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Review Article

Role of Flavonoids in Poultry Nutrition

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Abstract

Supplementation of flavonoids in poultry diets has proved to be effective in terms of nutritional, sensorial and microbiological quality of poultry meat and eggs. Several studies have determined the beneficial role of flavonoids in inhibiting lipid oxidation, reducing microbial growth, checking any pH-dependent deterioration and improving colour stability of meat products. Flavonoids are found naturally as secondary plant constituents, and are used as chicken food supplements due to their antioxidative characteristics. These extend the shelf life of poultry products. In poultry, different flavonoids have varying dosage levels, but are generally provided at amounts ranging from 0.049 to 0.19 percent. Flavonoid addition in poultry diet improves the lipid content of eggs and meat by lowering levels of cholesterol and triglycerides. Meat colouring can be enhanced up to 5%. Aim of this review is to evaluate how various flavonoids satisfy the demands of consumer, in terms of quality and safety of products, being a synthetic feed additive substitute in poultry feed industry. This study have aroused interest in further research on various flavonoid classes to determine the most effective compounds and their optimal doses for poultry.

Keywords: Flavonoid; Poultry; Diet; Nutritional; Antioxidative

Introduction

Flavonoids, also called as bioflavonoids, are secondary plant metabolites found in all species of plants that have been shown to improve plant development and preservation in a variety of ways, such as nitrogen - fixing, UV filtering, and cell growth regulation [1]. Though they are found in all plants, the highest density has been found in fruits. Flavonoids are also known as therapeutic ingredients and nutrition biomolecules. They are polyphenolic phytonutrients with a low molecular weight include a flavan structure (i.e. 2-phenyl-benzo-pyrane). This basic component comprises of 3 structural units: two benzene rings A and B that are linked by heterocyclic oxygen to create the pyrane ring C [2]. Flavonoids are classified under ten groups depending on their C-ring structure; however some are thought to become more significant due to their extensive presence in plant-based products. Various classes of flavonoids are as follows [3]:

- Anthocyanins
- Chalcones
- Flavanones
- Flavones
- Flavonols
- Isoflavonoids

Bioflavonoid assimilation is completely determined by their physicochemical parameters, which include molecular mass, volatility, arrangement, and solubility in water [4]. Flavonoids could be conjugated with glucuronic acid, and O-methylation. These pro-

cesses can aid in absorption. This kind of bioconversion happens in the lower GIT. Indigestible flavonoids from small intestine, as well as certain absorbed molecules, are released by bile, helping towards the biodegradation inside the colon, where the ring structure is broken down by the microbes. Two gut areas are engaged in metabolic activities: the lower portion of the GIT, hepatic, renal pathway and the colon [5].Many studies have demonstrated that flavonoids positive actions, ranging from antimutagenicity to anti-aging, are attributable to their powerful antioxidant effects. Flavonoids demonstrate antioxidant action through a variety of mechanisms, involving direct O2 radical's entrapment and neutralizing, decreased WBC entrapment, and modulation of nitric oxide and xanthine oxidase action. Nitric oxide is an oxidant that may combine with the other agents to form the very toxic lipid peroxides [6]. Flavonoids were shown to salvage these nitric oxide radicals effectively. Thus, this has been proposed that nitric oxide scavenges plays an important role in flavonoids therapeutic value. Various effects of flavonoids supplement in poultry diet are given in figure 1 [7].

Figure 1: Various effects of flavonoids supplement in poultry diet.

Dietary flavonoids and their effect on poultry and its products

Several researches have been conducted to evaluate the impact of flavonoid in poultry feed and its influence on quality of poultry products in general (Table 1).

Class of Flavonoids	Effect on Poultry and its Products
Flavones	Flavones from herbal fruit even at lower concentrations reduced intramuscular fat and the unsaturated-to-saturated linoleic acid content. It also boosted the carcass proportion and leg muscle protein content, while decreasing thawing losses and belly fat levels [8].
Flavonols	Dietary querecetin increased eggshell density, eggshell hardness, egg proteins and grading unit, and lowered core total cholesterol [9].
Flavanones	Adding supplementary flavanones to laying chickens boosted yolk mass content and yolk weight while decreasing yolk total cholesterol [10].
Isoflavones	Dietary subsidiary of isoflavones enhanced reproductive performance, egg mass, eggshell mass, layer thicknesses, and grading unit in game birds. It also reduced the MDA level [11].
Flavonols	Supplementation of flavonols in the diet enhanced antioxidant capacity by decreasing hepatic MDA generation, as well as blood triglycerides, lipid, and sugar levels in the poultry [12].
Anthocyanidins	Anthocyanin supplemented to broilers enhanced hepatic mass, flesh processing loss, and fat tissue deposit without altering flesh colour or acidity and also it decreased the shear force [13].

