THE MECHANISM OF GLYCYRRHIZA EXTRACT AND ITS APPLICATION IN POULTRY PRODUCTION

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The article presents studies of the effect of phytogenic preparations on the immune system and productivity of agricultural animals. Analysing the growing interest in the world in phytogenic drug, the article presents studies of the most popular herbal medicines - glycyrrhiza. This drug is one of the components of traditional Chinese medicinal herbs. Glycyrrhiza has the functions of invigorating qi and strengthening the spleen, expectorating phlegm and relieving cough and pain, clearing heat and detoxification, and reconciling the properties of medicine. Traditionally, this drug has been used for the prevention and treatment of humans as anti-tumor, anti-inflammatory, anti-viral, liver protection, skin care. It is known that glycyrrhiza residues in animal products do not have side effects on the human body, and this fact draws even more attention to the wider use of glycyrrhiza in modern animal husbandry.

However, some of the active components of glycyrrhiza, at the moment, are not fully research. The extraction process is also being studied. The mechanism of disease resistance and treatment with this drug are currently not very clear. As a result, the drug is not widely used in animal husbandry and poultry farming. Glycyrrhiza contains triterpene saponins, flavonoids, polysaccharides and other biologically active substances that are beneficial to the body. Possessing a complex of unique properties, such as: antioxidant, antibacterial, antiviral, antitumor, anti-inflammatory, as well as the ability to regulate the immune and biological activity of the body, control blood sugar levels, it is increasingly attracting attention to itself. This article reviews the chemical composition, mechanism of action and application of glycyrrhiza in poultry production, in order to provide a reference for the application of glycyrrhiza extract in poultry production.

Key words: glycyrrhiza extract, phytogenic preparations, antioxidant, antibacterial, antiviral, antitumor, anti-inflammatory, productivity, poultry.

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Glycyrrhiza is the dried roots and stems of legumes Glycyrrhiza uralensis Fisch, Glycyrrhiza inflata Bat, and Glycyrrhiza glabra L. It has excellent characteristics such as cold resistance, heat resistance, drought resistance, and salt-alkali resistance. It is a perennial legume herb and a commonly used Chinese medicinal material which is sweet in nature, flat in taste, and has the effects of invigorating the spleen and qi, clearing away heat and detoxification, eliminating phlegm, relieving cough and pain, and reconciling various drugs [1]. Glycyrrhiza is rich in chemical substances with biological activity, mainly triterpene saponins (mainly glycyrrhizin acid), flavonoids, coumarins, alkaloids, volatile oils, organic acids, sugars, etc. Currently, there are many studies on the effective ingredients of glycyrrhiza such as glycyrrhizin acid, glycyrrhetinic acid, glycyrrhizic acid and glycyrrhizin flavonoids. Glycyrrhizin acid is the main triterpenoid active ingredient in glycryr-
rhiza. Its main function is anti-tumor, anti-inflammatory and anti-virus [2].

1. The chemical composition of glycyrrhiza

Glycyrrhiza mainly contains triterpene saponins, flavonoids, polysaccharides, coumarins, volatile oils and amino acids, among which triterpenoids and flavonoids are its main components [3].

1.1 Triterpene saponins: There are more triterpene saponins in the roots and rhizomes of glycyrrhiza, such as glycyrrhizic acid, glycyrrhetinic acid, glycyrrhizin and isoglycyrrhizin, etc. Glycyrrhizic acid and its salts are collectively referred to as glycyrrhizin Su (glycyrrhizin, GL). The content of glycyrrhizic acid is an important parameter that determines the quality of glycyrrhiza herbs.

1.2 Flavonoids: glycyrrhiza contains a variety of flavonoids, mainly flavonoids, flavonols, chalcones, isoflavones, dihydrochalcones, dihydroflavonoids, etc. Flavonoids mainly include glycyrrhizin, glycyrrhizin, isoliquiritin, and isoliquiritin.

1.3 Polysaccharides: glycyrrhiza contains a variety of polysaccharide compounds, including: glucan, rhamnose, galactose, arabinose and so on.

1.4 Other ingredients: In addition to the above ingredients, glycyrrhiza also contains a small amount of coumarins, volatile oils, stilbene, sterols, organic acids, amino acids, etc. [4].

