

# Role and Effects of *Eucommia ulmoides* Leaves in the Growth Process of Livestock and Poultry

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**Abstract** Substitutes of feed antibiotics have been a key research topic in the new stage of animal husbandry. Chinese veterinary medicine refers to decoction pieces and their preparations processed from natural plants, animals, and minerals and used for animal disease prevention and improvement of animal production performance under the guidance of Chinese veterinary pharmacy theory. *Eucommia ulmoides* leaf extract has many active functional components such as chlorogenic acid, *E. ulmoides* polysaccharides and flavonoids, which have many biological properties such as antibacterial, antioxidant, immune-regulation, sugar ester- and bone metabolism-regulation effects. This paper explored active ingredients and biological properties of *E. ulmoides* leaf extract, as well as its role and effects in livestock and poultry breeding, providing a scientific basis for the use of *E. ulmoides* leaves in livestock and poultry breeding.

**Key words** *Eucommia ulmoides* leaves; Livestock and poultry farming; Role; Efficacy

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In modern farming, the abuse of antibiotics poses a huge threat to people's health. Exploring natural feed additives with antibiotic function instead of antibiotics has become the focus of many experts and scholars. *Eucommia ulmoides* Oliv. is a new type of green Chinese herbal feed additive, which has been widely paid attention to and studied by animal husbandry industries at home and abroad because of its unique advantages of all natural, multiple performance, small adverse reactions, no drug resistance and low harmful residues in edible livestock and poultry products<sup>[1]</sup>.

*E. ulmoides* is a deciduous tree species, which belongs to Eucommiaceae and is rare and unique in China. *E. ulmoides* has a long growth period, and it takes more than ten years to blossom and bear fruit. It is also a rare tree species in the world. The leaves, male flowers and fruits of *E. ulmoides* are rich in nucleic acids capable of improving cell vitality and chlorogenic acid with strong anticancer effect, and its contents are ten times higher than those of other plants. The understanding and medicinal health care of *E. ulmoides* by ancient Chinese medicine experts have a history of over two thousand years. The first medicinal book, *Sheng Nong's Herbal Classic*, and *Compendium of Materia Medica* written by Li Shizhen, a medical sage in the Ming Dynasty, both provide detailed records of the medicinal and health functions of *E. ulmoides*. *E. ulmoides* is non-toxic and has no side effects. Both great works have listed *E. ulmoides* as the top grade of traditional Chinese herb, and it has always been a well-known authentic

medicinal herb both domestically and internationally. In recent years, experiments have preliminarily demonstrated the effectiveness of *E. ulmoides* bark, *E. ulmoides* leaf extract and *E. ulmoides* leaf powder in improving the healthy growth and production function of fish. This paper reviewed the biological functions of *E. ulmoides* leaf extract and its application in livestock and poultry breeding, aiming to provide scientific reference for the application of *E. ulmoides* leaf extract in livestock and poultry breeding.

## Role of *E. ulmoides* Leaves in the Growth Process of Livestock and Poultry

### Improving nutrition metabolism

*E. ulmoides* leaves have the effects of promoting animal protein synthesis, improving cholesterol and lipid metabolism, increasing glucose transport in adipocytes, and lowering blood sugar. The unique components in *E. ulmoides* leaves, geniposidic acid and aucubin, can promote the composition and breakdown of collagen in animal skin, bones, and muscles. Related scholars have proposed that the crude extract of *E. ulmoides* leaves can significantly promote the collagen composition of mouse tissues<sup>[2-3]</sup>.

### Strengthening immune function

*E. ulmoides* leaves can improve the immune function of the body and strengthen its defense ability. Its immune mechanism is as follows: firstly, eucommiol and its glycoside, aucubin and kaempferol in *E. ulmoides* leaves can capture the protein composition of harmful pathogenic microorganism cell surface, thus hindering the polysaccharide protein composition of pathogenic microorganism cell surface. Secondly, they have the effect of immune activation. *E. ulmoides* polysaccharides can excite the reticuloendothelial system and strengthen the nonspecific immune function of the body<sup>[4]</sup>. The acidic polysaccharides isolated from *E. ulmoides* can activate the reticuloendothelial system and improve the nonspecific immunity of the body. Thirdly, polyphenols and their derivatives from *E. ulmoides* can resist oxidation and scavenge free

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radicals with the help of proton hydrogen, and can combine with some metal ions to prevent the oxidative damage of EDTA and hydrogen peroxide to DNA, so as to protect biofilm lipids and DNA macromolecules from being affected.

### Antibacterial and anti-inflammatory effects

*E. ulmoides* leaves contain a large amount of chlorogenic acid, which has strong and universal antibacterial, anti-inflammatory, cholagogic, hemostatic, and white blood cell-increasing effects. Experts analyzed the antibacterial activity of *E. ulmoides* leaf extract, and the results showed that ethanol, acetic acid and ethyl ester extracts of *E. ulmoides* leaves have inhibitory effects on bacteria and fungi, and the ethyl acetate extract has a unique inhibitory effect on *Aspergillus flavus* and *Aspergillus niger*; and n-butanol and water extracts have inhibitory value on bacteria, but no inhibitory effect on fungi<sup>[5]</sup>. The maximum inhibitory zone diameter of *E. ulmoides* leaf extract is greater than 10 mm, and the minimum inhibitory concentration is around 0.25% to 3.0%. The extract of *E. ulmoides* leaves has a certain degree of thermal stability in terms of antibacterial activity, and the antibacterial probability increases with time, with little change after 16 h<sup>[6]</sup>.