Table 1: Influence of various classes of Flavonoids in Poultry Diet.

Various effects of flavonoids

Meat quality

Supplementation of Flavonoids has been proven in studies to increase quality of meat and mitigate the adverse effects of pre-slaughter stresses. It also improved the organoleptic characteristics of meat as well as the fat profile [14]. Meat acidity is by far the most significant variable in the grade of poultry meat, and this is connected to pre-slaughter stressors such as feed withdraw, capturing, and shipping of poultry. It is directly related to WHC, colour, softness, eating quality, and taste. Antioxidant capacity, which would be the oxidizing of unsaturated fats in phospholipid bilayer and glycolipids that leads to off-flavors, is another essential feature for quality meat. Unsaturated fats, oxygen, and organic solvents that promote these processes (e. g. Fe) are all required during peroxida-

tion and are plentiful in meat presented aerobically or in elevated altered environment packing. Meat from non-ruminants has higher amounts of unsaturated fats and glycerides and typically has faster oxidation process than red meat from ruminants [15].

Egg quality

Total cholesterol in eggs continue to be a source of anxiety for some customers, although mistakenly. Citrus flavonoids have been shown to decrease egg fat in laying chickens. In addition to egg laying, nutritional administration with citrus flavonoids enhanced antimicrobial properties in egg production, particularly antioxidant enzyme, peroxidase, iron-chelating, and O_2 scavenger capacities [16].

Anti-cholinesterase activity

Acetylcholinesterase (AChE) is a crucial enzyme in CNS, and inhibiting it raises neuronal cholinergic levels, which is one of the treatments for moderate to severe Alzheimer's disease symptoms. As a result, one of the primary targets for medication discovery to treat Alzheimer's disease is the suppression of acetylcholinesterase. A variety of polyphenols have been found to have anti-cholinesterase action [17].

Anti-inflammatory activity

COX-1 and COX-2 are the 2 isoforms of the enzymes. COX-1 is a default enzyme that is responsible for the supply of prostaglandins that preserve the integrity of the gastric mucosa and sufficient vascular balance, while COX-2 is an inactivating protein that is only produced in response to an oxidant stress. Flavonoids have a good anti-inflammatory activity [18].

Xanthine oxidase modulators

XO catalysing the transformation of xanthine oxidase to xanthine and xanthine is converted to uric acid. Hyperuricaemia or a rise in uric acid levels in serum samples, can lead to serious consequences such as gout and kidney stones [19].

Disease combating activity

The body's antioxidative defense systems involve proteins such as catalase, peroxidase, and glutathione reductase. The various advantages are shown in figure 2 [20]. Flavonoids can protect against free radical damage in a variety of methods, one of which is direct scavenger of oxidative stress. Radicals oxidation flavonoids, producing in a more stable, fewer reactive radical. In other sense, flavonoids have moderate action on reactive oxygen species by interacting with the radical's reactive component [21]. Due to the obvious strong sensitivity of the polyphenols hydroxyl group, radicals are rendered inactive. Flavonoids and their impact on nervous system function are particularly prominent. The roles of flavonoids in numerous biologically active compounds, people's health, and agricultural are shown cumulatively. Butyrylcholinesterase (BChE); acetylcholinesterase (AChE); to degenerative illness induced by the interaction of oxidative stress, irritation, and metal oxide build-up are all factors to consider [22]. There is a huge amount of information available regarding the disease combating activity of flavonoids. Among the main diseases Alzheimer's disease and associated dementias are the most important diseases combated by flavonoids resulting from neuro-degeneration [23].

Figure 2: Various Advantages of Flavonoids Supplementation in Poultry Diet.

Conclusion

Flavonoids are supplemented in poultry diet to enhance meat and egg quality in commercial poultry, as well as to have other favourable impacts on poultry health status. Flavonoids increase the nutritional content of meat and eggs as well as their shelf life, sensory, and technical characteristics, thereby influencing customers' purchase preferences. However, there is a wide range of supplementary doses, which is most likely due to the heterogeneity of the different molecular structures of different substances, which eventually affects their bioactivities. Hence, further research should be carried out to know about the optimal doses for each class/compound of flavonoid family. Keeping poultry welfare and product safety in mind, detailed studies need to be performed to determine the impact of long-term supplementation in poultry sector.

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