

Contemporary challenges and trends in poultry production

In 2017, the world production of poultry meat exceeded the production of pork meat. Poultry meat production in the European Union countries has also increased for many decades and currently exceeds the own demand by about 6%. This means the risk of slowing down the growth of poultry production due to limited possibilities to sell the products. Export of poultry meat from the EU is difficult, inter alia, due to the growing production of cheaper poultry meat in the world, including Brazil, the USA, China and Ukraine. Increasing competition on the market is one of the challenges in poultry production in the EU, including countries such as Poland, where an intensive increase in production, consumption and export of poultry meat has been recorded in the last two decades. Another problem are the negative side effects of high concentration and intensification of poultry production, including consumer objections to the conditions of birds keeping and the burden on the environment by emission of harmful metabolites (carbon dioxide and ammonia) as well as unused feed components, including agents used in bird health protection, such as antibiotics.

Signaled problems (e.g. increase in production costs, competition on the market, limited resources of domestic high-protein feed) and growing concerns and expectations of consumers in many EU countries regarding the conditions of poultry keeping and the quality of products obtained, have led to this project undertaking. One of the assumptions of the project is to broaden the knowledge on the current challenges identified by the employees of small and medium-sized enterprises of poultry production in Hungary, Italy, Lithuania and Poland. Based on the results of questionnaire surveys conducted among feed producers, advisors, owners and employees of poultry farms, as well as managers responsible for the strategy and profitability of feed and poultry production, the problems were identified which, according to the respondents, are the most important for them.

The information collected in the questionnaire surveys, as well as the opinions of experts participating in the workshops with representatives of small and medium-sized enterprises of poultry production entitle to indicate the following main challenges in modern poultry production in the EU countries:

1. Poultry meat production with limited use of antibiotics;
2. Elimination of discomfort and health risks in poultry;

3. Reduction of emissions of metabolites and feces components into the environment;
4. Use of indigenous protein sources and by-products in the processing of fruit and vegetables;
5. Dissemination of branded products, including pro-health ones.

1. Poultry meat production with limited use of antibiotics

Reports from many countries indicate that one of the most recent trends in poultry farming is the search for the possibility of intensive rearing of broiler chickens without the addition of antibiotic coccidiostats to feed, exclusion of prophylactic use and limitation in therapy. This approach is the result of the acceptance of the “One Health” strategy, which values the nutritional needs of consumers of poultry meat, as well as the need to reduce the risk of antibiotic resistance in the pathogenic microbiota population. According to this strategy, in sustainable poultry production the use of antibiotics is subordinated to the principle “As little as possible but as often as necessary”. The recommended EU antibiotic use limit of less than 50 mg/kg body weight conversion factor (pcm) is a challenge for poultry meat producers in many countries where current antibiotic use is significantly higher. This also applies to Poland, with an average annual consumption of 129.4 mg/kg pcm. An effective solution to this problem should be sought in the improvement of bird living conditions, the use of non-antibiotic coccidiostats, consistent implementation of biosafety rules and effective methods of settling the digestive tract with the desired microbiota used as an alternative to antibiotics. Each of these actions is a serious challenge, necessary to be undertaken by the advisory services and poultry producers in the coming years.

In the elimination of antibiotics from poultry production, it is important to introduce non-antibiotic coccidiostats, as well as to support the biosafety program aimed at minimizing the therapeutic use of antibiotics. In the first direction, herbal preparations, extracts of polyphenols or other fractions (phytoncides) and chemical preparations are of interest. In the second direction, preparations of probiotics (selected bacteria or yeasts) and prebiotics (culture media for beneficial microorganisms) or an appropriate composition of both these components in the synbiotics are important elements. There are many indications that early use of effective probiotic preparations to stabilize the population of beneficial intestinal microbiota will reduce the frequency of veterinary interventions with antibiotics. Another



option, especially with regard to *Campylobacter* contamination of birds, may be to use bacteriophages as natural antimicrobials before slaughter of birds.

2. Elimination of discomfort and health risks in poultry

Modern poultry rearing technologies eliminate or minimize birds welfare risks such as lack of access to feed and water (*ad libitum*), physical and thermal burdens, fear and severe stress (eliminated by tested and optimized equipment, including appropriate ventilation/air conditioning systems). Consumers, on the other hand, raise concerns about the free movement of birds, in particular pain caused by bone disorders and injuries to birds in densely populated poultry houses and transport to slaughterhouses.

