

Recent Advancements in Poultry Health, Nutrition and Sustainability

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As the largest animal protein producer, the poultry industry is within the focus of mixed-diet consumers, as well as the livestock industry in general. The poultry industry is also extremely fast to uptake new technologies such as biotechnology, mechanization, robotics, and climate and nutrient control in order to be economically efficient and sustainable. Reducing the use of chemical fertilizers in agriculture is one of the EU Green Deal's priorities. The NPK supply of a 100 ha field by pelletized poultry litter was found to possess a smaller environmental impact compared to several combinations of chemical fertilizers [1]. Off-site coupled industrial chicken manure recycling technology (Hosoya compost) fundamentally affects the agricultural value of organic-based products [2]. Achieving the reduction in the N emissions in the poultry industry is vital. Feeding poultry with low-protein diets is an option, but their effects on the performance parameters and excreta composition of broiler chickens need to be investigated. It was found that the urinary N content of broiler chicken's excreta is lower than can be found in the literature, which should be considered in the ammonia inventory calculations [3]. The amount of phosphorus in the diet is also under debate. However, a P-deficient diet caused rickets in commercial chicks within three days [4]. There is constant pressure from pathogens and new threats, such as avian flu, that require new treatments and biosecurity measures. There are many novel approaches and answers to these challenges. Footpad dermatitis and hepatic lipidosis are health problems in fattening turkeys, where the positive influence of a higher methionine content in feed can be found on foot health and antioxidative capacity of the liver, although protein reduction might reduce growth performance [5]. The One Health approach, which requires a holistic approach, where genetics, nutrition, health treatment, and management need to be considered together, has gained ground in the poultry industry. *Citrullus colocynthis* (CC) has been known as a natural medicinal plant with wide-ranging biological activities, including antioxidant, anti-inflammatory, and antilipidemic effects. Dietary supplementation with 2.0 g/kg of ECCs could be considered a successful nutritional approach to producing healthier, lower-cholesterol eggs for consumers, in addition to enhancing the physiological and productive performance of laying hens by alleviating the stress of intensive commercial production [6]. Ascariidiosis in poultry results in a reduction in body weight gain, egg production, as well as microelement levels. Infected poultry have higher demands on feed with the addition of essential elements including zinc. The enrichment of the diet with inorganic zinc has a positive effect on the relative percentage of CD4+ lamina propria lymphocytes in the jejunum and on heterophil counts in the blood. In addition, inorganic zinc has an anti-inflammatory effect and activates IgA-producing cells in the jejunum of chicks infected with *A. galli* [7]. The microbiome of animals, both in the digestive tract and in the skin, plays an important role in protecting the host. The skin is one of the largest surface organs for animals, and therefore, the destabilization of the microbiota on its surface can increase the risk of diseases that may adversely affect animals' health and production rates. The housing envi-

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ronment in which animals live may affect the microbiota of their skin [8]. The gut microbiome seems to be a good indicator of the balanced health of an animal. The intestinal health of poultry is of great importance for the birds' growth and development. Probiotics-driven shifts in the gut microbiome can exert considerable indirect effect on the birds' welfare and production performance. The fecal bacteriobiome can be very useful for the global meta-analysis in order to gain a better insight into bacterial functioning and interactions with gut microbiota to improve poultry health, welfare and production performance [9]. For the adjustment of breeding programs for local, commercial, and exotic breeds, and to implement molecular breeding, a proper comprehension of phenotypic and genotypic variation is a *sine qua non* for sustainable breeding [10]. The status of animal welfare needs to be constantly monitored and improved. The use and effect of a new beak-abrasive material not yet examined on mortality of non-beak-trimmed laying hens of different genotypes housed in an alternative pen has been examined [11], and increased the behavioral repertoire of hens. Alternative food sources that support healthy human nutrition are in heavy demand. Ostrich meat, as lean meat with low intramuscular fat (0.5%) and cholesterol content, is suitable for this purpose [12].

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