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Effect of Probiotics on Broilers Performance

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Abstract: A probiotic is a live microbial feed supplement, which beneficially affects the host animal by improving its intestinal balance. It has been used as a substitute of antibiotics that is being used in considerable amounts as growth promoters in broilers production and is, associated with incalculable risks for human health resulting from the use of particular feed additives. This article reviews the scientific data showing that probiotics may positively affect various physiologic functions in ways that will permit them now or in the future to be classified as functional foods for which health claims (of enhanced production or reduction in disease risk) will be authorized. The article has been prepared under various subheadings including introduction into probiotics, mode of action including immune enhancement, growth stimulation, feed conversion ratio, competition for adhesion receptors, digestion and absorption and health management of diseased animals. The authors own results have been reviewed including: i) poultry growth is promoted with the increasing doses of probiotics up to a certain limit. The growth pattern increased relative to the control, up to 1.0 gram per 10 kg feed but beyond that the pattern was reversed; ii) no difference could be detected in feed conversion ratio of broilers as compared to control; iii) crypt cells proliferation of small intestine increased with the use of probiotics as compared to control. Present/future aspect of probiotics, is the last component of the article including; discovery of more probiotic organisms through genetic engineering.

Key words: Probiotic, broilers performance, poultry growth

Introduction

In Greek Probiotic means "for life" (Gibson and Fuller, 2000) and can be defined as a live microbial feed supplements, which beneficially affects the host animal by improving its intestinal balance (Fuller, 1989). With increasing concern about antibiotics resistance, the ban on sub-therapeutic antibiotics usage in Europe and the potential for a ban in the United States, there is an increasing interest in finding alternatives to antibiotics in poultry production. Probiotics are one of the approaches that have a potential to reduce chances of infections in poultry and subsequent contamination of poultry products. Probiotic foods have been consumed for centuries, either as natural components of foods. A food can be said functional if it contains a component (which may or may not be a nutrient) that affects one or a limited number of functions in the body in a targeted way so as to have positive effects on health (Bellisle *et al*., 1998) or if it has a physiologic or psychologic effect beyond the traditional nutritional effect (Clydesdale, 1997). Amongst the most promising targets for functional foods are the gastrointestinal functions, including those that control transit time, bowel habits, and mucosal motility as well as those that modulate epithelial cell proliferation. Promising targets are also gastrointestinal functions that are associated with a balance colonic microflora, that are associated with control of nutrient bioavailability (ions in particular), that modify gastrointestinal immune activity, or that are mediated by the endocrine activity of the gastrointestinal system. Finally, some systemic functions such as lipid homeostasis that are indirectly influenced by nutrient digestion or fermentation represent promising targets (Clydesdale, 1997; Roberfroid, 1996).

Mode of action of probiotics

Immune enhancement: There is extensive information on the immune system (Schat and Myers, 1991; Kitagaw *et al*., 1998; Mayer, 1998; Muir, 1998; Hershberg and Mayer, 2000; Shanahan, 2000; Erickson and Hubbard, 2000; Jeurissen *et al*., 2000; Spellberg and Edwards, 2001; Toms and Prowrie, 2001), the intestinal epithelium (Glick, 1995; Fontaine *et al*., 1996; Dai *et al*., 2000; Freitas and Cayuela, 2000; Deplancke and Gaskins, 2001; McCracken and Lorenz, 2001) and their interaction. Stress detrimentally affects the immune system and intestinal epithelium (Blecha, 2000; Matteri *at al*., 2000; Maunder, 2000; Soderholm and Perdue, 2001; Tache *et al*., 2001). The neuro-endocrine system is intimately involved in the response of immune and epithelial systems to stress (Cook, 1994; Kohm and Sanders, 2000; Levite, 2001; Petrovsky, 2001).

Havenaar and Spanhaak (1994) has reported that probiotics stimulate the immunity of the chickens in two ways (a) flora from probiotic migrate throughout the gut wall and multiply to a limited extent or (b) antigen released by the dead organisms are absorbed and thus stimulate the immune system. At present it is believed

that there is some relationship between the ability of strain to translocate and the ability to be immunogenic. The improvement in the immune system may be by three different ways: (a) enhanced macrophage activity and enhanced ability to phagocytose microorganism or carbon particles; (b) increased production of antibodies usually of IgG & IgM classes and interferon (a nonspecific antiviral agent) and; (c) increased local antibodies at mucosal surfaces such as the gut wall (usually IgA).

Growth stimulation: It has been stated that supplementation of probiotics has no effect on the performance of broiler chicks (ZuAnon *et al*., 1998; Patidar and Prajapati, 1999; Ergun *et al*., 2000; Kumprechtova *et al*., 2000). But Baidya *et al*., (1993) stated that probiotics were the most effective growth promoter. Probiotics fed chickens had more weight than other groups (Noh, 1997; Mohan *et al*., 1996; Zulkifli *et al*., 2000; Lan *et al*., 2003). Recently, it has been reported that poultry growth is promoted with the increasing doses of probiotic (Protexin, Hilton Pharma, Karachi Pakistan) from 0.5 to 1.5 grams per 10 kg feed. In our laboratory the growth pattern of treated birds showed an increase in weight gain relative to the control, up to 1.0 gram per 10 kg feed but beyond that the pattern was reversed (Ahmad, 2004).

Effect on feed conversion ratio: Feed conversion ratio as affected by probiotics is the subject of controversy. Some studies show that probiotics supplementation in feed of chickens improve the feed conversion ratio (Jagdish and Sen, 1993; Alvarez *et al.,* 1994; Hamid *et al.,* 1994; Silva *et al.,* 2000) while others suggest no such effect on feed conversion ratio (Samanta and Biswas, 1997; Gohain and Sapcota, 1998; Panda *et al.,* 1999; Ergun *et al.,* 2000; Panda *et al.,* 2000). Ahmad (2004) could not detect any difference in feed conversion ratio of broilers as compared to control.

