Introduction

Bacterial infections are an important problem for both health and productivity of poultry. Traditionally, antibiotics were used sub-therapeutically by the poultry industry to reduce the impact of bacterial infections. However, there are increasing consumer concerns about drug residues in meat products and the rise of antibiotic resistance of pathogenic bacteria. As a result, many countries have banned the inclusion of antibiotics in livestock diets as a routine means of growth promotion. Consequently, there is an increasing demand for alternatives to antibiotics (Swiatkiewicz et al., 2013).

Nucleotides are semi-essential nutrients: under conditions of rapid growth, stress and disease the own synthesis capacity of animals is not sufficient. Supplementation of animal feed with nucleotides improves animal productivity with respect to average daily gain and feed conversion ratio. This effect is especially pronounced in young chickens as nucleotides enhance the immune system resulting in increased numbers of immune cells and antibodies, reducing the impact of pathogenic infections. Consequently, dietary nucleotides provide a valuable tool to the poultry producer as an alternative to antibiotics.

Keywords: Nucleotides, Poultry, Antibiotic replacement
After decades of studies, the health benefits of nucleotides have in the meantime been well established in humans (Grimble & Westwood, 2001), and they have therefore been added to human infant formulas for decades (Boza & Martinez-Augustin, 2002). An increasing body of evidence demonstrates similar benefits in poultry (Rutz et al., 2008).

**Immune modulation: stronger and faster response against pathogens**

Maintaining a good immune status helps the animal to protect itself against pathogens. Nucleotides have been shown to enhance the immune system after dietary supplementation (Boza & Martinez-Augustin, 2002). Also in poultry, dietary supplementation with nucleotides has been shown to improve the immune system of broilers by increasing the production of leukocytes and macrophages (Dil & Qureshi, 2002). Under stress conditions, bird mortality was reduced by approximately 30% upon nucleotide feeding (Rutz et al., 2008). Frankic et al. (2006) showed that feeding nucleotides to mycotoxin-challenged chickens repaired DNA damage in immune cells, that are highly sensitive to mycotoxin action.

**Increasing rate of antibody formation after vaccination**

Poultry vaccines are an important component of poultry disease prevention and control. Dietary yeast nucleotides triggered a faster and stronger antibody response to routine vaccines in chickens. Chickens fed nucleotides reached the level of effective protection 1 week before the control group (Wu et al., 2018).

**Enhancing growth, development and integrity of the Gut**

Young chickens have an immature digestive system. The involvement of dietary nucleotides in intestinal growth and maturation of poultry has been well documented (Rutz et al., 2008). Wu et al. (2018) demonstrated that nucleotides supplementation resulted in a healthier gut flora, as demonstrated by higher concentrations of lactic acid bacteria and a more diverse intestinal microbiota. Moreover, chickens fed nucleotides had a healthier gut indicated by increased villus height and villus height to crypt depth intestinal villi (Jung & Batal, 2012; Wu et al., 2018).

**Boosting animal performance**

Supplementation of diets with nucleotides has been demonstrated to improve growth performance in poultry. The availability of nucleotides might be rate-limiting in rapidly dividing tissues, like in young chickens. Exogenous added nucleotides do not only overcome this bottleneck, but also reduce the energy requirement of the animal, as *de novo* synthesis of nucleotides is an energy demanding process. Yeast nucleotides added to bird feed lead to higher body weight, higher daily body weight gains, and better feed conversion ratios (Esteve-Garcia et al., 2007; Jung & Batal, 2012; Wang et al., 2009). Improvements in weight gain were especially noticed when nucleotides were fed the first 3 weeks of life, indicating optimal early development of the birds will support performance later on (Esteve-Garcia et al., 2007; Rutz et al., 2008). Jung & Batal (2012) also showed that nucleotides had an added beneficial effect on animal growth when birds were exposed to stress conditions such as high stocking density or dirty litters. Additionally, nucleotide supplementation improved egg production, egg fertility and egg hatchability (Bonato et al., 2014). Overall, the number of live chickens was 6% higher in the group fed nucleotides (Bonato et al., 2014). Birds that were fed nucleotides had a larger body weight and consequently a higher carcass yield including drumstick, thigh, wing and breast weights (Rutz et al., 2008).

**Improved meat quality**

When chicken were fed nucleotides, their meat was tenderer and redder in color which is more appealing to the consumer (Chiofalo et al., 2011; Zhang et al., 2008).
Moreover, the meat had improved nutritional characteristics as it contained more iron, more lipids with higher unsaturation degrees which have beneficial health effects in humans (Chiofalo et al., 2006; Chiofalo et al., 2011).

References


Wu, C., Yang, Z., Song, C., Liang, C., Li, H., Chen, W., Lin, W., Xie, Q. (2018) Effects of dietary yeast nucleotides supplementation on intestinal function, intestinal microbiota, and humoral immunity in specific pathogen-free chickens. Poultry Science 0:1-10