

# APPLICATION OF ALTERNATIVE GROWTH PROMOTERS IN BROILER PRODUCTION

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Invited paper

**Abstract:** Subsequent to banning of use of antibiotics as growth promoter in poultry nutrition, numerous studies turned to finding of alternative solutions, i.e. other, natural substances, which would have positive effect on chicken growth and feed conversion. Today, several groups of these additives are in use, and most often probiotics, prebiotics, enzymes, acidifiers, antioxidants and phyto-gene additives. Considering that each of the stated groups has its own specificities, objective of this work was to present main mechanism of their action and to present their effect on production results in fattening of broiler chickens through review of research published in this field.

**Key words:** growth promoters, broilers, gain, conversion

## Introduction

Growth promoters are chemical and biological substances which are added to livestock food with the aim to improve the growth of chickens in fattening, improve the utilization of food and in this way realize better production and financial results. Their mechanism of action varies. Positive effect can be expressed through better appetite, improved feed conversion, stimulation of the immune system and increased vitality, regulation of the intestinal micro-flora, etc. In any case, expected results of the use of these additives are increased financial effects of production.

Because of the fact that growth promoters have different mechanisms of action, it is necessary to present every group individually and present the effect which can be expected with their utilization.

## Probiotics

Probiotics are individual microorganisms or groups of microorganisms which have favourable effect on host by improving the characteristics of intestinal micro-flora (Fuller, 1989). Certain species of bacteria, fungi and yeasts belong to group of probiotics. Existing probiotics can be classified into colonizing species (*Lactobacillus sp.*, *Enterococcus sp.* and *Streptococcus sp.*) and free, non-colonizing species (*Bacillus* and *Saccharomyces cerevisiae*) (Žikić et al., 2006).

Probiotics display several ways of action: **antagonistic action** towards pathogen bacteria by secretion of products which inhibit their development, such as bacteriocins, organic acids and hydrogen peroxide; the other way is **competitive exclusion** which represents competition for locations to adhere to the intestinal mucous membranes and in this way pathogen micro-organisms are prevented from inhabiting the digestive tract, and the third way is competition for nutritious substances (Patterson and Brukholder, 2003). In this way, they create conditions in intestines which favour useful and inhibit the development of pathogen bacteria (Line et al, 1998). Their effect on production results reflects in reduction of risk of diseases (Line et al., 1998; Mountozouris et al., 2007), they improve the function of the immune system (Zulkifli et al., 2000; Kabir et al., 2004) and exhibit significant influence on morpho-functional characteristics of intestines (Ušćebrka et al., 2005; Yang et al., 2009). These effects lead to growth of broiler chickens (Jin et al., 1997; Li et al., 2008), improvement of feed conversion (Li et al., 2008; Zulkifli et al., 2000; Kabir et al, 2004) and reduced mortality (Mohan et al., 1996).

On the other hand, no positive results could be established in application of probiotic preparations in fattening of broilers in studies by certain number of researchers (Maiolino et al., 1992; Mountozouris et al., 2007). Wishing to explain in a scientific way inconsistent results which they obtained in their studies, majority of authors concluded that the effect of probiotics depended on the combination of bacterial strains contained in the probiotic preparation, level of its inclusion in the mixture, composition of mixture, quality of chickens and conditions of the environment in the production facility (Jin et al., 1997; Patterson and Brukholder, 2003).

## Prebiotics

Prebiotics are defined as non-digestible food components/ingredients which have positive effect on host in their selective growth and/or activation of certain number of bacterial strains present in intestines (Gibson and Roberfroid, 1995). The most significant compounds which belong to group of probiotics are oligosaccharides: fructo-oligosaccharides (FOS), gluco-oligosaccharides and

mannan-oligosaccharides (MOS). Their advantage compared to probiotics is that they promote growth of useful bacteria which are already present in the host organism and are adapted to all conditions of the environment (*Yang et al., 2009*). Favourable effects of addition of probiotics reflect in presence of antagonism towards pathogens, competition with pathogens, promotion of enzyme reaction, reduction of ammonia and phenol products and increase of resistance to colonization.

