population of microbes become skewed, favouring the acidophilic (acid-loving) bacteria.
• The condition often leads to acidosis and thereby upsets normal digestion.
• The addition of feed buffers and neutralisers, such as carbonates, bicarbonates, hydroxides, oxides, salts of VFA, phosphate salts, ammonium chloride and sodium sulphate have been shown to have beneficial effects.
• Recently the use of baking soda ($NaHCO_3$) has been shown to increase average daily gain by about 10 per cent, feed efficiency by 5 to 10 per cent, and milk production by about 0.5 liter per head per day.

Chelates

• The word “Chelates” is derived from the Greek word “Chele” meaning “claw” which is a good descriptive term for the manner in which polyvalent cations are held by the metal binding agents. Prior to union with the metal these organic substances are termed as “ligands”.

• Ligand + mineral = chelate element.
• Organic chelates of mineral elements, which are cyclic compounds, are the most important factors controlling absorption of a number of mineral elements.
• A particular element in chelated form may be released in ionic form at the intestinal wall or might be readily absorbed as the intact chelate.
• Chelates may be of naturally occurring substances such as chlorophyll, cytochromes, haemoglobin, vitamin B12, some amino acids, etc., or may be of synthetic substances like ethylenediaminetetracetic acid (EDTA.)

ENZYMES

• Enzymes are protein which have the property of catalysing specific biochemical reactions. They are found in all plants and animals and are responsible for growth and the maintenance of health.
• Microorganism also produce enzymes and in recent years it has been possible to produce enzymes using microorganism on an industrial scale, extract and use these enzymes in a wide range of processes for the production of feed and natural products.
• Poultry feeds are largely composed or plant and vegetables materials and there are enzymes developed to degrade, modify or extract the plant polymers found in some of the cereals and their byproducts. The enzymes can be used to improve the feeding of poultry in the following way:

o By improving the efficiency of the utilisation of the feed
o By upgrading cereals byproducts or feed components that are poorly digested
o By providing additional digestive enzymes to help poultry to withstand stress conditions eg. Hot climates
• Some of the cereals are compounds of polymers either of glucose (beta glucan) or arabinose and xylose (pentosan or hemicellulose). These polymers are not well digested by poultry and this can be result in loss of energy in two ways:
o Energy may be lost become these polymers hinder the digestion of starch by coating starch granules and preventing the action of starch digesting enzymes in the intestine.
o Energy may be lost because the animals own enzymes are not capable of degrading the polymers and therefore they pass through the digestive system untouched.
• By adding microbial enzymes to the feed these polymers can be degraded and their energy value made available to the bird.
• The dual role of enzymes has been demonstrated in trials with barley based feed supplemented with beta-glucanase, where the apparent increase in available energy was far in excess of that available in the beta-glucan of the barley.
• In this case not only was the problem of sticky dropping completely eliminated but the chicken’s rate of growth was equivalent to that observed normally with feeds containing a higher energy density (eg. Wheat based).

Choice of enzyme

• Because feed is normally composed of a single raw material of constant quality, it is important that the correct choice of enzyme product be made.
• Even in the case of a relatively well defined problem such as that in barley, the use of multi enzyme activity products has an advantage.
• The enzymes should fulfil the following criteria for practical application:
o The enzymes must be active at the pH of the animals digestive system and capable of surviving transit through the stomach
o They must be in a physical form in which they can be safely and easily mixed into all forms of animal feed
o The products should be of a high standarised activity that will remain stable both before and after incorporation into the feed or pre-mix
o The enzymes must be capable of surviving normal pelleting conditions

CHELATES AS FEED ADDITIVE

• Type I: Chelates that Aid in transport and to store metal ions
o Chelates of this group behave as a carrier for proper absorption, transportation in the circulatory system and passing across cell membranes to deposit the metal ion at the site where needed.