2. The mechanism of the chemical components of glycyrrhiza

Glycyrrhiza belongs to the tonic Chinese herbal medicine. It has the functions of replenishing the qi, relieving emergency and relieving pain, clearing away heat and detoxification, relieving cough and expectorating, and reconciling various medicines. From the perspective of modern medicine, glycyrrhiza has a variety of medicinal effects, including anti-tumor, anti-oxidation, anti-inflammatory, anti-viral, immune regulation, lowering blood sugar and lipids, protecting liver and skin care, etc. [5].

2.1 Anti-tumor

The anti-tumor effect of glycyrrhiza is mainly manifested in regulating the body's immunity, blocking the cell cycle, and inducing cell apoptosis. The research on the anti-tumor effect of glycyrrhiza mainly includes anti-prostate cancer, breast cancer, myeloma, gastric cancer, liver cancer, lung cancer and cervical cancer. Research by Seon M R et al. [6] showed that isoastoguste A, an active ingredient extracted from glycyrrhiza can inhibit DNA synthesis, induce human prostate cancer cells DU145 and mouse breast cancer cells 4T1 cell cycle arrest in G1 phase, and reduce cell cycle proteins. The expression of cycLinA and cycLin D1 inhibits the expression of proliferating nuclear cell antigen and the expression of cyclin-dependent kinase (CDK2) and CDK4 protein in tumor tissues. Xu Shumei et al. [7] found that glycyrrhetinic acid GA had a certain inhibitory effect on the proliferation of myeloma U266 cells, and its inhibitory effect is mainly manifested in time and concentration dependence. Lee CS [8] has shown that 18β-glycyrrhetic acid can increase the lethality of human cervical cancer SiHa cells and has a positive effect on the treatment of cervical cancer. Xiao et al. [9] found that glycyrrhiza chalcone A could increase the expression of Rb (C-15) in human gastric cancer cell lines MKN-28, AGS and MKN-45, and reduce cyclin A, cyclin B and mouse double microgene (MDM2) expression, thereby inhibiting the proliferation of gastric cancer cells.

Studies have shown that glycyrrhiza extract can inhibit the proliferation of breast cancer cells MCF-7 by increasing the expression of tumor suppressor genes p53 and p27 and reducing the expression of cell cycle-related genes [10]. Glycyrrhizin is a compound called dihydroflavonol monomer extracted from glycyrrhiza. Studies have found that glycyrrhizin can inhibit the invasion and metastasis of human melanoma A375 cells by up-regulating the gene expression levels of PTEN and TIMP2, down-regulating the expression of Matrix Metalloproteinase2 (MMP2) protein, and obstructing the p-AKT signaling pathway [11]. Glycyrrhizin plays an anti-tumor effect by inhibiting vascular endothelial growth factor (VEGF) and is expected to treat cervical cancer [12]. Glycyrrhizin can also reduce the expression of matrix metalloproteinase-2 by inhibiting the PI3K/Akt signaling pathway [13]. Isoliquiritin also has the effect of inducing apoptosis of human gastric cancer cells MGC-803 [14].

Glycyrrhiza flavonoids have obvious anti-tumor effects on human liver cancer cells (H22) and sarcoma180 (S180), and the combination with cyclophosphamide has obvious synergistic and attenuating effects [15]. Glycyrrhiza polysaccharides may inhibit the growth of solid tumors and prolong the survival period of mice with ascites tumors by affecting the expression of Bcl-2, p53 and bax protein genes [16]. Xie et al. [17] found that glycyrrhizin in Hela cells inhibited the growth of tumor cells by inhibiting the activity of HIF-1α and down-regulating the expression of VEGF. The above research results indicate that glycyrrhiza has an inhibitory effect on tumor cells, plays an active role in anti-tumor, and is a potential interfering agent that hinders cancer progression.

