

USING PREBIOTICS IN POULTRY NUTRITION¹

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Contents: Feed additives comprise basically different substances which should not be harmful, but they have to demonstrate efficiency in their purpose. Nowadays, growth promoters attract significant attention of both scientists and consumers. Among numerous substances, antibiotics are the best known and world wide spread growth promoters. However, together with antibiotics, prebiotics also attract attention as alternative.

Use of antibiotics as growth promoters causes increase of weight, better food conversion and low cost of therapy. Beside positive effects there are also certain negative and harmful effects such as production of resistant strains of enterobacteria, cross-resistance and finally antibiotics residues in food of animal origin.

Prebiotics cause similar effects as antibiotics, but without residues and carencia. Positive effects are based on known significant antibiotics ratio, since balance in mikropopulation of digestive system enables digestibility and resorption of nutrients by increasing resistance to entero pathogens. Further, optimal morphology structure of the gastrointestinal tract, especially in *villi intestinales*, is significant.

Key words: growth promoters, prebiotics, poultry.

Introduction

Antibiotics are given in a small dosages for growth promoting and have positive effects especially in young growing animals. Using antibiotics as growth promoters causes weight increase, better food conversion and low cost of therapy. Beside positive effects it is possible for certain negative effects such as production of resistant strains of enterobacteria to occur. That problem is complicated by cross-resistance which is a consequence of adaptive ability of microbes and antibiotics mutagen effects. The second, maybe more significant problem, is appearance of antibiotics residues and their possible genotoxic effects.

Alternative possibilities have been used in control of enteropathogens and in growth stimulation for the last ten years (Sinovec and Ševković, 1996). Use of prebiotics shows similar effects as antibiotics, but without residua and carencia. Positive effects are based on known significant antibiotics ratio, since balance in mikropopulation of digestive system enables digestibility and resorption of nutrients by increasing resistance to enteropathogens (Sinovec et al., 1998).

Prebiotics as growth promoters

Prebiotics are non-digestible food ingredients which beneficially affect the host selectively stimulating the growth and/or activity of one or limited number of bacteria in the digestive system and thus improve the host health (Gibson and Roberfroid, 1995). Prebiotics directly target the colon, have a selective fermentation and help maintaining a balanced microflora, preferably by being utilized by promoting species and increased pathogens by faeces. Beside the local effects, other systemic effects may also occur after absorption of fermentation products into the bloodstream.

In order to be classified as probiotics, food ingredients have also to satisfy certain additional demands, such as neither to be hydrolyzed nor absorbed in the upper part of the gastrointestinal tract, be a selective substrate for one or a limited number of beneficial bacteria comensal to the colon, to stimulate their growth and/or metabolically activate them and consequently, to be able to alter the colonic flora in favor of a healthier composition.

Among food ingredients, non-digestible carbohydrates (oligo and polysaccharides) some peptides and proteins, certain lipids are candidate for prebiotics. Because of their chemical structure, these compounds are not hydrolyzed by enzymes nor absorbed in the upper part of gastrointestinal tract, which could be called "colonic foods", i.e., foods entering the colon and serving as substrates for the endogenous colonic bacteria, thus indirectly providing the host with energy, metabolic substrates and essential micronutrients. Among the

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colonic food, non digestible carbohydrates are naturally occurring and are able to fulfill the criteria for prebiotics as defined above. Non digestible carbohydrates include miscellaneous compounds such as resistant starch, non-starch polysaccharides (plant cell wall polysaccharides, hemicellulose, pectins, gums), and non digestible oligosaccharides (*Delzenne and Roberfrojd, 1994*). However, even though they can all be classified as colonic foods, not all are prebiotics because for most of these substances, the process of colonic fermentation is rather nonspecific. Because of that they stimulate the growth and/or metabolic activity of different bacterial species, including species that are both potential and beneficial, consequently, they lack the necessary metabolic selectivity as a critical criterion for classification as prebiotic. Among non digestible carbohydrates the most significant are certain oligosaccharides.

Oligosaccharides contain 2-10 units of monosaccharides which are bound by glycoside bond between hemiacetal group (or hemiketal) from one sugar and hydroxy group of second sugar. Fructo-oligosaccharidess (FOS), oligosaccharides which presence in FOS (also which presence in fruit), have application in human medicine (Spiegel at al., 1997). In veterinary medicine they are used successfully in infection caused by Salmonella, but MOS are the most significant in that case (Newman, 1997). MOS are macromolecular polymers of mannose in which a principal chain contains residua mannose links with α -(1-6) bonds, and that chain bear a short chain (1-3 mannose) attached, α -(1 \rightarrow 2) and α -(1 \rightarrow 3) bonds. Mannans, glucans and hytin together are a major components of yeast cell wall, in which participate with 30%.

