Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2021; 9(1): 572-575

Received: 28-11-2020
Accepted: 30-12-2020

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Effect on physical parameters by *Zingiber officinale* on lead induced toxicity in broilers chickens

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Abstract
The present research investigation was carried out to study effect of 50% ethanolic rhizome extract of *Zingiber officinale* on physical parameters on Lead induced toxicity in broiler birds. 140 broiler chicks were divided into 7 groups each comprising of 20 birds. The toxicity was induced by administration of lead acetate @200mg/kg feed from T_2 to T_7 and T_1 as normal control. T_3 & T_4 was given Ascorbic acid @200mg/kg feed & extract @200mg/kg BW, respectively. T_5 was given Ascorbic acid @200mg/kg feed & extract @200mg/kg BW. T_6 was given extract @300mg/kg BW. Group T_7 received Ascorbic acid @200mg/kg feed and etract @300mg/kg BW. The results showed that, lead treated group with *Zingiber officinale* extract i.e. T_4 and T_6 and with L-Ascorbic Acid i.e. T_5 and T_7 has suppressed the negative impact of lead on body weight and body weight gain, also by ascorbic Acid alone (T_3). However, all the treatment of *Zingiber officinale* extract alone and with ascorbic acid does not produced significant positive effect on feed consumption. The feed conversion ratio (FCR) was significantly improved by *Zingiber officinale* all treatments. Finally, it has concluded that extract of *Zingiber officinale* alone and with L-ascorbic acid has protective effect against the lead induced toxicity in broiler birds.

Keywords: Medicinal plants, *Zingiber officinale*, lead toxicity, broiler birds

1. Introduction
Heavy metals from man made pollution sources are constantly released into aquatic and terrestrial ecosystems and therefore, the concern about the effect of anthropogenic pollution on the ecosystem is growing. Contamination with heavy metals is a serious threat because of their toxicity, bioaccumulation and biomagnifications in the food chain [1]. These pollutants often have direct physiological toxic effects because they are stored or incorporated in tissues, sometimes permanently [2].

Lead (Pb) exposure is a major public health problem; therefore it has been paid attention by researchers in probing further into its toxicity. Lead is used extensively in building materials, pigments, to glaze ceramics, water pipes and glass, paints, dyes, artificial jewellery, cosmetics, protective coatings, acid storage batteries and also as gasoline additives. So it is considered to be one of the major environmental pollutants and has been incriminated as a cause of accidental poisoning in domestic animals and birds more than any other substances [3]. In poultry, lead (Pb) produces acute and chronic poisoning and induces a broad range of physiological, biochemical and behavioural dysfunctions. The main source of metals in chickens arises from contaminated poultry feeds and water. In view of the fact that poultry feed has been reported to be affected due to the use of heavy metals contained feed additives in poultry feed production system [4].

Ginger, the rhizomes of the plant *Zingiber officinale* (Family *Zingiberaceae*), is one of the most widely used culinary agent and spice in the world [5]. Phytochemical studies have shown that the unique culinary and medicinal properties of ginger are due to the presence of active phytochemicals [6]. Preclinical studies carried out with laboratory animals have also shown that ginger to possess protective effect against the toxicity produced by heavy metals [7]. Therefore, the present research work was planned to investigate the protective activity of *Zingiber officinale* along with L-ascorbic acid against lead acetate induced toxicity in poultry with reference to physical parameters.

2. Materials and Methods

2.1 Preparation of 50% Ethanol cold extract

The plant material i.e. roots (rhizomes) of plant *Zingiber officinale* was collected from the local market of Nagpur and were dried at room temperature. 500 gram of powder of dried rhizome of *Zingiber officinale* was mixed with 2000ml of 50% Ethanol in flask and allowed to stand at room temperature for 72 hrs with frequent agitation until the soluble matter get dissolved. After 72 hrs, the mixture was filtered through muslin cloth, so as to remove the insoluble material. The filtrates were again filtered through filter paper and then poured in clean and already weighed petri in cool and dry place.

2.2 Experimental animals

The Institutional Animal Ethics Committee (IAEC) (CPCSEA Reg. No. 244/GO/ReBi/S/2000/CPCSEA Dated 01.08.2000) approved the experimental protocol. The experimental protocol met the national guidelines as per the guidelines of the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), Ministry of Social Justice and Empowerment, Government of India. The present research work was carried out 140 Broiler chicks were purchased from M/s. Atharvaraj Hatcheries, Nagpur. Broiler chicks were kept under standard managemental conditions as per the norms of BIS. All the birds were maintained on deep litter system at Poultry Farm, Department of Poultry Sciences, Nagpur Veterinary College, Nagpur and were fed on commercial diet and provided free access of drinking water during experimental period. Brooding was carried out with electric hover brooders and continued until 14th day of age. All the broiler chicks were fed on commercial feed purchased from M/s Supreme Agrovet Industries, Nagpur and provided free access of drinking water during experiment.