2.2 Antioxidant

Oxidative damage is closely related to the occurrence and development of tumors. In many tumor hypoxia tolerance environments, hypoxia inducible factor 1(HIF-1) protein degradation pathway is inhibited, the level of HIF-1 protein in the nucleus increases, and the expression of downstream genes such as vascular endothelial growth factor VEGF is enhanced, which is conducive to tumor cell growth, invasion and metastasis [18]. Studies have shown that glycyrrhiza polysaccharides can prevent oxidative damage in the body by optimizing the body's defense system to prevent oxidation, so as to achieve the purpose of anti-oxidation [19]. Conkisn et al. [20] showed that glycyrrhizin could improve the activity of oxidases such as glutathione peroxidase (GSH-Px) and superoxide dismutase (SOD), as well as malondialdehyde (MDA) and other lipid oxidation metabolites, and remove free radicals in the brain and inhibit lipid peroxidation in the brain [21]. The experiment of Liu Jyun et al. [22] showed that glycyrrhiza polysaccharide could scavenge DPPH free radicals and hydroxyl free radicals, and had strong antioxidant activity. Isoliquiritin and glycyrrhizin have certain scavenging effects on hydroxyl free radicals, superoxide anions and DPPH [23]. The experiment of Xue Wei et al. [24] showed that the scavenging ability of glycyrrhiza polysaccharides on DPPH free radicals, OH free radicals, O^2- free radicals and ABTS increased with the increase of the concentration of glycyrrhiza polysaccharides. When the concentration of glycyrrhiza polysaccharide reaches 3 mg/mL, the scavenging ability of DPPH free radicals, OH free radicals, O^2- free radicals and ABTS are 50.75±0.13%, 52.32±0.13%, 25.84±0.35%, 44.57±0.15%, respectively. Glycyrrhiza polysaccharide can effectively inhibit α-glucosidase activity. As the concentration of glycyrrhiza polysaccharide increases, the ability to inhibit α-
глюказидази зростає. Коли концентрація глюкокортикоїду полисахариду досягає 6 мг/мл, його інгібіційна активність щодо глюказидази досягла 64.77%.

2.3 Protect the liver

Normal cells maintain the integrity of cell physiological functions in a normal oxygen physiological state. Tumors, especially solid tumor cells, adapt to hypoxia tolerance to maintain tumor development and deterioration. Hypoxia can promote occurrence of malignant biological behaviors of the growth, infiltration and metastasis of solid tumor cells [18]. Studies have shown that glycyrrhiza can reduce the liver damage caused by dioxore by regulating oxidative stress and inhibiting liver and protein expression, and it is related to the time of drug administration [25]. Glycyrrhizin is produced by the deglycosylation of glycyrrhizic acid. The experiment of Zhang Yiping [18] showed that the effective part of glycyrrhizin could effectively inhibit the activity of human liver cancer cells, and down-regulate the hypoxia signal HIF1α and its downstream target gene VEGF. The expression level is not conducive to the malignant progress of liver cancer cell SMMC7721. At the same time, glycyrrhizin can regulate the biological behaviors related to liver cancer Hep G2 cell apoptosis. Further studies have shown that glycyrrhizin promotes antioxidant enzyme activity and inhibits oxidation metabolism and restores mitochondrial pathways of anti-apoptotic genes, inhibits inflammation and fibrosis, thereby preventing chronic liver injury and malignant transformation in rats caused by the carcinogen CCl4 through the PGC-1α pathway. Nrf2 is a key transcription factor that induces antioxidant enzymes. Kim et al. [26] reported that glycyrrhizin could prevent liver lipid degeneration and antioxidant damage by activating Nrf2.

At present, the treatment of hepatitis is mainly achieved through anti-virus, inducing interferon, regulating body immunity, and anti-inflammatory effects. Glycyrrhizin can directly fight hepatitis virus and inhibit interferon, increase the activity of NK cells and inhibit hepatitis virus [27]. Clinically, glycyrrhizin acid preparations have glucocorticoid-like effects, can reduce the infiltration of inflammatory cells, inhibit the release of various inflammatory mediators, and have membrane stabilization. They are commonly used drugs for anti-inflammatory and liver protection, and the magnesium isoglycyrrhizinate present in natural glycyrrhizin acid (Magnesium isoglycyrrhizinate, MgG) can significantly improve liver function and reduce the degree of liver fibrosis [28]. Experimental and clinical studies have shown that glycyrrhizin diamine and compound glycyrrhizin have a preventive effect on liver injury, and are of great significance for the early prevention of the development of chronic hepatitis B to cirrhosis [29,30,31]. The research results of Liang et al. [32] showed that glycyrrhizin polysaccharide could effectively alleviate the acute liver injury induced by CCL4 in mice, and reduce serum Alanine Transaminase (ALT), Aspartate aminotransferase (AST), Alkaline Phosphatase (ALP), Lactate Demineralization Hydrogenase (LDH) activities and mutations of caspase-3, TGF-β1 and TGF-β1 mRNA and have a hepatoprotective effect. Chen Yunhua et al. [33] found that isoliquiritin had the effect of protecting the liver. The total flavonoids of glycyrrhiza may be able to interfere with non-alcoholic fatty liver by activating AMPK signaling molecules [34]. Glycyrrhetinic acid is the aglycone of glycyrrhizin, which has biological activities such as liver protection, detoxification and antioxidant, and can obviously promote the apoptosis of liver cancer cells. [2] Diammonium glycyrrhizinate has a significant effect on reducing the ALT of patients with chronic viral hepatitis. After intravenous administration, more than 85% of patients' ALT decreased significantly and returned to normal, and it has a preventive effect on liver damage caused by various hepatotoxic agents [35]. The results of these studies all show that glycyrrhiza extract can be used as an effective drug for improving liver function and health.

