Unithiol – the means preventing lead accumulation in tissues and organs of broiler

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Abstract

Environmental exposure to lead and lead containing compounds being detrimental to human health (especially health of children) is one of the important ecological problems of the modern world. The human organism is primarily exposed to lead via food (about 85%). Food and raw materials for the food industry may be contaminated by lead transferred from soil, water, atmosphere, and fodder of agricultural animals.

As removal of heavy metals from finished food products is highly problematic, it is necessary to prevent or limit the accumulation of heavy metals in poultry during rearing.

Unithiol is a dithiol antidote preparation. It can be used for preventing or limiting lead accumulation.

In this study we investigated the ability of unithiol to prevent lead accumulation in broiler organs and tissues. In our experiment broilers were reared on a diet with increased lead content (100 mg per kg of diet). Supplementation of unithiol to a broiler diet (17 mg per kg) from 2-weeks old to the end of the rearing (6 weeks old) decreased the lead content in the tissue of the broilers. Levels in kidneys and liver it were 1.2-1.3 times, and in meat — 1.7 times lower as compared to those in the control group.

When a double dose of unithiol (34 mg per kg) was used during the sixth week of rearing, the lead content in liver and kidneys was 1.4 – 1.8 times, and in meat — 2.6 times lower as compared to the control group.

Introduction

Environmental exposure to lead and lead containing compounds being detrimental to human health (especially health of children) is one of the important ecological problems of the modern world. The human organism is primarily exposed to lead via food (about 85% according to Khudoley *et al.*, 1996). Food and raw materials for the food industry may be contaminated by lead transferred from soil, water, atmosphere, and fodder of agricultural animals (Maystupenko *et al.*, 1996; Khudoley *et al.*, 1996).

The highest lead content was observed in fish and also in wheat bran, root vegetables and in other crop products that had been raised near motorways and industrial regions (Ansay *et al.*, 1987). As removal of heavy metals from finished food products is highly problematic, it is necessary to prevent or limit the accumulation of heavy metals in poultry during rearing.

Unithiol is a dithiol antidote preparation. It can be used for preventing or limiting lead accumulation. One molecule of this substance contains two SH – groups that are able to compete with such groups of proteins for heavy metals (Sokolovsky, 1979; Shilov *et al.*, 1999). The complex of unithiol with these metals is eliminated from the organism by the kidneys and with the faeces (Shilov *et al.*, 1999).

Unithiol is a water soluble white powder. It is not toxic for human and agric animals (Shilov *et al.*, 1999).

Materials and methods

The experiment was carried out with broilers of “Konkurent-2” cross reared in cage batteries from the 1st day to 6 weeks of age. All technological parameters (temperature, humidity and lighting regimes, quantity of birds per square unit, feed and water supply) were in accordance to VNITIP recommendations published in 1999. The scheme of the experiment is presented in Table 1.

Table1 Scheme of experiment.

Groups	Ration	Period of feeding, days	
		Lead salt	unithiol
1	Basic ration (BR)	-	-
2	BR + 17 mg of unithiol per 1 kg of feed	-	15-42
3	BR + 100 mg of lead per 1 kg of feed	15-42	-
4	BR + 100 mg of lead + 17 mg of unithiol per 1 kg of feed	15-42	15-42
5	BR + 100 mg of lead + 34 mg of unithiol per 1 kg of feed	15-35	36-42

Each group contained 20 chickens. The ratio of males and females in each group was 50:50. All treatment were carried out in two replicates. The diet of experimental groups 3-5 contained lead nitrate in a dose of 100 mg of lead per kg of feed (maximal permitted concentration (MPC) of lead in the feed is 5 mg/kg). The dose of unithiol used in this experiment was derived as optimal in our previous work (Lysenko (2003)). Unithiol and lead were added to basal diet of the chickens from 15 to 42 days of rearing. At the age of 42 days, all broilers were slaughtered for determination of lead content in kidney, liver and muscle tissues. From each group 6 samples of liver, kidney and muscle were analyzed. The determination was carried out by use of atomic – absorption spectrometry (AAS). The limit of detection of AAS method for Pb in the tissues was – 30 µg /kg (Martinyuk et at. 1979).