2.3 Experimental protocol

Broiler chicks (140) were divided into 7 groups T_1, T_2, T_3, T_4, T_5, T_6, and T_7 each group comprising of 20 birds. The lead toxicity was induced by administration of lead acetate @200mg/kg of feed for 30 days [8]. Group T_1 served as normal control, Group T_2 served as lead acetate control. Group T_3 and T_4 were received L-Ascorbic acid @200mg/kg feed and plant extract @200mg/kg BW along with Lead acetate, respectively. Group T_5 was received L-Ascorbic acid @200mg/kg feed and plant extract @200mg/kg b.w along with Lead acetate. Group T_6 was received plant extract @300mg/kg BW along with Lead acetate. Group T_7 was received L-Ascorbic acid @200mg/kg feed and plant extract @300mg/kg BW along with Lead acetate. The experiment was conducted for period of thirty days. Physical parameters such as weekly body weight/body weight gain body weight/body weight gain feed conversion ratio (FCR) were recorded to evaluate the study.

3. Results

a. Live body weight and gain in body weight of broiler.

The means values of weekly live body weight and gain in body weight of birds of different groups were recorded and analyzed. From the table no. 1, it was revealed that lead control group (T_2) showed significant reduction in live body weight as compared to normal control group (T_1) for first, second, third and fourth week of experiment. The results of weekly gain in body weight by broilers, it was revealed that, all groups does not showed significant decrease in weight gain at third and fourth week. However, overall weight gain at the end of experiment, in group T_2 was found to be lowest as compared to other treatment group (T_3, T_4, T_5, T_6 and T_7) and normal control (T_1) group which proved the addition of lead acetate @ 200 mg/kg feed reduced growth of broilers in terms of body weight and body weight gain. Groups treated with *Z. officinale* extract alone @ 200 & 300mg/kg BW (T_4 and T_5) and with L- ascorbic acid (T_5 and T_7) showed significant increase in live body weight and gain in body weight of birds (P<0.05) as compared with lead control (T_2).

b. Feed consumption and feed conversion ratio in broiler.

The values for the weekly feed consumption and feed conversion ratio shown in table no. 2 revealed that there was significant decrease in feed consumption in all lead treated groups (T_2, T_3, T_4, T_5, T_6 and T_7) as compared to normal group (T_1). Similarly, the FCR in lead control group (T_2) was more than other treatments groups. At the end of experiment, it was found that all the treatment groups (T_3, T_4, T_5, T_6 and T_7) has significantly (P<0.05) improved the FCR, however, there was a no significant increase in feed intake in all the treatment groups as compared with lead control (T_2).

4. Discussions

At first, second, third and fourth week of experiment, lead significantly reduced the body weight of lead treated birds (T_2) as compared to the birds in normal group. Further, at end of experiment, group T_2 showed decreased in overall live body weight and gain in body weight as compared to other treatment group and normal control (T_1). Lead toxicity might be associated with number of physiological changes such as glucose metabolism, haematological disorder, impairment of kidney and liver functions. Addition of a heavy metal mixture like lead to broiler drinking water caused decrease growth may be due to metabolic disorders associated with lead, such as inhibition of enzymes involved in heme synthesis and the oxidase system [9, 10]. Lead also has a strong affinity to mitochondria and many of its pathological effects may be caused by ultra structural and functional changes in these organelles [11-13]. It has been demonstrated that lead has a potential for inducing oxidative stress, which may in turn result in loss of cellular functions and tissue damage, possibly leading to growth depression and impairment of health [14, 15]. Further, free radicals are constantly produced in the body and certain amounts of these components are necessary for normal physiological functions but if their production exceeds normal levels due to metal toxicity results in to the peroxidative damage to the cell membrane and organelles [16].

In our investigations, the overall feed intake significantly decreased in all lead treated groups as compared to normal group. Similarly, Feed Conversion Ratio (FCR) of lead control group (T_2) has found to be significantly more than other treatments and control group. The lowered physical performance in lead treatment groups could be due to the metabolic disorders associated with lead toxicity. Previous studies have also reported the decreased weight gain and feed intake result in higher feed: gain ratio in lead exposed chickens [17- 20].