2.4 Immune regulation

Glycyrrhizin is an effective biological response modifier, and its immune function is manifested in many aspects such as immunocompetent cells, cytokines, complement and so on. Glycyrrhizin can enhance the proliferation and activity of helper T lymphocytes, promote the production of IL-2, IFN-γ, IL-1 and other cytokines by lymphocytes, and inhibit the production of IL-4, IL-10, IL-8, etc. At the same time, it has complement activity and can selectively inhibit the activation pathway of the complement system [36].

Glycyrrhiza polysaccharides play an immunomodulatory effect mainly by activating the body’s immune system [37]. Wang Lirong et al. [38] showed that glycyrrhiza polysaccharide could significantly increase the weight of mice and increase the formation rate of E2 rosettes of lymphocytes, thereby improving cellular immune function. Hong et al. [39] studied the effect of glycyrrhiza polysaccharide on the proliferation of spleen lymphocytes and serum antibody levels in mice with a high-fat diet, and found that glycyrrhiza polysaccharide could promote the proliferation of mouse spleen lymphocytes and increase the levels of various antibodies in serum. Li Fasheng et al. [40] used ovalbumin to stimulate the immune response of mice, then administrated the mice with glycyrrhiza polysaccharide, and then stimulated the body's immune system with the same antigen. The results show that both 50mg/L and 100mg/L of glycyrrhiza polysaccharide could increase the immune response level of mice and the level of cytokine IFN-γ. The aqueous extract of glycyrrhiza contains abundant high-stability miRNAs, which can affect the growth status of human immune cells in vitro, and the abundance miRNA156 does have a certain effect on the expression of immune cell-related genes[41]. Glycyrrhiza extract isoliquiritin and cortexin can promote the activity of regulatory T cells in vivo and in vitro, and can reduce the colitis induced by Dextran Sulfate Sodium Salt (DSS) in mice by exerting an immunosuppressive effect [42].