Similar to probiotics, results of the effects on broiler performance are contradictory; in analysis of the effects of implementation of FOS on broiler performances it was established that improvement of gain was by 5-8%, and improvement of feed conversion by 2-6% (*Li et al., 2008; Yang et al., 2009*). But, *Biggs et al. (2007)* obtained research results showing decrease of gain by 2% in group fed FOS in diet. Also, in case of application of MOS, some authors obtained results confirming the improvement of gain and feed conversion in fattening chickens by up to 6% (*Roch, 1998; Newman, 1999*). *Žikić et al. (2008)* obtained significantly positive effect of prebiotics on performance and height of intestinal villus in small intestines of broilers. Results obtained in studies carried out at the Faculty of Agriculture in Novi Sad (*Perić et al., 2005a, 2005b, Ušćebrka et al., 2005*) indicate positive effect of BioMOS on performance of broiler chickens, but it is necessary to emphasize that obtained differences for investigated parameters weren't statistically significant. Similar results were stated also by *Mateo et al. (2000)*. This proves that effect of application of prebiotics depends on the condition of animals, environment conditions, composition of food and level and type of prebiotic included in the mixtures.

In very extensive study carried out by *Hooge (2003)* in which effects of mannan-oligosaccharides (BioMOS) were analyzed from 24 trials with 34 repetitions, improvement of body gain by 1,88% was established, as well as of feed conversion by 2,27%. Although relatively moderate, these improvements are statistically highly significant which, according to this author, means that in long term and in more repetitions utilization of these additives will have positive result.

## ***Synbiotics***

This is relatively recent term among additives used in poultry nutrition. Synbiotics are combination primarily of probiotics and prebiotics, as well as other promoting substances which together exhibit joint effect in regard to health of digestive tract, digestibility and performances of broilers. Investigations showed that combinations used in synbiotics are often more efficient in relation to individual additives (*Ušćebrka et al., 2005; Li et al., 2008*). Of course, in this case also the effect of their application depends on numerous factors which have already been mentioned in previous paragraphs.

## Enzymes

Supplementation of mixtures for broiler with enzymes is applied in order to increase the efficiency of production of poultry meat. This is especially interesting if enzymes which enable utilization of feeds of poorer nutritive value are used. Numerous authors have established that by application of enzymes production performances can be improved by even 10% (*Cowieson et al., 2000, Cmiljanić et al., 2001*), whereas in some studies no positive effect has been reported (*McNab and Bernard, 1997; Perić et al., 2002*). It is obvious that the positive effect of application of these additives depends on the quantity and quality of feeds included in the mixture, used level and type of enzyme, as well as fattening conditions (*Acamovic, 2001; Lukić et al., 2002*). Obtained results in some researches indicate that better effect is realized with utilization of two or more enzymes in food (*Silversides and Bedford, 1999; Chesson 2001*). Therefore, new enzyme combinations are constantly analyzed, as well as their optimum doses, in order to realize positive financial effect through improved utilization of feeds.

In researches stated by *Perić et al. (2008b)*, by application of enzyme preparation positive effects in gain and feed conversion were realized, regardless if it was added to standard mixtures or mixtures of reduced nutritive value. Positive effect of introduction of enzymes on chicken growth was also established by *Scutte and Pereira (1998)* and *Chesson (2001)*. Stated authors, however, point out that in application of enzymes positive results are achieved especially in very young chickens, whereas in older categories these positive effects are less present. Contrary to these results, *Perić et al. (2002)* could not establish the positive effect by introduction of enzymes into mixtures with reduced level of energy and protein. *McNab and Bernard (1997)* established that adding of enzyme mixture increased the amino acids digestibility coefficient by approx. 9%, but expected positive effect on broiler performance in some of their trials was not determined. Stated results confirm the assumption that application of enzymes in nutrition of fattening chickens is a complex issue and depends on numerous factors of which some are not under our control at all times.

## Acidifiers

Acidifiers have been used in poultry nutrition for long time, in different forms and combinations which are constantly changing. Organic acids reduce pH value of food and in this way act as conserving agents and prevent microbiological/microbial contamination of food, and this effect is exhibited also in digestive tract of poultry (*Eidelsburger and Kirchgessner, 1994; Freitag et al., 1999*). Result of this is improved consumption of food, better feed conversion and

increased gain. Favourable effect of supplementation of individual organic acids to mixtures was established relatively long time ago for formic acid (*Kirchgessner et al., 1991*) and fumaric acid (*Vogt et al., 1981*). In research published by *Ao et al. (2009)* it was established that citric acid in combination with  $\alpha$ -galactosidase increased the effect of enzyme action, but also had negative effect of feed consumption and gain.

