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Effect of probiotics in poultry for improving meat quality

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The ban on the use of antibiotic growth promoters in many countries in order to satisfy the consumers' demands for healthy and safe meat leads to increasing researchers' interest in finding strategies to maintain chicken health and production. Probiotics which are live microbial compounds are considered a good alternative to antibiotics, as their use in poultry diets has been associated with positive effects on health and growth in birds. Changes in growth performance often affect various meat quality traits and in this context, more and more recent research show that using probiotics as dietary supplements exhibit potential as a natural way to improve poultry meat quality. The review discusses the changes in the physicochemical characteristics as well as fatty acids profile and oxidative stability in poultry meat as affected by various probiotics added to the diet of the birds.

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Introduction: why probiotics?

The production and consumption of poultry meat and in particular chicken meat, has been significantly increasing. This rapid growth is to a great extent associated to the demands of the consumers for a healthier diet and meat as its essential component. In addition to the high quality protein, chicken meat is rich in polyunsaturated fatty acids, especially n-3 PUFA that are beneficial for the human health [1]. As stated by Marangoni et al. [2], numerous epidemiological studies all over the world and in highly diverse population groups prove that poultry meat consumption within a balanced diet is associated with good health. Very often, to improve meat production through promoting growth rate, increasing feed conversion and preventing disease, poultry industry uses antibiotics [3,4]. Their extensive use, however, leads to imbalance of the intestinal microflora, appearance of resistant bacteria and also drug residues in the bird

organism, and that was the reason for the antibiotics in livestock industry to be banned in many countries, including the European Union. Natural feed additives or 'live probiotics' are constantly gaining interest as one of the alternatives to antibiotics in the poultry industry [5]. The primary aim of the use of probiotics in poultry diet is to maintain and improve the performance of the birds [6,7,8*], and also to prevent and control enteric pathogens [9,10,11,12*]. In this context, increasing numbers of probiotic products are being developed and used in poultry nutrition [13].

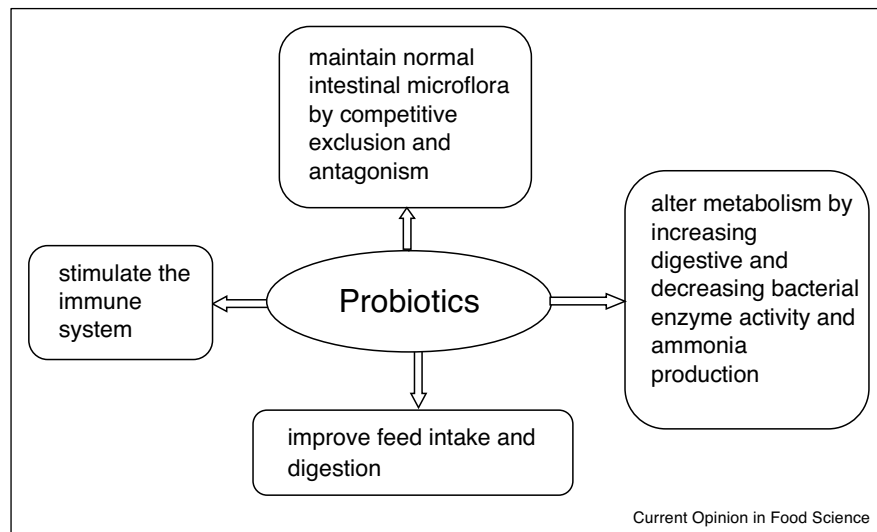
What is a probiotic and possible ways to improve poultry meat quality

The word 'probiotic' comes from the Greek words 'pro' and 'biotic,' meaning 'for life' [14] and was first used by Lilly & Stillwell in 1965 [15] as opposite to the word antibiotic, to designate unknown growth promoting substances produced by a ciliate protozoan that stimulated the growth of another ciliate. The joint Food and Agriculture Organization of the United Nations (FAO) and World Health Organization (WHO) Working Group defined probiotics as "live micro-organisms which when administered in adequate amounts confer a health benefit on the host" [16]. This definition is widely accepted and adopted by the International Scientific Association for Probiotics and Prebiotics [17]. As a whole probiotics consist of various types of microorganisms that improve gut microflora and affect both the local and systemic immune systems by secreting beneficial enzymes, organic acids, vitamins and nontoxic antibacterial substances upon ingestion. In the poultry the mode of action of probiotics is schematised on [Figure 1](#).