2.5 Anti-inflammatory

Inflammation is a defense response of the body and the initial cause of many chronic diseases. Inflammation is caused by a variety of inflammatory factors released in the process of inflammation, which can be divided into infectious inflammation and aseptic inflammation. Kim et al. [43] found that isoliquiritin can achieve anti-inflammatory effects by inhibiting the expression of IKK, ERK1/2 enzymes, p38 phosphorylation, and inhibiting the production of IL-4 and IL-5. Wei et al. [44] showed that the total extract of glycyrrhiza, flavonoids and saponins have anti-inflammatory and analgesic effects, and the flavonoids have the best effect through UPLC-QTOF-MS metabolomics method. Qu Xiaomai et al. [45] verified that the water extract of glycyrrhiza in mice could significantly inhibit the formation of granuloma and toe swelling in mice through the mouse xylene ear swelling model and the egg white-induced toe swelling model, indicating that the water extract of glycyrrhiza Has anti-inflammatory effects. Wu Minman et al. [46] proved through experiments that aqueous extract of glycyrrhiza can hinder the
metabolism of arachidonic acid and inhibit the release of hista-
mine from mast cells, which has a significant anti-inflammatory
effect. Dong Jinxiang et al. [47] studied the regulation of Gansu
wild glycyrrhiza endophyte fermentation broth and host deco-
cation, total flavonoids, and total saponins on lipopolysaccharide
LPS-stimulated mouse macrophage (raw264.7) cell inflamm-
action model secretion of inflammatory factors The results showed
that the fermentation broth of glycyrrhiza endophytes JTYB018
and JTYF027 can inhibit raw264.7 secreting NO, TNF-α, and IL-
6. Research by Wang Liyao et al. [48] showed that the com-
 pound licostilbene B derived from glycyrrhiza can inhibit the
phosphorylation of p65 subunits, ERK, JNK, and p38 proteins,
thereby inhibiting the activation of NF-κB and MAPKs pathways
induced by LPS and exerting anti-inflammatory effects. effect.
Zhao Yunsheng et al. [49] studied the effects of different
doses of glycyrrhiza polysaccharides on acute inflammation
in mice, and found that the high-dose group (10 mg/10 g) and the
low-dose group (3 mg/10 g) of glycyrrhiza polysaccharides had
the inhibition rate on mouse abdominal cavity capillary permea-
bility 38.95% and 15.41% respectively, indicated that glycyrrhiza
polysaccharide has a significant inhibitory effect on acute in-
flammation in mice. Tanaka et al. [50] analyzed the volatile oil
components in glycyrrhiza roots by gas mass spectrometry,
which were mainly aldehyde and caproic acid, and measured its
anti-inflammatory activity by ELSA kit, and found that the volatile
oil components had strong anti-inflammatory activity. Liu
Yuanyuan et al. [51] used UPLC-QTOF-MS metabolomics method
to analyze the pharmacodynamic mechanism of
Gancao Fuzi Decoction. The alkaloids, flavonoids and saponins
in Gancao Fuzi Decoction treat arthritis by regulate amino acid
metabolism, energy metabolism, intestinal metabolism and
metabolism of intestinal flora. Wei et al. [52] found that the total
extract of glycyrrhiza, flavonoids and saponins have anti-
 inflammatory and analgesic effects through the metabolomics
method of UPLC-QTOF-MS, which the flavonoids have the best
effect. Zhao Jie et al. [53] have shown that ephedra-glycercin can
significantly inhibit carrageenan-induced pleural fluid exudation
and increase in the number of white blood cells in the inflamma-
tory area, indicating that it can inhibit inflammation and the
adhesion and aggregation of inflammatory cells, and has a good
anti-inflammatory effect/. It can be seen that glycyrrhiza extract
is closely related to the body's anti-inflammatory, and can be
used as an ideal source of potential anti-inflammatory drugs.

2.6 Antivirus

The antiviral mechanism of glycyrrhiza polysaccharide
may be achieved by enhancing the activity of immune cells and
enhancing the ability of antigen-presenting cells to swallow
pathogenic microorganisms [54]. The study of He Dan et al. [55]
showed that glycyrrhiza extract could induce the function of
glycoprotein (P-gp) and up-regulate its expression, thereby
promoting P-gp-mediated efflux of intracellular toxins to achieve
antiviral effects. Glycyrrhizinic acid can inhibit viral replication
and has a good antiviral effect on the treatment of hepatitis B virus,
HIV, SARS virus, etc. [56]. The mechanism of glycyrrhizic acid
inhibiting HIV replication is mainly to reduce the activity of pro-
tein kinase C and can effectively prevent the spread of HIV.
Glycyrrhizinic acid can also inhibit and reduce the activity of DNA
synthesis rate-limiting enzymes and nucleotide reductases to
hinder the migration of tumor cells during the synthesis phase,
thereby allowing cancer cells to differentiate and inhibit cancer
cell proliferation[2]. Song et al. [57] isolated 28 triterpene sapo-
nins from glycyrrhiza root and tested them for anti-H1N1 and
anti-HIV activities. The results showed that ursapontins M/S/T
and 22β-acetoxyglycyrrhizin have strong anti-H1N1 activity. Its
IC50 values are 48.0, 42.7, 39.6, and 49.1 μM respectively. 22β-
acetoxyglycyrrhizin and 3-O-β-D-Glucuronopyranosylglycyrrhe-
tinic acid have strong activity against HIV, and their IC50 values
are 29.5 and 41.7 μM respectively. The compounds of oleic acid,
dehydrocucurbitacin D and glycyrhetinic acid extracted
from glycyrrhiza have good inhibiting effects on strepto-
coccus mutans, staphylococcus aureus, mexitilin-resistant
staphylococcus aureus, quinolone-resistant staphylococcus aureus
and bacillus subtilis. The minimum inhibitory concentra-
tion of the inhibitory effect is 16-32μg/mL, 8-16μg/mL and 32-
64μg/mL[58]. Glycyrrhizol extract has a good antibacterial effect
on Gram-positive bacteria, and its minimum inhibitory concen-
tration is 1.25 mg/ml [59].