Results and discussion

The experimental data show that addition of lead to the chickens diet resulted in a decrease in weight gain of the broilers. At the end of experiment weight gain was minimal in the 3rd group (BR+lead) – 1726g – being 5% less than in the control group (1823 g) and maximal in 2nd group (BR + unithiol) – being 3.7% more than in the control group. Addition of unithiol to the feed containing the added lead (4th group) resulted in an increase of live weight of 4.3% as compared to the 3rd group.

Use of the double dose of unithiol (34 mg/kg) during the last week of experiment, also lead to an increase in weight gain. Weight gain of the 5th group was 3.1% higher than in the 3rd group.

The feed conversion ratio (kg feed/kg weight gain) was lowest in the 2nd group (BR+unithiol) and highest in 3rd group (BR+lead) (Table 2).

Table 2 Feed consumption per 1 bird and per 1 kg of body weight gain.

Index	Groups				
	1	2	3	4	5
Per 1 bird, kg	3.73±0.13	3.67±0.15	3.86±0.20	3.75±0.10	3.78±0.11
Per 1 kg of body weight gain, kg	2.09±0.10	1.98±0.13	2.29±0.10	2.13±0.13	2.17±0.10

The differences in growth are not due to chance The reason of the growth differences: difference in feed consumption or difference in feed conversion are however not clear.

The mortality was minimal (zero) in 2nd and 4th groups and highest in 3rd and 5th groups (Table 3).

Table 3 Total mortality (%) at the end of experiment (6 weeks).

GROUPS				
1	2	3	4	5
2.8	0	16.7	0	16.7

The basal diet contained 1.55 mg/kg lead. The data presented in Table 4 show that addition of lead to the diet resulted increased lead levels in all tissues. Inclusion unithiol in the broilers diet in concentrations of 17 and 34 mg/kg feed, resulted in significant decreases in the lead content of broilers tissues.

Table 4 Lead content in broiler tissues (mg/kg).

Group	Liver	Kidneys	Muscle
MPC (Tolerance)	0.60	0.60	0.20
1	0.62±0.04	0.98±0.05	Not detected (<0.03)
2	0.40±0.02	0.67±0.03	Not detected (<0.03)
3	6.11±0.11	10.0±0.18	1.44±0.03
4	4.80±0.08	8.50±0.09	0.83±0.05
5	3.40±0.12	7.00±0.14	0.54±0.02

In the 4th group (BR + lead and unithiol from the 2nd week onwards) the lead content of liver, kidneys and muscle was lower as compared to those in the 3rd group (BR+lead from the 2nd week onwards), with a factor of 1.3, 1.2 and 1.7 respectively. In the 5 th group (lead from the 2nd to the 5th week + twice the dose of unithiol from the 5th week onwards) the lead levels in liver, kidneys and muscle were lower than in 3rd group, by a factor of 1.8, 1.4 and 2.7 respectively.

Therefore, the inclusion of unithiol resulted in a significant decrease in the lead content in organs and tissues of broilers. A suppression of the toxic effect of lead is the most probable reason for the increase in body weight gain when unithiol was added to the diet.

Conclusions

1. Addition of unithiol to a broilers diet resulted in a significant decrease of the lead content in broiler tissues.
2. Addition of unithiol to a broilers diet in a dose of 17mg/kg from 2 weeks age till the end of the rearing (6 weeks) resulted in decrease of lead content of liver and kidneys by a factor of 1.2-1.3 and in meat by a factor of 1.7.
3. Use of a double dose of unithiol (34 mg/kg) during the last week of rearing resulted in a decrease of the lead content in liver, kidney and meat by a factor of 1.8, 1.4 and 2.7.

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