### Improving the quality and flavor of livestock and poultry products

*E. ulmoides* has the value of promoting the growth of bone cells and muscle fibers, and can increase the content of muscle collagen. Its mechanism of action is as follows: firstly, the unique components in *E. ulmoides* bark and leaves, geniposidic acid and aucubin, can promote the synthesis and decomposition of collagen protein in animal skin, bones, and muscles, maintain calcium and phosphorus metabolism, and prevent muscle weakness. Secondly, the anti-lipid peroxidation effect of its active ingredients achieved by improving the metabolism of sugars, esters and proteins in animals, can hinder the occurrence of malondialdehyde induced by  $Fe^{2+}$ <sup>[7-12]</sup>. Reasonably feeding *E. ulmoides* to broilers can promote the composition of sweet compounds and soluble collagen in meat, making muscle fibers delicate and tender. Feeding pigs can increase the content of total and delicious amino acids in pork, improve the quality of pig carcasses and muscles, increase cooked meat percentage, and promote muscle firmness and elasticity. *E. ulmoides* can make carp meat more tender and juicy, increasing the nutritional content of carps<sup>[13]</sup>.

## Effects of *E. ulmoides* Leaves on the Growth of Livestock and Poultry

### Effects of *E. ulmoides* leaves in poultry production

Related research reports conducted production function and immune performance tests on Guifei chickens using *E. ulmoides* extract, eucommin. The results showed that the feed gain ratio of Guifei chickens in the *E. ulmoides* extract experimental groups decreased by 4.4% and 6.7%, respectively, compared with the control group; adding 1 500 mg/kg of eucommin to the diet could significantly improve percentage of ANAE<sup>+</sup> cells and peripheral blood lymphocyte transformation rate in Guifei chickens; the *E. ulmoides* extract could clearly promote the development of the spleen; and the experimental groups showed an increase in the

titer of Newcastle disease serum antibody and IgG content in Guifei chickens<sup>[14-16]</sup>. Experts proposed in experiments that adding pure *E. ulmoides* powder to the diet of broilers can increase their weight, reduce the risk of death, and improve feed returns; and adding the pure powder could improve the flavor of chicken to a certain extent simultaneously. Some scholars added *E. ulmoides* powder to the feed of laying hens, which not only improved the egg production function of laying hens and increased the egg production rate by more than 10%, but also increased the cholesterol and high-density lipoprotein contents in eggs produced by laying hens fed with *E. ulmoides* feed additives compared with the control group<sup>[17-18]</sup>. It can be seen that the optimal application concentration of *E. ulmoides* leaf extract varies among different broilers. Meanwhile, considering that there are many product types of *E. ulmoides* leaf extract in the market, the differences in effective ingredients such as chlorogenic acid in *E. ulmoides* leaf extract may also affect its optimal application concentration.

### Effects of *E. ulmoides* leaves in pig production

Fresh *E. ulmoides* leaves were used in pig breeding in China as early as the Ming Dynasty, and the effectiveness of their extract on weaned piglets was specifically demonstrated in improving the intestinal immune function and antioxidant performance of piglets, further ensuring their growth function. Related researchers believed that providing a concentration of *E. ulmoides* leaf extract at 250 mg/kg to weaned piglets significantly enhanced their daily weight gain and resistance to oxidative stress<sup>[19]</sup>. Some experts used similar *E. ulmoides* leaf extract products with a concentration of 250 mg/kg to feed weaned piglets. It could significantly improve the development level of small intestinal villi, enhance the capacity of intestinal mucous epithelial cells to secrete proteins, and ultimately enhance the immune system of weaned piglets<sup>[13]</sup>. The promoting effect on the intestinal health of piglets may be related to the integrity of the intestinal tract barrier protected by active substances such as xanthic acid in the extract of *E. ulmoides* leaves.

Meanwhile, the effectiveness of *E. ulmoides* leaf extract in fattening pigs is specifically demonstrated in its promoting effect on pig growth and its impact on fat metabolism. Scholars have shown that *E. ulmoides* leaf extract with 30% xanthic acid could effectively increase the average daily weight gain of fattening pigs and reduce the feed gain ratio<sup>[20]</sup>. In addition, because the extract of *E. ulmoides* leaves mentioned above participated in the metabolism of fat and sugars in the body, adding crude extract of *E. ulmoides* leaves to the diet of fattening pigs also improved the quality of their pork, especially in terms of significantly affecting indicators such as pH<sub>24h</sub>, fiber density, and color, and significantly reducing fiber diameter.

## Conclusions

To sum up, in recent years, with the improvement of people's safety awareness of high-quality meat products, the use of antibiotics has been strictly controlled worldwide, and the EU and China have banned the addition of antibacterial additives such as zinc bacitracin to feed. *E. ulmoides* additive has the unique functions of enhancing immunity, resisting disease and stress, promoting

growth and improving meat quality, *etc.* As a new multifunctional feed additive, it has been paid more and more attention, but several key problems about its biological activity still need to be solved; ① corresponding relationship between specific biological functions, especially the immunomodulation of *E. ulmoides* leaf extract, and single active compounds in the extract, and its action pathway, ② analysis of the effects of various functional active ingredients on different cultured animals, and ③ optimization of preparation conditions of *E. ulmoides* leaf extract, especially the study on the differences of active components in extracts obtained by different processes and their effects on *in-vitro* and *in-vivo* functions. Therefore, in-depth analysis of the relationship between single active compound components and appropriate compatible combinations, and their biological functions will still be an important direction in the future. With the continuous improvement of research, the application of *E. ulmoides* leaf extract as a multifunctional feed additive in livestock and poultry breeding will receive more and more attention. This paper explored the use of *E. ulmoides* leaves in the growth process of livestock and poultry for reducing animal emissions, improving environmental protection, effectively promoting animal growth, improving animal immunity, and reducing the occurrence of animal diseases, hoping to serve agriculture, rural areas, and farmers, improve quality and efficiency, and assist in rural revitalization.

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