Characterists of probiotic:

Competing for adhesion receptors: Different strains of probiotic bacteria may exert different effects based on specific capabilities and enzymatic activities, even within one species (Ouwehand *et al.,* 1999; Bernet *et al.,* 1993). Different microorganisms express habitat preferences that may differ in various host species (Freter, 1992). Lactobacilli are among the indigenous flora colonizing the chicken's crop, stomach of mice and rats, and the lower ileum in man. Bacteria colonizing such high-transit-rate sites must adhere firmly to the mucosal epithelium (Savage, 1972; Fuller, 1973; Beachey, 1980). Most of the bacterial colonies adhere to the intestinal wall and so does the probiotic. This is the reason that the colonies are not swept away due to the peristalsis's along the intestinal wall. This effect prevents the pathogenic bacterial colonization along the intestinal wall and therefore, prevents disease development (Fuller, 2000). Numerous studies have shown that probiotics inhibit pathogens and disturbance of the intestinal microbiota with the antibiotics can increase susceptibility to infection but addition of probiotics increase resistance to infection (Stavric and Kornegay, 1995; Rolfe, 2000). Proposed mechanisms of pathogen inhibition by the intestinal microbiota include competition for nutrient, production of toxic conditions and compounds (volatile fatty acids, low pH and bacteroicins), competition for binding sites on the intestinal epithelium and stimulation of the immune system (Fuller, 1989; Gibson and Fuller, 2000; Rolfe, 2000).

Digestion and absorption: Useful bacterial growth facilitates the fermentation process in all kinds of animals including man. This fermentation is of nutritional significance in most if not all animals. This is of special importance in the ruminants and to some extent in non-ruminants and provides substantial amount of energy to the host. In the chicken's crop small amount of starch is broken down by the fermentative process. However, this is less significant and is achieved with the help of enzymes present in the small intestine of the chickens. The bacterial breakdown produces various types of organic acids, which provide energy to the host. The organic acids namely, acetic acid, butyric acid, propionic acid and others, which cause reduction in pH which in turn reduces the activity of enzymes in the small intestine which is not desired. Some of the bacteria are useful for the production of vitamins i.e. vitamin A & K of the deficient diet in vitamins (Fuller, 1997). Probiotics have effect on the main physiological functions of the gastrointestinal tract, which are digestion, absorption and propulsion (Fioramonti *et al.,* 2003). Ahmad (2004) reported an increase of crypt cells proliferation of small intestines with the use of probiotics as compared to control.

Health management of diseased animals: Vanderhoof (2001) review the concept of probiotics as a viable therapeutic modality in the treatment of gastrointestinal disease. The antibiotics used for the hope of growth stimulation affect the gut microflora, which results in the reduction of the resistance to infection caused by certain bacteria. The exact mechanism is not clear and is open for research (Areneo *et al.,* 1996). Sub-therapeutic antibiotics not only influence intestinal microbial populations and activities but also affect animal metabolism and specifically alter intestinal function (Anderson *et al.,* 2000). As already described, with the use of sub-therapeutic antibiotics, the intestinal pathogenic micro-flora creates resistance and useful microflora assisting digestive process is damaged. The

probiotic supplementation helps and repairs the deficiencies in the gut flora and a balanced intestinal microbiota enhancing resistance to infection and reduction (Fuller, 1989; Blecha, 2000; Soderholm and Perdue, 2001).

Present/future of probiotics: Studies with probiotics have been difficult to assess because many of the earlier studies were not statistically analyzed, experimental protocols were not clearly defined, microorganisms were not identified and viability of the organisms was not verified (Simon *et al.,* 2001). The antibiotics used for the hope of growth stimulation affect the gut microflora, which results in the reduction of the resistance to infection caused by certain bacteria. (Areneo *et al.,* 1996). The mechanism of action of probiotics is not yet known and is open for research, although there are several hypotheses. There is increasing evidence to suggest that probiotics act by stimulating the host's immune systems. The only accepted example of effective protection against infections provided by living micro-organism is the 'Nurmi concept', whereby one-day-old chicks acquire an enhanced protection against Salmonella infections when they are administered the complex intestinal flora of older chicks. The effects of probiotics on the growth, feed conversion or production of farm animals are, even in specific situations, not consistent enough to consider their use out of economic considerations (Veldman, 1992), In a very short period of time, many studies have been conducted to validate the concept of probiotics as a viable modality in the poultry production. Some known beneficial effects of probiotics include reduction in the severity and duration of rotavirus diarrhea (Oberhelman *et al.,* 1999), reductioin in the risk of traveler's diarrhea (Ribeiro and Vanderhoof, 1998), reduction in the risk of relapsing after the occurrence of *Clostridium difficile* - associated diarrhea (Pochapin *et al.,* 1998), reduction in the risk of antibiotic-associated diarrhea in children (Vanderhoof *et al.,* 1999), immune enhancement (Prowrie, 2001), stimulating the growth (Kumprechtova *et al.,* 2000; Zulkifli *et al.,* 2000; Lan *et al.,* 2003) feed conversion ratio (Silva *et al.,* 2000; Ergun *et al.,* 2000; Panda *et al.,* 2000) digestion and absorption (Fuller, 1997), competing for adhesion receptors (Savage, 1972; Fuller, 1973; Beachey, 1980). Although the number of organisms studied is small, the list is growing and it is likely that many more probiotic organisms with a variety of different benefits will be discovered. Additional organisms may eventually be developed through genetic engineering (Vanderhoof, 2001).

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