Among amino acids, cysteine and histidine are particularly effective metal binding agents and may be of primary importance in the transport and storage of mineral elements throughout the animal body.

Ethylene diamine tetracetic acid (EDTA) and other similar synthetic ligands also may improve the availability of zinc and other minerals.
• Type II: Chelates essential in metabolism
o Many chelates of animal body are holding metal ions in such a cyclic fashion which are absolutely necessary to be in that form to perform metabolic function. Vitamin B12, cytochrome enzymes and haemoglobin are some of the examples of this type.
o Haemoglobin molecule without its content of ferrous form of iron will be of no use in transporting oxygen.
• Type III: Chelates which interfere with utilisation of essential cations
o There are some chelates found in the body which might have accidentally formed and are of no use to the subject.
o Rather, those chelates may be detrimental for the proper utilisation of the element. Phytic acid-Zn chelate or oxalic acid calcium chelate are examples of this type.

ADDITIVES THAT PROMOTES GROWTH AND PRODUCTION

Antibiotics

• These are substances which are produced by living organisms (mould, bacteria or green plants) and which in small concentration have bacteriostatic or bactericidal properties.
• They were originally developed for medical and veterinary purposes to control specific pathogenic organisms.
• Later it was discovered that certain antibiotics could increase the rate of growth of young pigs and chicks when included in their diet in small amounts.
• Soon after this report a wide range of antibiotics have been tested and the following have been shown to have growth promoting properties: penicillin, oxytetracycline (Terramycin), chlortetracycline, bacitracin, streptomycin, tyrothricin, gramicidin, neomycin, erythromycin and flavomycin.
• Increased weight gain is most evident during the period of rapid growth and then decreases.
• Differences between control and treated animals are greater when the diet is slightly deficient or marginal in protein, B-vitamins or certain mineral elements.

Mode of action of antibiotics

• Antibiotics “spare” protein, amino acids and vitamin on diets containing 1 to 3 per cent less protein, but balance experiments have often failed to show increased nitrogen retention. Growth stimulation has been greatest when the antibiotic penicillin supplement has been added to a ration containing no protein supplements of animal origin or to a ration low in vitamin B12. Under hygienic conditions growth increases are small.
• Intestinal wall of animals fed antibiotics is thinner than that of untreated animals which might explain the enhanced absorption of calcium shown for chicks.
• Reduce or eliminate the activity of pathogens causing “subclinical infection.”
• Reduce the growth of micro-organisms that compete with the host for supplies of nutrients.
• Antibiotics alter intestinal bacteria so that less urease is produced and thus less ammonia is formed. Ammonia is highly toxic and suppresses growth in non-ruminants.
• Stimulate the growth of micro-organisms that synthesise known or unidentified nutrients.
Following points should be kept in mind while using antibiotics for animal feeding:

• Antibiotics should be used only for
o growing and fattening pigs for slaughter as pork or bacon;
o growing chicks and turkey poults for killing as table poultry.
• Antibiotics should not be used in the feed of ruminant animals (cattle, sheep and goats), breeding

pigs and breeding and laying poultry stock.
• While adding antibiotics at the recommended level, care should be taken that they are thoroughly and evenly mixed with the feed.
• For best results, antibiotics should be used with properly balanced feeds. Also, the feeds containing antibiotics should be fed only to the type of stock for which they are intended.
• Antibiotics are not a substitute for good management and healthy living conditions, or for properly balanced rations.