2.7 Lowering blood sugar and blood lipids

DushkinM [60] et al. reported that the ethanol extract of
glycyrrhiza can reduce the blood glucose level of rats fed high-
fat diet, and can improve their glucose tolerance. Zhao Haiyan
et al. [61] have shown that glycyrrhiza flavonoids can reduce the
blood sugar level of diabetic rats, and can also regulate lipid
metabolism disorders. The total flavonoids of glycyrrhiza have
the effect of reducing hyperlipidemia in hyperlipidemia model
rats induced by high-fat diet. Its mechanism of action may be
through increasing the expression of PPARG protein molecules,
thereby increasing the expression of adenosine monophosphate
activated protein kinase (AMPK) and p-AMPK protein molecules
to achieve the effect of treating hyperlipidemia [62]. α-
glucoamidase inhibitor is a new type of oral hypoglycemic agent,
clinically used as the first choice for the treatment of type 2
diabetes, and an auxiliary drug for type 1 diabetes. Zeng Lan
et al. [63] first discovered and proved that the isoflavone com-
pound in glycyrrhiza had α-glucosidase inhibitory effect, which
provides a new way for the further development and utilization
of glycyrrhiza. Peng Lei et al. [64] studied the hypoglycemic
effect of ethanol extract of glycyrrhiza. The experimental re-
sults showed that ethanol extract of glycyrrhiza could reduce
serum glycosylated hemoglobin, triglycerides, low-density lip-
protein, and total cholesterol content, and improve its oral glu-
cose tolerance. And It could also increase the level of insulin
in the serum to lower the blood sugar level of diabetic mice. Glycyrrhiza chalcone E is a partial agonist of PPAR-γ, which can
promote PPAR-γ mRNA expression in white adipose tissue,
reduce fat cell volume and promotepreadipocyte differentia-
tion, thereby improving insulin resistance and reducing dietary obesi-
ity diabetes blood glucose and blood lipids in mice [65].

2.8 Protect the skin

Zhao Weide [66] studied the effect of glycyrrhiza and
calvaria miltorrhiza extraction ratio on the whitening activity of
the extract, and the results showed that the glycyrrhiza and calvaria
compound extract could inhibit tyrosinase activity, resist ultravio-
et radiation and reduce the production of melanin, promote
metabolism and soften the role of the stratum corneum, and will
not cause irritation to human skin.

Studies have shown that 5% glycyrrhiza extract aque-
ous solution for external use has a protective effect on ultravio-
et-induced skin photaging and cell apoptosis in mice. Its pro-
tective effect may be related to inducing the production of SOD,
MDA, and TNF-α in skin tissues and reducing skin cell apopto-
sis [87]. G9315 is a mixture of 6 flavonoids extracted from

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glycyrrhiza inflata. 2 mg skin application can significantly inhibit the formation of papilloma in mice induced by dimethylbenzanthracene (DMBA) combined with croton oil [16]. The study of Nerya [68] found that the isoglycyrrhizin in glycyrrhiza had an inhibitory effect on the tyrosinase monophenolase that synthesized melanin, and the inhibitory effect was dose-dependent. Therefore, they believe that chalcone flavonoids can be used as lead compound candidates for skin whitening agents.

3. Application of glycyrrhiza in poultry production

Wu Hua et al. [69] studied the effect of adding glycerrhizae residues in the feed on the performance of broiler chickens, and found that compared with the control group, the addition of 3% glycerrhizae residues group can significantly increase the daily gain of broilers and reduce feed weight gain ratio (P <0.05), and can significantly increase the apparent metabolic rate of crude fat in the diet (P <0.05). The addition of different levels of glycerrhiza residue group can reduce the apparent metabolic rate of crude fat in the diet ( P <0.05). The study by Shao Qi et al. [70] showed that adding a proper amount of glycerrhiza cream can significantly increase the antioxidant capacity in broiler serum. The antioxidant capacity of the 50 mg/l group was significantly higher than that of the 0 mg/l and 100 mg/l groups (P<0.05).

