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Role of Probiotics in Poultry Production

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Indian poultry industry, one of the fastest growing segment of animal husbandry sector, is experiencing uncertainty because of chronic and acute problems of high feeding cost, emerging and remerging diseases, vaccine failure and fluctuating market price of meat and eggs. Feed and feeding management accounts for 60-70% of broiler and 70-80% of egg production cost. Economizing the cost of feeding is one of the effective tools for making poultry farming a sustainable enterprise. Under-availability of cost effective feed ingredients is the major factor that is hampering growth of poultry industry as there is a close relation between nutrition and health of poultry. Extensive research works have been conducted in India and abroad for reducing the feed cost encompassing judicious use of available feed resources, precise nutrient supply and augmenting nutrient utilization through processing, supplementation of deficient nutrients and suitable feed additives.

Feed additives have made it possible to provide more eggs and meat that would not be possible without them. The feed additives, administered orally in relatively small amount for improving intrinsic value of the nutrient mix, have been renamed as micro-feeding stuffs. Feed additives for poultry include antibiotics, antioxidants, synthetic micronutrients, enzymes, prebiotics, probiotics, anticoccidials, mould inhibitors, herbal products, etc.

The impact of biotechnology in poultry nutrition is of significant importance. Biotechnology plays a vital role in the poultry feed industry. Nutritionists are continually putting their efforts into producing better and more economical feed. Good feed alone will not serve the purpose but its better utilization is also essential. Dietary changes as well as lack of a healthy diet can influence the balance of the microflora in the gut thus predisposing to digestion upsets. A well-balanced ration sufficient in energy and nutrients is also of great importance in maintaining a healthy gut. A great deal of attention has recently been received

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from nutritionists and veterinary experts for proper utilization of nutrients and the use of probiotics for growth promotion of poultry.

In broiler nutrition, probiotic species belonging to *Lactobacillus*, *Streptococcus*, *Bacillus*, *Bifidobacterium*, *Enterococcus*, *Aspergillus*, *Candida*, and *Saccharomyces* have a beneficial effect on broiler performance, modulation of intestinal microflora and pathogen inhibition, intestinal histological changes, immunomodulation, certain haemato-biochemical parameters, improving sensory characteristics of dressed broiler meat and promoting microbiological meat quality of broilers.

Probiotics

The term "probiotic" is derived from Greek and means pro: for and bios: life (for life) in contradiction to antibiotic which means: against life. The term probiotic was first introduced by Lilly and Stillwel (1965) to describe growth-promoting factors produced by microorganisms. Over the years the word probiotic has been used in several different ways. It was originally used to describe substances produced by one protozoan which stimulated by another, but it was later used to describe animal feed supplements which had a beneficial effect on the host animal by affecting its gut flora. Crawford [1979] defined probiotics as "a culture of specific living micro-organisms (primarily *Lactobacillus spp.*) which implants in the animal to ensure the effective establishment of intestinal populations of both beneficial and pathogenic organisms". Fuller [1989] later gave a unique definition of probiotics as "a live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance". The US National Food Ingredient Association presented, probiotic (direct fed microbial) as a source of live naturally occurring microorganisms and this includes bacteria, fungi and yeast [Miles and Bootwalla, 1991]. According to the currently adopted definition by FAO/WHO, probiotics are "live microorganisms which when administered in adequate amounts confer a health benefit on the host" [Anonymous, 2001]. More precisely, probiotics are live microorganisms of nonpathogenic and nontoxic in nature, which when administered through the digestive route, are favorable to the host's health [Guillot, 1998].

Among these so-called alternatives to antibiotics are probiotics. These adverse effects of antibiotics discourage their use and suggest the use of beneficial live cultures (probiotics)

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promoting growth of beneficial bacteria – which acts same as antibiotic without its adverse effects. It effects like-

1. Improved growth rate and feed utilization of animals.
2. Preventing colonization of harmful microorganisms in animal intestine.
3. Alleviation of lactose intolerance.
4. Relief of constipation.
5. Neutralization of entero toxins produced by pathogens.
6. Antitumoral / anticarcinogenic effect.
7. Anticholesterolamic effect.
8. Immunity inducer.