One of the reasons for the deformities and bone damage observed in poultry rearing in recent decades is too low skeleton adaptation to the rapid weight gain of birds. This applies to broiler chickens as well as turkeys, where the increase in body weight to 16 weeks of age in relation to tibia is doubled. For this reason, the most common skeletal disorder of broiler chickens and young turkeys is tibia (dyschondroplasia), rickets and lameness, and osteoporosis in laying hens. In chickens, the incidence of limb bone deformities may be limited by slower growth during the first 15-20 days of life. It is estimated that 70-80% of bone mass is genetically determined, and the environmental impact, especially diet, is estimated at 20-30%. Intensive selection of birds for increased bone strength may therefore provide an effective solution to this problem.

It is known that in maintaining proper integrity and strength of the skeleton, an important role is played by adequate levels of calcium, phosphorus and vitamin D in feed, determining the processes of bone mineralization. The optimal quantitative relationship between calcium and phosphorus, regulated by the level and solubility of the compounds and the addition of microbiological phytase, is an important issue. In recent years, attention has been paid to many trace elements such as copper, zinc and manganese, the content of which in the diet affects bone metabolism. Studies carried out in the last decade shown that the unfavorable content of ash, calcium and potassium in chicken tibia may be the result of too low sodium content in the mixture with too little addition of chloride or other source of this element. The same adverse effect occurs if the mixture contains excessive amounts of sodium, exceeding the nutritional requirements of chickens and young turkeys. Compared to broiler chickens, in turkey rearing the salt supplement must be greater so as not to reduce the geometric and endurance parameters of the bones in birds of much higher body weight.



Another environmental factor that may increase the risk to the health of birds is too high level of ammonia in the poultry house. The production of ammonia mainly depends on the amount of nitrogenous substances excreted by the animals and the microbiological activity in the feces. Nitrogen excretion in feces can be reduced by reducing the protein content of feed, more precisely adjusted to the needs of birds, changing with age and productivity. In addition, the production of ammonia in a poultry house can be effectively reduced by using a high water binding capacity litter. Compared to straw and shavings, the water binding capacity of granulated straw or lignocellulose is approximately twice as high. The effectiveness of the ventilation system is also important, especially in critical periods, low temperature in winter and high temperature and humidity in summer. Another factor in a poultry house environment that can increase the risk to bird health is dust in the air, which comes from litter, feed, feathers and skin. In addition to direct effects on the respiratory system of birds, dust also carries endotoxins, bacteria and yeasts, which can be highly allergenic. For this reason, it is advisable to install an exhaust air purification system to reduce the environmental impact of the farm.

3. Reduction of emissions of metabolites and feces components into the environment

Restrictions on the use of antibiotics in poultry production, in addition to the justification presented in point 1, are necessary due to the fact that these substances are excreted in the feces and accumulated in the litter. In general, the presence of antibiotics in the litter is longer than the waiting period because litter is usually removed immediately after the house is emptied, which means that the antibiotic is transferred to the environment. Extending the shelf life and/or applying heat treatment to the litter can help to reduce the adverse environmental impact of poultry production.

Another serious burden on the environment is the large emission of nitrogen compounds in poultry manure. Many modern studies have shown that nitrogen content in poultry manure can be reduced by reducing protein content to 14-15% in the diet of laying hens and to 16-17% in the diet of broilers. This is possible with an appropriate addition of synthetic amino acids balancing the amino acid composition and improving the use of protein in poultry. The results of modern studies also indicate that it is possible to significantly reduce the emission of many environmentally harmful macroelements (mainly phosphorus) and mineral microelements, such as zinc, copper and manganese. In the case of phosphorus, a helpful effective phytase addition helps to increase the use of this element from the basic components



of the diet and to reduce the feed phosphate consumption. The need to reduce zinc, copper and manganese emissions in poultry manure is highlighted by modern studies and reports of the European Food Safety Authority (EFSA). They show that the feed industry uses the amounts of salts of these elements which are too high in relation to the nutritional requirements of poultry.

4. Alternative protein sources and by-products of the food industry in poultry feeding

In response to the demands of consumers who are concerned about the predominant role of transgenic soya in animal nutrition, alternative protein raw materials are being sought in many EU countries. These are primarily local crops of indigenous legumes and rape. Over the last decade, publications from German, Polish and Italian research centers have shown that improved varieties of rape, lupine, field bean and pea can be a substitute for part or even the full content of post-extraction soybean meal in poultry diets. Unfortunately, despite the support programs for domestic legume crops introduced in some countries (e.g. Poland), the area under cultivation of these crops is still small and the protein yield per hectare is quite low. In recent years, there has been a growing interest in technologies for breeding and drying insect larvae as a source of protein and fodder fat, with the expectation that the EU will allow the use of this product in poultry feeding.

