Antioxidant Action of Curcumin to Reduce Oxidative Stress Effect on Poultry Heat Stress Condition

By Fajrin Sidiq and Wira Wisnu Wardani

High ambient temperature is a major problem of poultry production in tropical region. Heat stress does not only influence health status and welfare of animal, but also affects survival and product quality. Azad et al. (2010) worked on an experiment about heat stress affected to the broiler performance from Ross and Cobb (see Figure 1).

Figure 1. The temperature treatment was control (24°C), Cyclic (32-24-32 °C), and Constant (32 and 34°C)

Lipid peroxidation is an autocatalytic free radical-mediated destructive process whereby polyunsaturated fatty acids in the cell membranes undergo degradation to form lipid hydroperoxides. These latter compounds spontaneously rearrange to produce multiple degradation products, including MDA (Chance et al., 1979). Oxidative stress was documented in pancreatic tissue by mean of methods showing generation of ROS and accumulation of products of ROS-mediated lipid peroxidation, with concomitant depletion of enzymatic and low molecular weight antioxidant (Dabrowski et al., 1999). Nurjanah (2014) reported that MDA level in the liver both in normal or heat stress condition was higher than plasma and breast muscle of broiler. It showed that the oxidative activity in the liver is much greater than in the other organ.

Heat stress extremely affected the body weight gain and feed consumption of both strain on the constant temperature of 32°C and above. Heat stress induces Reactive Oxygen Species (ROS). ROS continuously generated internal cells by several oxidase enzymes and by dismutation of the superoxide anion formed by electron leakage during mitochondrial respiration (Fridovich, 1978). Oxidative stress occurs because of ROS, when the free radical is higher than the antioxidant. In heat-stressed chicken the increasing of mitochondrial ROS production will cause oxidative damage. Changes in mitochondrial oxidative modified lipid and protein can be detected then increased the malondialdehyde (MDA) level (Mujahid et al., 2007).

For years, inclusion of phytochemical compound from plant extract in feed show positive correlation in reducing oxidative stress. Curcumin is an active ingredient in the traditional herbal which derived from dietary spice turmeric (Curcuma longa) (Sahin et al., 2012).

Experimental studies have demonstrates that curcumin is a pharmacologically safe agent with many activities including antioxidant function, anticancer, anti-inflammatory, antidepressant, and antimicrobial property.
Sahin et al. (2012) in his experiment described the effect of curcumin inclusion in the heat stress condition by measuring the MDA level as marker of oxidative stress. A positive effect was observed in lowering MDA level in the serum. Higher inclusion level effectively reduced MDA level in the serum (See Figure 2).

Figure 2. The effects of environmental temperature (white bars; TN = thermoneutral 22°C for 24 h/d) and grey bars; HS = heat stress (34°C for 8h/d followed by 22°C for 16 h/d) and dietary curcumin supplementation (without line, 0 mg/kg; vertical line, one dose of curcumin; horizontal line, two doses of curcumin).

Several reports have shown that the curuminoid of the yellowish pigments present in the powder of dried turmeric inhibits superoxide anion generation (Iqbal et al., 2003). Emadi and Kermanshi (2007) fed broiler chicks’ turmeric from hatch to 49 day and stated that turmeric might have some positive effects on liver enzymes that directly or indirectly reflect a healthier liver.

Trouw Nutrition with its innovation dedicated an animal health product that has solubility in the water. Orange is a water soluble vitamin with curcumin included. Its stability in the water is important to avoid the sedimentation and more precise in dose because of its active ingredient soluble in water and easier to absorb also match with animal requirement or formula calculation. Water application is easier to do and more effective in using Orange. Orange with curcumin work as hepatic protection and antioxidant by scavenging the free radical and reduce oxidative stress activity in the liver. Healthier liver may support better performance of poultry. Experiment was done to proof the effect of Orange to the laying hen performance. (See Figure 3 and 4)

Curcumin in Orange affected the feed intake of laying hen. Lower feed intake shows us feed efficiency during rearing because feed conversion ratio (FCR) value from week three until seven was better than the control one.

During heat stress condition, feed should be more effective because of lower intake depends on the ambient temperature and humidity. Reducing oxidative stress by using curcumin as an antioxidant combined with water soluble vitamins may be an effective way. It is very good for poultry to support its performance and consider it as a mean to a better productivity. Curcumin as antioxidant works in the tissue especially on the liver by scavenging prooxidant in the body. Hepatoprotective action of curcumin in the Orange maintain good condition and health of poultry. It supports good productivity and its persistency.
Figure 5 shows productivity are increasing by using *Orange* with contained curcumin as antioxidant. Regression function showed very good response (8.17 X) compared to control (6.45 X). The regression function of treatment with *Orange* have been seen more regressive day by day. Liver is very important organ in the metabolism and detoxifying process.

**Figure 5. The Effect of the *Orange* in drinking water to Production (%) of laying hen.**

Lipid is metabolized in the liver and active mitochondria cell is dominant inside the liver, that is why liver is an important organ to be protected. By protecting liver organ from oxidative damage it can reduce economical issue and prevent complication from the other diseases, therefore we can create long lasting and more persistent production of laying hen.

**Conclusion**

According to the disease evidence, heat stress that induces oxidative stress is a serious health and economical problem. Curcumin supplementation improved performance and production also ameliorated the negative effects on lipid peroxidation and antioxidant enzymes in liver of poultry reared under heat stress condition. *OrangeTM*, a water soluble vitamins combined with curcumin could help to maintain liver health and against oxidative damage.

For further information and references, please contact Fajrin Sidiq (fajrin.sidiq@nutreco.com)
The series of Farm-O-San products is an essential vitamin supplement products in powder that can be administered through the drinking water for poultry in which helps optimize the body’s metabolism of nutrients in livestock.

Farm-O-San effectively help optimize the metabolic processes in the livestock body, accelerate healing, reduce metabolic stress or adverse impact on certain conditions*.

Farm-O-San products for poultry:
- Farm-O-San Orange
  - Pressing the metabolic effects of stress and improve feed Intake*
- Farm-O-San Perfexsol H
  - Complete combination of vitamin H
- Farm-O-San Perfexsol L
  - Complete combination of vitamins
- Farm-O-San Nutri-C
  - Minimize the impact of stress due to heat stress

Produced by:

Distributed by:

PT Indovetraco Makmur Abadi