Probiotics	**Animal Nutrition**
Goal	Quick response
Effectiveness	Easy to assess
Characteristics of intake	As additive in mixed feed
Frequency of intake	10-20 times per day
Micro organism (most frequently used)	*Enterococcus faecium*, *Bacillus* sps, *Sacchromyces cervisiae*
Natural Habitat	Digestive tract, soil, fruits

Classification of Probiotics

They are broadly classified as:

1. Bacteria, mainly lactic acid bacteria (LAB): Lactobacilli sps., Bifidobacterium sps., Lactococcus sps., Streptococcus sps., Enterococcus sps. and other species.
2. Fungi or yeast:
   a. Saccharomyces sps.
   b. Trichlosporon sps.

Types of probiotic organisms used in Poultry: Lactobacillus acidophilus, Lactobacillus bulgaricus, Lactobacillus lactis, Lactobacillus rhamnose, Lactobacillus fermentum, Streptococcus thermophilus, Streptococcus faecium, Lactobacillus sporogenes, Bacillus subtilis, Bacillus licheniformis and Saccharomyces boulardii.

Composition of Probiotics

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Probiotics can be compounded in various ways depending on the sort of use intended. They can either included in the pelleted feed or through their food (Fuller 1989). Probiotic preparation may be made up of a single strain or may contain any number up to eight strains. The advantage of multiple strain preparations is that they're active against a wide range of conditions and in a wider range of animal species.

Fuller (1989) listed the following organisms are species used in probiotic preparations, Lactobacillus bulgaricus, Lactobacillus plantarum,, Streptococcus thermophillus, Enterococcus faecium, entero coccus faecalis, Bifidobacterium species and E.coli. With the exception of Lactobacillus bulgaricus and Streptococcus thermophillus, all the other organisms are all intestinal strains.

Lactobacillus, Streptococcus and Bifidobacterium are the commonly used groups in the production of probiotics.

Characteristics of good Probiotics

- Be of host origin
- Non-pathogenic
- Withstand processing and storage
- Resist gastric acid and bile
- Adhere to epithelium or mucus
- Persist in the intestinal tract
- Produce inhibitory compounds
- Modulate immune response
- Alter microbial activities

Criteria for Selection of Probiotics in the Poultry Production

The perceived desirable traits for selection of functional probiotics are many. The probiotic bacteria must fulfill the following conditions: it must be a normal inhabitant of the gut, and it must be able to adhere to the intestinal epithelium to overcome potential hurdles, such as the low pH of the stomach, the presence of bile acids in the intestines, and the competition against other micro-organisms in the gastro-intestinal tract [Nurm *et al*., 1983; Chateau et al., 1993]. Many *in vitro* assays have been developed for the pre-selection of probiotic strains [Ehrmann *et al*., 2002; Morelli, 2000; Koenen et al., 2004]. The competitiveness of the most promising strains selected by *in vitro* assays was evaluated *in*

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vivo for monitoring of their persistence in chickens [Garriga et al., 1998]. In addition, potential probiotics must exert its beneficial effects (*e.g.*, enhanced nutrition and increased immune response) in the host. Finally, the probiotic must be viable under normal storage conditions and technologically suitable for industrial processes (*e.g.*, lyophilized).

Mode of Action of Probiotics

- Maintain normal intestinal microflora by competitive exclusion and antagonism
- Alter metabolism by increasing digestive enzyme activity and decreasing bacterial enzyme activity and ammonia production
- Improve feed intake and digestion
- Neutralize enterotoxins and stimulate the immune system

Methods of administration of probiotics

There are four different methods for administering competitive exclusion preparations (probiotic):

a) Introducing the treatment material into the crop by tube and syringe.
b) Introducing the treatment material into the beak using a hypodermic syringe fitted with a beaded needle.
c) Allowing each chick to drink from the tip of a pipette.
d) Dipping the beak of the bird in the treatment material.
e) From investigation of Nurmi and Rantala (1973) it was concluded that intubation into the crop has been used in laboratory trials especially when precise control of the treatment dose is important.

Mead et al. (1989) recommended the method, which allows chicks to drink from the tip of pipette. Administration of competitive exclusion (CE) preparations via the beak is also commonly used in laboratory trials and beak dipping may be appropriate in some circumstances.