Recently, producers of additives offer in their production program different combinations of acidifiers for which it has been established to have better effect compared to single/individual organic acids (*Luckstadt, 2005*). However, in utilization of acidifiers it should always be taken into consideration that these are substances which can exhibit negative effect on humans, animal and equipment, and it is necessary to carefully select adequate preparations, in sense of combinations of acids, their doses and forms.

## Antioxidants

To this group belong substances which act as antioxidants, such as vitamin E, selenium, carotinoids, etc. Selenium is component of enzyme glutathione peroxidase (GSHPx) which prevents forming of free radicals which are very harmful to cells in the way that they disrupt their integrity (*Kanački et al., 2008*). Therefore, selenium and other antioxidants have favourable effect on quality of broiler meat (*Surai, 2002; Tomović et al., 2006; Perić et al., 2007a*). Protective effect of selenium and vitamin E is stated also by *Roch et al. (2000)*. These authors established better protective effect of organically bound selenium compared to inorganic selenium forms, based on production and some bio-chemical parameters, including activity of GSHPx. One of the most accepted approaches to preservation of sensory properties of meat is addition of antioxidants, such as selenium or vitamin E, directly to livestock food or during technological procedure of processing (*Surai, 2002, Perić et al., 2007b*).

Beside positive effect on quality of meat, *Edens et al. (2000)* and *Perić et al. (2006)* established better feathering and body mass of chickens fed organic forms of selenium. *Perić et al. (2007c, 2008c)* stated that addition of organically bound selenium into food for broiler parents significantly increases quality of one day old chickens.

## Phytogenic additives (phytobiotics)

This group consists of substances deriving from medicinal plants or spices which have positive effect on production and health of animals. As phytobiotics whole plants can be used, parts of plants or essential oils. Phytogenic additives influence improvement of consumption and conversion of food, digestibility and

gain of broiler chickens (Ertas et al., 2005). Mechanism of the action of these additives is not completely clear. Some plant extracts influence digestion and secretion of digestive enzymes, and, besides, they exhibit antibacterial, antiviral and antioxidant (Ertas et al., 2005; Cross et al., 2007).

Results of research of application of phytobiotics in nutrition of broiler chickens are not completely consistent. Some authors state significant positive effects on broiler performance (Ertas et al., 2005; Cross et al., 2007, Perić et al., 2008a), whereas another group of authors established no influence on gain, consumption or conversion of food (Cross et al., 2007; Ocak et al., 2008). Assumption is that differences in results are consequences of numerous factors, of which Yang et al. (2009) point out four: 1) type and part of plant used and their physical properties, 2) time of harvest, 3) preparation method of phytogenic additive and 4) compatibility with other food components. If we add influence of the quality of chickens, their health condition and environment conditions in the production facility, then it can be concluded that positive effect of phytobiotics cannot always be demonstrated. Considering previous results, researchers state that this group of additives has great potential, but the right combination and doses of phytobiotics has to be selected.

## Conclusion

Withdrawal of antibiotics from poultry foods created need for alternative solutions which would influence improvement of health and production traits of broiler chickens. Alternative growth promoters are probiotics, prebiotics, enzymes, antioxidants, acidifiers and phytogenic additives. They all in majority of cases demonstrated positive effect on health and performance of broiler chickens, but further research related to mechanism of the action of these compounds and their interaction with other factors of production is necessary. In this way application of alternative growth promoters in nutrition of fattening chickens would be more efficient.

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## Upotreba alternativnih stimulatora porasta u tovu brojlerskih pilića

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### Rezime

Nakon zabrane upotrebe antibiotika kao promotera porasta u ishrani živine, veliki broj istraživanja okrenut je upravo iznalaženju alternativnih rešenja, odnosno nekih drugih, prirodnih supstanci koje će imati pozitivan efekat na prirast pilića i konverziju hrane. Danas je u upotrebi više grupa ovih aditiva, a najčešće se koriste probiotici, prebiotici, enzimi, zakišeljivači, antioksidanti i fitogeni aditivi. S obzirom na to da svaka od navedenih grupa ima svoje specifičnosti, cilj ovoga rada je da prikaže osnovni mehanizam njihovog delovanja i da kroz pregled novijih istraživanja iz ove oblasti prikaže njihov efekat na proizvodne rezultate u tovu brojlerskih pilića.

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