The results showed that extract of *Zingiber officinale* extract alone @ 200 & 300mg/kg BW alone and with L-Ascorbic Acid has significantly reversed the depressive effect of lead on Body Weight and Body Weight Gain and also by Ascorbic Acid alone. However, the negative effect on feed consumption by lead was not fully overcome by the treatment

of *Zingiber officinale* extract alone and with ascorbic and the findings of feed intake which were contraindicated in this study. Further, *Zingiber officinale* extracts alone and with L-ascorbic Acid has significantly improved feed conversion ratio than lead control group (T_2)

The suppression of negative effect of lead toxicity in terms of body weight, gain in body weight and FCR might be due to the medicinal, antioxidant, therapeutic, detoxifying properties of plant *Zingiber officinale* and L-ascorbic acid against various metal toxicities related disorders. As, development of oxidative stress due the over production of free radicals inside the body by lead toxicity, neutralising entities have to be present in order to alleviate such per-oxidative damage and antioxidant defence system which includes natural and synthetic antioxidants and antioxidant enzymes present in the biological system [21].

Besides this, ginger has digestive stimulant action, stimulating the production of saliva, also used in traditional medicines as ingredients of pharmacological preparations to cure digestive disorders. Ginger had many active compounds such as atsiril oil, bornoeal, kamfen, limonene, gingirol, gingiberen and gingerdiol [22], all these compounds improves the feed digestion and stimulates its enzymes and thus enhancing feed conversion ratio which makes to increase in body weight gain [23]. The mechanism of digestive stimulant action of ginger has been understood in animal studies [24]. It has documented that ginger stimulates bile acid production by the liver and its secretion into bile which play significant role in the digestion and absorption of dietary fat [25]. It also stimulates the activity of digestive enzymes of pancreas-lipase, amylase, and proteases (trypsin, chymotrypsin, and carboxy peptidase) [26]. Ginger lowered the food transit time in experimental rats by facilitating digestion [27]. Among several spices which are perceived to stimulate the digestive system, ginger probably is to be ranked at the top based on the available evidence [24]. The increased body weights in vitamin C treated groups are also in agreement with the earlier research studies. The antioxidant supplementation increases weight gain and feed efficiency [28] and also under stress conditions dietary supplemented ascorbic acid alleviates the effect of heat stress on the performance of broiler chicks [29, 30].

Table 1: Effect of *Zingiber officinale* rhizomes extract on weekly live body weight & gain in body weight on lead induced toxicity in broiler.

Parameter	Week	T_1	T_2	T_3	T_4	T_5	T_6	T_7
		Control Group	Lead acetate @200mg/kg feed	Lead acetate @200mg/kg feed + AA @200 mg/kg feed	Lead acetate @200mg/kg feed + Ext. @200 mg/kg b.w.	Lead acetate @200mg/kg feed + Ext.@200mg/kg b.w. + AA @200 mg/kg feed	Lead acetate @200mg/kg feed + Ext. @300 mg/kg b.w.	Lead acetate @200mg/kg feed + Ext.@300mg/kg b.w. + AA @200 mg/kg feed
	Initial	37.50±0.40	36.80±0.65	37.70±0.65	38.50±0.66	36.30±0.63	39.00±0.58	37.60±0.84
Live Body Weight (g)	I	141.00±2.94^{a}	128.00±4.08^{bcd}	136.70±4.23^{ab}	122.30±4.43^{cd}	132.70±5.01^{abc}	125.10±2.48^{cd}	118.50±3.89^{d}
	II	407.30±8.03^{a}	335.10±15.9^{b}	394.80±10.70^{a}	349.80±12.65^{b}	352.80±10.38^{b}	355.00±5.55^{b}	338.80±11.47^{b}
	III	802.75±14.58^{ab}	739.45±14.14^{c}	814.65±23.56^{a}	749.30±21.30^{c}	769.35±24.99^{abc}	771.20±10.21^{abc}	758.45±10.97^{bc}
	IV	1355.95±23.49^{a}	1170.10±20.01^{c}	1293.50±28.15^{ab}	1243.45±28.98^{b}	1249.85±20.48^{b}	1266.60±15.74^{b}	1258.10±14.82^{b}
Gain in Body Weight (g)	I	103.50±3.07^{a}	91.20±4.33^{bcd}	100.00±4.13^{ab}	88.80±4.22^{d}	96.40±5.27^{abc}	86.10±2.76^{cd}	80.90±3.67^{d}
	II	266.30±10.00^{a}	207.10±14.15^{c}	257.10±10.29^{ab}	227.50±15.39^{bc}	220.10±11.4^{c}	229.90±5.36^{bc}	220.30±33.68^{c}
	III	395.45±18.05	404.35±11.13	419.85±19.81	399.50±24.25	416.55±26.39	416.20±11.95	417.65±12.15
	IV	553.20±28.92	430.65±14.48	478.85±40.00	494.15±36.26	480.50±39.17	495.40±17.74	501.65±15.91
	Overall	1318.45±23.39^{a}	1133.30±20.11^{c}	1255.80±27.90^{ab}	1204.95±26.94^{b}	1213.55±39.62^{b}	1227.60±15.94^{b}	1220.50±14.76^{b}