The microorganisms currently being used in probiotic preparations for poultry are varied and many ([Table 1](#)).

Selection of probiotic strain should consider of attributes such as being of host origin, non-pathogenic, technologically suitable for industrial processes, acid-resistance and bile-resistance, adherence to the gut epithelial tissue, persistence in the gastrointestinal tract for short period. Also, probiotic should produce antimicrobial substances, modulate immune responses and influence the metabolic activities of the gut [19]. The research on the probiotic application in poultry industry emphasize more often on their influence on the growth performance of the birds and their carcass composition [20,21]. Changes in growth parameters, however, might be associated with alteration of meat quality characteristics, and thus on the one hand, the feeding strategies using probiotics exhibit potential as a natural way to improve poultry meat quality *in vivo*. On

Figure 1



Mode of action of probiotics in poultry (adapted by Kabir [18]).

the other hand, some research report results on the effect of the application of probiotics *post mortem*, in the processed products of poultry meat, mainly concerning its safety [22].

Evaluation of the effect of dietary probiotics on the physicochemical characteristics of poultry meat

Physicochemical properties of meat are important since they determine to a great extent the possibilities for its storage or further processing. They are interconnected and affect the sensory qualities of meat, therefore the influence of probiotics will be presented on the whole complex of these parameters.

The pH of meat is a significant index of its quality and together with colour should be used in the evaluation of meat, especially for further purposes of storage [23]. It is closely related to other important characteristics such as

water holding capacity. Studies on the probiotic administration in poultry showed that pH might be influenced, but the results depend on the type of microorganisms and also on the specifics of the experimental design. Ivanovic et al. [24] studied the effect of two probiotics supplied in different amount to the diet of broiler chickens and found significant changes in the pH measured 24 hours *post mortem* in breast and thigh meat, which differed between the microorganisms used. Receiving 0.05% *Streptococcus faecium cernelle* 68 in the feed significantly decreased pH, while 0.01% of *Bacillus cereus* IP 5832 increased pH in both meat cuts. Zheng et al. [25**] showed significantly higher pH in breast both 45 min and 24 hours *post mortem* in broilers receiving *Enterococcus faecium* in the diet which was accompanied by lower drip loss and cooking loss. In addition, there are studies examining the effect of probiotic on the quality characteristics of chicken meat while the latter has been subjected to storage. Mazaheri et al. [26] studied the influence of mushroom waste,

Table 1

Microorganisms used for probiotic preparations in poultry.

Microorganisms	Genus	Species
Bacteria	<i>Lactobacillus</i>	<i>thermophilus, acidophilus, brevis, bulgaricus, casei, fermentum, gallinarum, jensenii, plantarum, reuteri, rhamnosus, salivarius</i>
	<i>Bacillus</i>	<i>amiloique-faciencie, cereus, coagulans, licheniformis, megaterium, mesentericus, natto, polymixa, subtilis,</i>
	<i>Bifidobacterium</i>	<i>animalis, bifidium, bifidus, thermophilus</i>
	<i>Enterococcus</i>	<i>faecium</i>
	<i>Escherichia</i>	<i>coli</i>
Fungi	<i>Aspergillus</i>	<i>niger, oryzae</i>
Yeasts	<i>Saccharomyces</i>	<i>boulardii, cerevisiae, faecium, salivarius</i> subsp. <i>thermophilus</i>

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