Yi Lei et al. [71] studied the effect of glycerrhiza polysaccharides on the antioxidant activity of chickens. The drug group was injected intramuscularly with low (1mg/mL), medium (2mg/mL), and high (4mg/mL) concentration of glycerrhiza polysaccharide for 1mL. The results showed that glycerrhiza polysaccharide could significantly improve the total antioxidant capacity of T-AOC, glutathione peroxidase GSH-Px and catalase CAT activities of Roman chickens (P<0.05) ), and the high dose group had the best effect. The research results of Dong Yongjun et al. [72] showed that adding 1.0g/kg of glycerrhiza polysaccharides to feed has a significant impact on the microflora of the animal's digestive tract, which can promote the proliferation of beneficial intestinal bacteria bifidobacterium and lactobacillus, and inhibit proliferation of harmful bacteria of enterococcus and salmonella in the large intestine. Wang Lirong et al. [73] studied the effect of glycerrhiza polysaccharide on the antibody titer and body weight of Newcastle disease in chickens and found that glycerrhiza polysaccharide had a certain effect on improving the immunity and weight gain of chickens. Grinding glycerrhiza and its rhizomes as feed additives can improve the production performance and immune performance of Muscovy ducks, and increase the total protein, albumin and various indicators in the blood of Muscovy ducks [74]. Ma Lu et al. [75] studied the effects of adding different levels of glycerrhiza polysaccharides in the diet on the immune function of broiler chickens. The results showed that the addition of glycerrhiza polysaccharides in the diet could improve the immune organ index and Newcastle disease antibody of broilers to a certain extent. The level and the mass concentration of immunoglobulin, the mass concentration of cytokines and the gene expression level of spleen-related cytokines can improve the immune function of the body. Zhang Cai et al. [76] studied the effects of adding different levels of glycerrhiza polysaccharides in the diet on the growth performance and serum biochemical indicators of broilers. The results of the study showed that the 500 mg/kg group and the 1,000 mg/kg group were added to the diet, glycerrhiza polysaccharides can significantly increase the average daily gain (ADG) of 22-42-day-old broilers and reduce the feed-to-weight ratio (F/G) (P<0.05). And it can increase the mass concentration of total protein (TP) and globulin (GLB) in broiler serum and the concentration of high-density lipoprotein (HDL-C) (P<0.05), and can significantly reduce alanine aminotransferase (ALT) and glyceral The concentration of triester (TG) and uric acid (UA) (P<0.05).

Chen Jingyi[77] et al. studied the effects of alternative products on the growth performance and immune function of broiler chickens, and the results showed that the glycerrhiza extract group could significantly increase the weight of the chicks (P<0.05), and the thymus and bursa of Fabricius in the glycerrhiza extract group, Newcastle disease (ND) antibody titer, avian influenza H9N2 antibody titer, IL-2 and IFN-γ levels were significantly higher than those of the control group (P<0.05). The above results all showed that the addition of glycerrhiza extract in the diet could improve the production performance of poultry, immune function, reduce production costs, and improve economic benefits.

Conclusions

With the continuous improvement of living standards, people's awareness of health and the demand for animal products are also increasing. Glycerrhiza has many functions such as anti-tumor, anti-inflammatory, anti-viral, liver protection, skin care, etc., and the residue of glycerrhiza in animal products also has no side effects on the human body, and this makes glycerrhiza get a widely attention. However, the active ingredients of glycerrhiza, the best extraction process and the mechanism of disease resistance and treatment are not very clear, and they have not been widely used in livestock and poultry production, which limits the wide application of glycerrhiza. Future research directions for glycerrhiza:

1) Explore the mechanism of action of the active ingredients of glycerrhiza extract in animal bodies.
2) Appropriate addition ratio of glycerrhiza extract in the diet.
3) Further optimize the extraction process of glycerrhiza.
4) Use the biologically active ingredients of glycerrhiza extract to replace antibiotics in animal husbandry.

With the in-depth research on the effective chemical components, pharmacological effects and extraction technology of glycerrhiza, the application value of glycerrhiza will be further developed and comprehensively utilized, which will have a profound impact on the development of medical care and modern animal husbandry.

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У статті наведені дослідження впливу фітогенного препарату на мукну систему та продуктивність сільськогосподарських тварин. Аналізуючи сучасну тенденцію щодо зацікавленості фітогеничними рослинними препаратами, в статті представлено дослідження найбільш популярного препарату - глицирізину. Даний препарат - це один з компонентів традиційних китайських лікувальних засобів. Глицирізин має еластичність багаторічної і є використовується для профілактики та лікування різних захворювань. Глицирізин має властивості антиоксидантної та противірусної дії на організм людини, і цей факт ще більше привертає увагу до себе.