Values are mean S.E. for 20 birds in each group. Values not sharing a common superscript in a column differ significantly (P<0.05)

Table 2: Effect of *Zingiber officinale* rhizomes extract on weekly Feed intake & FCR on lead induced toxicity in broiler

Parameter	Week	T_1	T_2	T_3	T_4	T_5	T_6	T_7
		Control Group	Lead acetate @200mg/kg feed	Lead acetate @200mg/kg feed + AA @200 mg/kg feed	Lead acetate @200mg/kg feed + Ext. @200 mg/kg b.w.	Lead acetate @200mg/kg feed + Ext.@200mg/kg b.w. + AA @200 mg/kg feed	Lead acetate @200mg/kg feed + Ext. @300 mg/kg b.w.	Lead acetate @200mg/kg feed + Ext.@300mg/kg b.w. + AA @200 mg/kg feed
Feed Intake (g)	I	120.33±5.00^{a}	110.50±5.00^{d}	111.52±8.51^{c}	105.83±2.10^{e}	103.33±4.30^{f}	115.57±6.52^{b}	96.83±2.10^{g}
	II	326.83±10.94^{d}	340.66±21.90^{c}	359.16±33.10^{a}	313.28±12.13^{f}	309.83±4.70^{g}	341.61±12.65^{b}	321.19±8.94^{e}
	III	498.04±7.98^{a}	491.41±13.59^{b}	463.39±9.30^{c}	418.08±11.48^{d}	411.78±9.39^{e}	491.49±4.92^{b}	403.22±15.05^{f}
	IV	940.24±5.78^{a}	880.17±6.23^{b}	791.32±7.76^{d}	708.24±8.70^{g}	749.6±7.35^{e}	827.62±7.52^{c}	745.62±8.44^{f}
	Total	1885.45±10.39^{a}	1822.75±15.72^{b}	1725.41±18.66^{d}	1545.44±19.80^{g}	1574.11±24.60^{e}	1776.25±21.32^{c}	1566.88±25.61^{f}
FCR	I	1.18±0.03^{b}	1.26±0.06^{ab}	1.14±0.04^{b}	1.34±0.09^{a}	1.12±0.53^{b}	1.36±0.04^{a}	1.24±0.06^{ab}
	II	1.26±0.05^{c}	1.85±0.16^{a}	1.44±0.06^{bc}	1.53±0.12^{abc}	1.47±0.07^{bc}	1.50±0.03^{abc}	1.72±0.24^{ab}
	III	1.33±0.09^{a}	1.23±0.03^{ab}	1.15±0.05^{bc}	1.11±0.06^{bcd}	1.05±0.06^{cd}	1.19±0.03^{abc}	0.97±0.02^{d}
	IV	1.85±0.79	2.08±0.30	1.95±0.98	1.72±0.11	1.78±0.69	1.71±0.28	1.50±0.17
	Overall	1.43±0.02^{b}	1.61±0.02^{a}	1.38±0.03^{b}	1.29±0.03^{c}	1.31±0.03^{c}	1.45±0.01^{b}	1.28±0.01^{c}

Values are mean S.E. for 20 birds in each group. Values not sharing a common superscript in a column differ significantly (P<0.05)

5. Conclusion

Form this investigation it can be concluded that, 50% ethanolic rhizome extract of *Zingiber officinale* alone and with L-ascorbic acid has possesses significant protective effect against the lead induced toxicity by improving body weight and feed conversion ratio in broiler birds.

6. Acknowledgements

The author is very much thankful to Associate Dean, Nagpur Veterinary College, Nagpur and Head, Department of Veterinary Pharmacology & Toxicology, Nagpur Veterinary College, Nagpur for providing necessary facility & infrastructure to carry out the above research investigation.

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