Mode of action mannans are based on compatibility structure of mannan and lectins which are on pillas surface and fimbriae of bacteria. On surface of the bacteria, which commonly prevail in pathology of gastrointestinal tract of mono gastric animals (*E. coli, Salmonella, Clostridium, Vibrio*) there are lectins which bacteria use to attach on epithelia cells of intestinal mucosa. The intestinal mucosa has polysaccharide structure on surface that is compatible to lectins. The addition of manan oligosaccharides results with complex mannans-bacteria and prevent adherence pathogens to intestinum wall (*Marković et al., 1997*). Although, bacteria have the other mechanisms of adherence for intestinal epithelia cells which are resistant on mannan inhibition, a great number of *E.coli* (66%) and *Salmonella* (53%) strains, have mannan sensitive adhesins.

Non dissolved (indigestible) MOS pass to distal parts of digestive system, and there binds bacteria. That is the way to prevent colonization of distal parts of digestive system with pathogens and their elimination. In unfavourable condition (change pH of intestinal content and lesion of intestinal mucosae) and due to passage of pathogens in front parts gastrointestinal tract, MOS acts on the same way.

Selective activity of MOS are based on fact that beneficial bacteria in digestive system (*Bifidobacterium longum, Lactobacillus casei, L. acidophilus, L. delbrekii*) contain mannanase enzyme which prevent making complex. That ensures selectivity binding mannan oligosaccharides only for pathogens which normally do not have this enzyme.

Previously described mode of binding MOS is not typical only for bacteria. Some toxins, viruses and eukaryotic cells have the ability to recognize determined sugar on surface the other cells too (*Devegowda et al., 1994; Stanly et al., 1993*).

In addition, MOS shows systemic effects which primarily manifested in positive effects on immune system in various cases of bacterial infections and tumors (*Harris et al., 1991*).

FOS from wheat and legume grains, MOS cell wall of yeast may be used as sources of oligosaccharides for animals, but in human medicine significantly greater oligosaccharides amounts are obtained from bananas, artichoke, garlic, tomatoes, honey etc. (*Mul and Perry, 1994*).

Prebiotics in poultry nutrition

MOS contributes in the described ways to increase of vitality in animals, reduction of losses and improvement in food utilizing, what causes optimal results in production and acceptable economic effects, so for a long time in a world they have been an integral part of a majority of industrial mixtures for poultry nutrition (*Šefer and Sinovec, 1998*).

Oligosaccharides are indigestible by endogenous enzymes and they can decrease utilizing energy (*Leske et al., 1993*). It is known that oligosaccharides are able to produce volatile fatty acid which stimulate peristalsis and decrease time to pass through intestinum and may have negative effect on digestibility. On the other side, as compensatory mechanism there is the increase length of jejunum, ileum and caecum in chicken, such as length villi in ileum (*Trevino et al., 1990*). Because of that in literature can be found some differences

in regard to the effect of MOS on nutrients digestibility and effect on production results, but most of authors (*Durst, 1996; Trevino et al. 1990*) claim that using oligosaccharides doesn't significantly influence the nutrients' digestibility.

Examination on the MOS effects on production results in broilers (*Petersen, 1998; Kumprecht et al., 1998; Roch, 1998; Newman, 1999*) showed that daily increase gain was 4-8%. At the same time, in the case of the same or lower consumption there was significantly better conversion for 5-8%. Statistical differences in broilers mortality between groups were not found, but numerically it was lower in groups which were fed with MOS. Also, comparative examinations established that differences between broilers performances which were fed with mixtures containing antibiotics, that is, prebiotics was not significant, but the both additives are equally effective in promoting growth (*Roch, 1998*).

