

Hawthorn flavonoid extract can use as an effective herbal drug to prevent pulmonary hypertension in broiler chickens

Abstract

An experiment was conducted to investigate the effect of hawthorn flavonoid extract (HFE) to prevent pulmonary hypertension in broiler chickens. A total of 225 day-old unsexed broiler chicks (Ross308) were assigned to 3 treatments with five replicates in 15 floor pens randomly. Experimental groups were provided by adding 0, 0.1 and 0.2 mL of hawthorn flavonoid extract per liter of chicken's drinking water. The results showed that HFE significantly ($P < 0.05$) decreased the heart weight, RV: TV ratio, and percentage of birds with PHS compared to the control group. In conclusion, HFE could effectively use as an herbal drug to prevent pulmonary hypertension in chickens.

Keywords: chicken, hawthorn flavonoid extract, PHS, oxygen pressure, broiler chickens, oligomeric proanthocyanidins, Hawthorn, epicatechin, hyperoside, ventricular failure, drinking water

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Introduction

Modern broiler chickens with rapid growth have disposed to pulmonary hypertension syndrome (PHS) due to the imbalance between oxygen-demanding muscles and oxygen-supplying organs such as heart and lungs.¹ Also intensive genetic improvement of growth traits in broiler chickens has created a situation where the development and end size of the heart and lung is unsynchronized and leads to increasing the sensitivity of broilers to pulmonary hypertension and right ventricular failure.² At high altitudes with low partial oxygen pressure, the sensitivity of broilers to PHS will increase and finally leads to right ventricular failure and ascites.³ *Crataegus oxyacantha* (Hawthorn) as a famous medical plant is traditionally used in treatment of cardiac diseases and cardiovascular problems.⁴⁻⁶ Flavonoids and oligomeric proanthocyanidins (OPCs) are the main chemical constituents in hawthorn.⁷⁻⁹ Other bioactive components in different scales are exist in hawthorn flavonoid extract.^{10,11} Generally, flavonoid extract of hawthorn indicates potent antioxidant and free radical scavenging activities, due to the impact of epicatechin, hyperoside, and chlorogenic acid compounds.⁴⁻⁸ These compounds are reported to have many pharmacological effects, including neuroprotective, hepatoprotective, cardioprotective, and nephroprotective.⁴⁻⁷ Furthermore, hawthorn fruit possesses tonic effects on the heart and could reduce cardiovascular risk factors.⁷ Objectives of the present study were to investigate the effects of hawthorn flavonoid extract to improve cardiac indices and preventing of PHS in pulmonary hypertensive chickens.

Materials and methods

Experimental design

Experiment was conducted in the experimental facility of Shahrekord University (high altitude area with 2,100m height), in accordance with the recommendations in the Guide for the Care and Use Committee of Shahrekord University. A number of 225 day-

old unsexed broiler chicks (Ross308) were assigned to 3 treatments with 5 replicates across 15 floor pens measuring 2m² randomly. All pens had similar average body weights (46.8±1.2g) at the beginning of the experiment and were reared according to recommendations of Ross 308 manual guide. A basal diet were formulated for the experimental period according to NRC recommendations (NRC, 1994). Experimental groups were provided by adding 0.0, 0.1 and 0.2mL of hawthorn flavonoid extract per liter of drinking water. Each mL of oral hawthorn (*Crataegus*) flavonoid extract contained 2.5mg of total flavonoids compounds in form of hyperoside, produced by Iran-Darouk pharmacy Co, under production code of 3067-88-02. In this study, hypobaric hypoxia was defined as reduced partial pressure of oxygen that occurs as the altitude increases up to 1500m (induced hypobaric hypoxia).^{12,13} Therefore, the partial pressure of oxygen in the experimental site calculated 15.75% compare to the sea level (21%), and considered as the hypobaric hypoxia condition which could be leads to the PHS and ascites.¹⁴

Measurements

At the end of trail (42 days of age), 10 birds per treatment were selected and killed for measurement and processing. The heart was removed, weighted and stripped of auricles, major vessels and fat. The RV (right ventricle including the valve) was carefully cut away from the left ventricle (LV) and septum. The RV was weighed, the left ventricle and septum were added, and finally the TV (total ventricles) was weighed. The RV: TV was calculated as important index for evaluating pulmonary hypertension.¹² When the RV: TV ratio was greater than 0.25 indicated as pulmonary hypertension and considered as birds with PHS.³

Statistical analysis

Results were analyzed by GLM using SAS software in a completely randomized design. The statistical model used for traits was $Y_{ijk} = \mu + T_i + e_{ij}$. In this model, Y_{ijk} is observation; μ is the general

mean; T_i is the effect for being in treatment i ; and e_{ij} is random error. Means were separated by Duncan's multiple range tests.

Results and discussion

Inclusion of HFE in broiler drinking water at both levels of 0.1 and 0.2 mL significantly ($P < 0.05$) declined the heart weight, RV:TV ratio and affected birds with PHS (Table 1). According to the results, significant reduction in heart weight, RV:TV ratio and PHS% after receiving HFE can be attributed to present of polyphenols and OPCs in hawthorn (*Crataegus oxyacantha*).¹⁵ Polyphenols family including flavonoids and non-flavonoids compounds exhibit a wide range of pharmaceutical effects like cardioprotective,⁴⁻⁷ and anti-oxidative.¹⁶ Greater production of ROS in chickens was reported due to their susceptibility to oxidative stress.^{1,2} Bioactive compounds in HFE can contribute to the protective roles against oxidative stress, lipid peroxidation and increasing activity of serum antioxidant enzymes such as glutathione peroxidase, superoxide dismutase and catalase, which counteract the oxidative stress.⁴⁻⁷ So decreased in percentage of affected birds with PHS is concerned to presence of epicatechin, hyperoside, and chlorogenic acid as potent antioxidants and free radical scavenging agents to harness oxidative damages caused by PHS and other cardiovascular lesions.³ Therefore, HFE may suppress ROS production and reduces the oxidative stress of birds, which led to reducing the PHS percentage.⁴⁻⁷ The RV:TV ratio have been reduced in HFE consuming birds. These results confirm ability of HFE to prevent heart hypertrophy and particularly right ventricular hypertrophy. Birds of the control group with RV:TV ratio more than 0.25 are in pre-ascitic condition and this situation has been improved when birds consumed HFE at levels of 0.1 or 0.2 mL per liter of drinking water.^{17,18}

Table 1 Effect of HFE on heart weight, RV:TV ratio and PHSI in chickens at 42 days of age

Item	Drinking levels of HFE (mL)			SEM
	Control (0)	0.1	0.2	
Heart Weight (gram)	13.5 ^a	12.3 ^b	11.5 ^c	0.29
RV:TV (ratio)	0.32 ^a	0.25 ^b	0.22 ^b	0.02
Birds with PHS (%)	57.34 ^a	44.66 ^b	36.84 ^c	3.85

^aPHS, pulmonary hypertension syndrome; each mean represents values from 10 replicates. ^{ab} Superscripts in the same row with different letters are statistically different ($P < 0.05$).

Conclusion

According to the results of this study HFE especially at the level of 0.2 mL/L could prevent of pulmonary hypertension through lowering the heart weight and the RV:TV ratio as well as decreased the number of birds affected with PHS. Therefore HFE is an effective herbal drug to prevent pulmonary hypertension in chickens.

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Conflict of interest

The author declares there is no conflict of interest.

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