Probiotics

• It is defined as a live microbial feed supplement, which beneficially affects the host animals by improving its intestional microbial balance. The probiotic preparation are generally composed of organisms of lactobacilli and/or streptococci species, few many contain yeast caltones.
• They benefit the host by:
o Having a direct antagonistic effect against specific group of undesirable or harmful organism through production of antibacterial compounds, elementary or minimising their competition of nutrients.
o Altering the pattern of microbial metabolism in the gastro intentional tract.
o Stimulation of immunity.
o Neutralisation of enterotoxins formed by pathegenic organism.
• Thus resulting in increased growth rate, improved feed efficiency

ADDITIVES THAT ALTER METABOLISM

Hormones

• These are chemicals released by a specific area of the body (ductless glands) and are transported to another region within the animal where they elicit a physiological response.
• Extensive use is being made of synthetic and purified estrogens, androgens, progestogens, growth hormones and thyroxine or thyroprotein (iodinated casein) to stimulate the growth and fattening of meat producing animals. There is concern, however, about possible harmful effects of any residues of these materials in the meat or milk for the consumers.
• The whole question whether hormones should be used as growth promoters is still debatable but it seems logical that with any feeding system the economic advantages, however great should never take precedence over any potential risk to human health. These substances may induce cancer in human beings if taken over a prolonged period through products of the treated animals. The use of such substances in poultry rearing has been prohibited by law in U.S.A.

Implants

• Implants are hormone or hormone like products that are designed to release slowly, but constantly, the active chemicals for absorption into the bloodstream. These are implanted subcutaneously in the ear.(eg.) diethylstilbesterol (DES).

ADDITIVES THAT AFFECT THE HEALTH STATUS OF LIVESTOCK

• Antibloat compounds:
o Surfactants such as poloxalene is used as a preventive for pasture bloat,several other products have been shown to be highly effective to prevent bloat are also available in the market.
• Antifungal additives:

o Mould inhibitors are added to feed liable to be contaminated with various types of fungi such as Aspergillus flavus, Penicillium cyclopium etc.
o Before adding commercial inhibitors all feedstuff should be dried below 10 percent moisture. Propionic, acetic acid and sodium propionate are added in high moisture grain to inhibit mould growth.
o Antifungals such as Nystatin and copper sulphate preparations are also in use to concentrate feeds to prevent moulds.

• Anticoccidials:

o Various brands of anticocidials are now available in the country to prevent the growth of coccidia which are protozoa and live inside the cells of the intestinal lining of livestock.

• Antihelmintics:

o Under some practical feeding conditions anthelmintics have also been used. The compounds act by reducing parasitic infections.

Anticaking agents

• Anticaking agents are anhydrous substance that can pick up moisture without themselves becoming wet. They are added to dry mixes to prevent the particles clumping together and so keep the product free flowing.
• They are either anhydrous salts or substance that hold water by surface adhesion yet themselves remain free flowing:

o Salt or long chain fatty acids.
o Calcium phosphate
o Potassium and sodium ferryocyanide
o Magnesium oxide
o Salts silicic acid – Al, Mg, Ca, Salt.
• Sodium aluminium silicate
• Sodium calcium aluminium silicate
• Calcium aluminium silicate
Humectants
• These are substance which are required to keep the product moist, as for example, bread and cakes.
• Anticaking agents immobilise moisture that was picked up. Humectants are not of much use in poultry feed.
Firming and crisping agents
• These are substances that preserve the texture or vegetable tissues and by maintaining the water pressure inside them, keep them turgid.
• It prevents a loss of water from the tissues.

Sequestrants

• Certain metals – copper, iron can act as pro-oxidant catalytic and there fore need to the immobilised. Sequestrants are compounds added to do this.
• These compounds should have affinity to metal ions and should prevent the metal in becoming engaged in oxidative action. Most effective sequestrants Ethylene diamine tetraacetic acid (EDTA).
• Calcium salt of EDTA works satisfactorily as a sequestrant without interferring with trace mineral metabolism.

Sweeteners

• It is common constitution of food but yet used as additive. Eg. Sugar
• Some are poorly digestible, may cause digestive upsets.
• Saccharin – extensively used during World War I. It is a compound without any calorific value.
• Additives such as humectants, firming and crisping agents, sweeteners, emulsifiers, stabilisers, acid, buffers are not commonly used in poultry feeds.

Reference:On request.