The most important by-products of the food industry used in poultry production are post-extraction meals (mainly soybean and to a lesser extent also rapeseed ones), the main protein components of compound feed. Fodder flours, wheat germ and sprouts, dried distillers grains with solubles (DGGS) and potato protein concentrates are used to a lesser extent. A relatively new issue is the better use of the biological potential of fruit and vegetables processed into juices. Due to the large scale of juice production, millions of tones of marc are produced, in which a significant part of the ingredients determining the health value of fruit and vegetables remains. Studies on poultry show that polyphenolic compounds and dietary fiber of fruit marc may have a beneficial effect on the functioning of the digestive tract and antioxidant protection of fast-growing birds. Fodder use of fruit marc, as well as obtaining extracts of selected compounds (e.g. polyphenol fraction) for the production of dietary supplements, is included in the concept of limiting losses in production and food use. This direction, under the slogan “zero waste”, is initiated in many EU countries, including the activities of the *European Institute of Innovation and Technology*.



5. Dissemination of branded products, including pro-health ones

In the questionnaire surveys, nearly 2/3 of respondents declare interest in the living conditions and diet of poultry and in the quality of poultry products. At the same time, the structure of purchases of poultry products indicates that the real behavior of consumers on the market is determined by their income and the prices of products are the main selection criterion. However, one should expect a gradual increase in the number of consumers accepting higher prices of products of non-standard quality. This applies to branded products with an appropriate certificate confirming the place and conditions of production, including higher standards of bird keeping or a favorable (including pro-health) modification of nutrition. Under the conditions of many RIS areas, this product group includes chicken meat from free-range farming, with higher production costs compared to large-scale production, as well as eggs from free-range farming, less economically efficient than cage keeping of laying hens. Retail chains play an active role in the implementation of consumer demands, e.g. by withdrawing eggs from cage farming from the trade and limiting the scale of sales of fast-growing chicken carcasses.

Due to the significant position of meat in the diet of developed countries, the structure and volume of consumption of meat and meat products is important in health prevention, especially in reducing the risk of cardiovascular diseases and cancer. One of the important factors is too low content of polyunsaturated fatty acids n-3, in relation to n-6 acids, increasing the incidence of cardiovascular diseases in humans and contributing to high mortality. In Europe, the best known example of a health promoting product to improve the ratio of n-3 to n-6 acids in the human diet are Columbus eggs with an increased content of n-3 fatty acids, including DHA (600 and 100 mg respectively). Similar trials, using fish oil, algae products and linseed oil, are being undertaken to improve the fatty acid profile of chicken and turkey meat. In a cycle of studies conducted in Canada, it was found that the expected content of 300 mg of polyunsaturated n-3 acids in 100 g of meat was obtained after 11 and 26 days, if the diet containing 17% and 10% of linseed was applied. In both cases, the obtained omega-3 fatty acid content was sufficient to label meat as a source of polyunsaturated omega-3 fatty acids. In similar studies in Poland, it was shown that the fatty acid profile of meat can be modified in the feeding of turkeys for slaughter by using components with high α -linolenic acid content, such as linseed oil or flax seeds, in feed mixtures. The use of 5% linseed oil in turkey diets allows to reduce the ratio of PUFAs n-6/n-3 to 1.2:1 in meat, compared to the level above 5:1, if turkeys were fed with a mixture supplemented only with soybean or



rapeseed oil. In order to obtain a favorable ratio of PUFAs n-6/n-3 in turkey meat, it is not necessary to use linseed oil during the whole rearing period, but only during the last 3-4 weeks before slaughter. The implementation of the results of the mentioned research into production practice is far from complete and the meat of chickens and turkeys with pro-health fatty acid composition remains one of the niche products targeted at a small group of recipients.

The material was created within the project "CHAMPP: Contemporary challenges and issues of the poultry production sector" financed by EIT Food - Knowledge and Innovation Community EIT Food, carried out by the Institute of Animal Reproduction and Food Research in Olsztyn (Poland) in cooperation with Queen's University Belfast (Great Britain), University of Hohenheim (Germany), University of Turin (Italy) and Microbion (Italy).

The project team would like to thank the following people: prof. Jan Jankowski, prof. Michael A. Grashorn, prof. Zenon Zduńczyk for their help in preparing materials for employees of small and medium-sized enterprises, and prof. Piotr Szeleszczuk, organizers of the "ProHealth4" conference in Jachranka, Karol Rudnicki, organizers of the "22nd European Symposium on Poultry Nutrition" in Gdańsk, Stanisław Pietruszyński, Andrzej Barcz for the help in conducting surveys among entrepreneurs.



This activity has received funding from EIT Food, the innovation community on Food of the European Institute of Innovation and Technology (EIT), a body of the EU, under the Horizon 2020, the EU Framework Programme for Research and Innovation