Administration via drinking water

The method is effective as treatment of individual chicks by gavage even though the first field application of the method showed only 11% reduction in the incidence of S. typhimurium var. copenhagen (Seuna et al., 1978). Practical application of competitive exclusion preparations through the first drinking water of the hatched chicks while the feed is withheld is not always optimal.

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Droplet and spray application

Pivnick and Nurmi (1982) applied first the method of administering competitive exclusion cultures by using aerosols. Goren et al., (1984) developed a spray application method for treating of newly hatched chicks, either in the hatchers themselves or in the delivery boxes. Newly hatched chicks were treated with a homogenate of either crop or caecal material or a mixture of both cultures of aerobically and anaerobically cultured intestinal microorganisms from adult hens.

Administering through the feed

Classical probiotics like Lactobacillus or Streptococcus rarely produce optimum results in the pelleted feed usually fed to broilers. This seems to be due to the fact that the lactic acid bacteria are destroyed partly or totally by the current pelleting process. The optimum viability temperature of lactic acid bacteria is around $35–38^0$ C (Crawford, 1979), while pelletization may increase the temperature of finished feed up to 80^0 C.

Evaluating Probiotic Effects on Immune Response

Kabir *et al.* [2004] evaluated the dynamics of probiotics on immune response of broilers and they reported significantly higher antibody production ($P<0.01$) in experimental birds as compared to control ones. They also demonstrated that the differences in the weight of spleen and bursa of probiotics and conventional fed broilers could be attributed to different level of antibody production in response to SRBC.

Evaluating Probiotic Effects on Meat Quality

Kabir *et al.* [2005] evaluated the effects of probiotics on the sensory characteristics and microbiological quality of dressed broiler meat and reported that supplementation of probiotics in broiler ration improved the meat quality both at prefreezing and postfreezing storage. Zhang *et al.* [2005] conducted an experiment with 240, day-old, male broilers to investigate the effects of *Saccharomyces cerevisiae* (SC) cell components on the meat quality and they reported that meat tenderness could be improved by the whole yeast (WY) or *Saccharomyces cerevisiae* extract (YE).

Effects of probiotics on growth performance

Hygiene in broiler production is also important and usually different hygienic conditions have relative influence on the effectiveness of treating broilers with probiotics. The Hazard Analysis Critical Control Point (HACCP) concept can also be applied to live bird production

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(Simonsen et al., 1987; Mead, 1991). Live bird production involving breeding, hatching and rearing belong to the second category of Critical Control Points (CCP2) (Icmsf, 1988). For broiler flocks, the following requirements should be met (Oosterom, 1991): 1) Salmonella free breeders producing non-infected chicks; 2) measures to prevent any domestic or wild animals from gaining access to the premises; 3) provision of protective clothing, effective cleaning and disinfection, and appropriate resting periods; 4) use of Salmonella-free feed and litter, and avoidance of spreading slurry or manure too close to premises.

The supplementation of either mixture of Lactobacilli cultures or preparations of Lactobacilli and other bacteria in chickens' feed has given variable results. Kim et al. (1988) reported that addition of commercial probiotic (L. sporogenes) increased weight gain of chicks fed a diet containing 10% mouldy maize at 2 or 6 weeks of age. Similar improvement in body weight gain of chickens fed a culture of L. sporogenes have also been reported by Kalbande et al. (1992) and Mohan and Christopher (1988).

Conclusions

The concept of probiotics in recent year is no more confusing as was earlier thought. It now constitutes an important aspect of applied biotechnological research and therefore as opposed to antibiotics and chemotherapeutic agents can be employed for growth promotion in poultry. In past years, men considered all bacteria as harmful, forgetting about the use of the organisms in food preparation and preservation, thus making probiotic concept somewhat difficult to accept. Scientists now are triggering effort to establish the delicate symbiotic relationship of poultry with their bacteria, especially in the digestive tract, where they are very important to the well being of man and poultry. Since probiotics do not result in the development and spread of microbial resistance, they offer immense potential to become an alternative to antibiotics. The probiotics could be successfully used as nutritional tools in poultry feeds for promotion of growth, modulation of intestinal microflora and pathogen inhibition, immunomodulation and promoting meat quality of poultry.

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