In his investigations (*Marković, 2005*) has confirmed that antibiotics as growth promoters have positive effects at animal growth (*Gadd, 1997*) which based in bigger gain (about 5%) with better conversion (about 6%) average. Moreover, it's shown unambiguous that prebiotics are effectively growth promoters in feeding poultry. Use of prebiotics showed bigger daily gain approximately 8-10% with lower conversion at 10-15% (*Petersen, 1998; Pupavac et al., 1998*). Because of that, it can be concluded that alternative stimulators are possibility to choose growth stimulates using physiological potential and mechanisms of animals. Use of prebiotics showed similar effects as obtained by antibiotics (*Kumprecht et al., 1998*), but undesirable effects were eliminated (residues, carenca, resistance, allergy, genotoxic effects). The data, which were obtained, show that the effects were significant in final period of growth, due to faster and more complete development of young organisms in the first period.

Knowing basic physiological and biological characteristics of digestive system is a base of modern nutrition of various species and categories of animals. Digestive system, especially intestines is a place where a greater part of the most significant physiological and biochemical functions of digestion occur, which are influenced by morphological, microbiological and biochemical factors. Gastrointestinal tract ensures great surface to directly contact between animals and palette of nutrients, microorganisms and exogenous toxins (*Spring, 1997*). Therefore, mucosa must ensure undisturbed exchange of nutrients between lumen and systematic circulation, and in the same time prevent penetrating of pathogens. A great intestinal surface with optimal functional maturity enterocytes is important prerequisite to make possible maximal digestion and resorption of nutrients, and gain optimal performances.

Use of antibiotics mildly increases villi length and width, with decreasing the total number of bacteria and healthy composition presented micro flora. Although it is known that oligosaccharides can decrease energy utilization (*Leske et al., 1993*), and that VFA, which made in digestible, stimulates peristaltic and decreases pass time through intestines, as compensatory mechanism there is increase of villi length in ileum. *Spring (1996)* showed that feeding with MOS significantly ($p < 0.05$) increases length, but not width of villies. *Bradley et al. (1994)* concluded that besides the increasing of villi length, there is a decrease in depth of the crypts too which is in agreement with in own research results (*Sinovec et al., 2005, 2005a*). A number of gobbler cells is not significantly different between groups, as a number cells on unit did not change, it can be concluded that the increase of number of cells are bound to increase of villi length (*Marković, 2005*).

Previously described characteristics of intestinal morphology in broilers in the experiment can explain production improvement (*Loddi et al., 2004*). Increasing of length and width of villi especially at using alternative stimulators increases the resorption surface. In addition to this, decreasing of depth of the crypts shows the decrease in changing of enterocytes, that is, lower requirements (needs) for construction of new cells. It is known that requirements (needs) for maintaining the normal structure of digestive system in energy and proteins are greater significantly when compared with the other organs at broilers in intensive grow, requirements of digestive system in proteins are approximately 12% from total requirements. Because of that it is considered that change in intestinal morphology can be a basis for better resorption and lower secretion, which in common give better performance.

Observing results in whole, and data from other researches it can be concluded that use of prebiotics as alternatives in growth promoters and control of entero pathogens has its nutritive, medical and economical justification.

UPOTREBA PREBIOTIKA U ISHRANI ŽIVINE

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Rezime

Dodaci stočnoj hrani, u užem smislu, obuhvataju raznovrsne materije koje ne smeju da budu škodljive, a moraju da ispolje efikasnost u smislu namene. U poslednje vreme posebnu pažnju naučne i stručne javnosti, a svakako i potrošača, izazivaju stimulatori rasta. Među brojnim jedinjenjima, antibiotici predstavljaju najpoznatije i najraširenije stimulare rasta. Međutim, pored antibiotika, sve veću pažnju privlače i alternativna rešenja kao što su prebiotici.

Korišćenjem antibiotika kao stimulatora rasta postiže se veći prirast, bolja konverzija hrane i niži troškovi lečenja. Pored pozitivnih, navode se i mogući negativni, pa i štetni efekti kao što su stvaranje rezistentnih sojeva enterobakterija, zatim pojava unakrsne rezistencije, kao i rezidue antibiotika u namirnicama animalnog porekla.

Korišćenjem prebiotika postižu se slični efekti kao pri korišćenju antibiotika s tim što ne ostavljaju rezidue, niti imaju karencu. Pozitivni efekti zasnivaju se na dobro poznatom značaju eubiotičkih odnosa, jer ravnoteža u mikropopulaciji digestivnog trakta omogućava efikasno varenje i resorpciju hranljivih materija povećavajući otpornost prema poremećajima izazvanim enteropatogenim bakterijama. Pored toga, od velikog značaja je i optimalna morfološka građa organa za varenje, posebno crevnih resica.

Ključne reči: stimulatori rasta, prebiotici, živina

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