Detoxification of Dietary Lead by Methionine and Garlic in Rabbits

Shehata, S.A.

Department of Animal Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.
sashehata@zu.edu.eg

Abstract: This work was carried out to evaluate the ability of methionine or garlic on detoxification of lead acetate in rabbit diet. Two experiments were carried out. The period of each experiment was 7 weeks. In the 1st experiment, sixty growing New-Zealand White (NZW) male rabbits were assigned to four experimental diets (15 in each). The 1st diet served as control, the 2nd one was contaminated with 0.50% lead acetate and the other experimental diets contained the same level of lead acetate plus 0.08% and 0.16% DL-methionine, respectively. In the 2nd experiment, seventy five growing NZW male rabbits were assigned to five experimental diets (15 in each). The 1st diet served as control, the 2nd one was contaminated with 0.50% lead acetate and the other experimental diets contained the same level of lead acetate plus 1, 2 and 3% garlic, respectively.
Obtained results of 1st and 2nd experiments showed that addition of methionine or garlic improved significantly rabbit feed intake, daily body weight gain, feed conversion, digestibility of all nutrients and blood parameters including serum total protein, albumin, globulin, aspertate amino transferase and alanine aminotransferase. The dressing percentage significantly decreased in rabbits fed diet polluted with lead acetate only in comparison with fed lead plus additives and control. On the other hand the weight of kidneys and heart as % of live body weight increased significantly by lead acetate. The residue of lead in liver, kidneys and muscles reduced significantly by additives. The % of mortality rate was not affected in all tested groups in all trials. In conclusion, the addition of 0.08% methionine more than the optimium requirement or 2 % fresh garlic to growing rabbit diet was safe and practical method to minimize the lead toxicity in rabbit diet.
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1. Introduction

In Egypt, the heavy metals concentration in feed exceeded the maximum permissible limit including fish **(Rashed, 2001)**; vegetables and fruits **(Radwan and Salama, 2006)** as well as in human organs **(Kriegel *et al*., 2006)**.

Lead toxicity is due to its binding with sulfur groups on important protein specially enzymes, hormones and cell receptor; displace some minerals (calcium, zinc, selenium, magnesium and copper) from the body and decreased metabolism of carbohydrate, protein and lipids **(ATSDR, 1993)**. Also, the heme synthesis and glutathione level decreased due to lead **(Saxena and Flora, 2004)**. Lead increased the lipid peroxidation in liver, kidney and brain **(Patra *et al*., 2001).** The functions of adrenal, liver and kidneys impaired by lead **(Fathi *et al*., 1999)**.

Methionine and garlic were used to recover the shortage in sulphur groups of protein enzymes, hormones, cell receptor which are lost by lead toxicity. Methionine and its product like S-adenosyl-L-methionine (SAM) and garlic protect rat and chickens from the toxic effect of lead **(Senapati *et al*., 2001 and Murugavel *et al*., 2007)**. Garlic is a good source of nutrients (sulfur, vitamins, minerals, essential amino acids and fatty acids), increase the glutathione enzymes, prevention the carcinogenicity & mutagenicity **(Shukla and Kalra, 2007)**, stimulate the immune system and function of organs **(Shehata *et al*., 2003)**.

This study aimed to reveal the ability of different methionine or garlic levels on minimizing the lead toxicity on growing rabbits performance.

2. Materials and methods

This work was carried out in the Department of Animal Production, Fac. of Agric., Zagazig University, Egypt. Two experiments were carried out (the period of each experiment was 7 weeks). In the 1st one, sixty growing NZW male rabbits with average body weight of 800 ± 8 g were randomly assigned to four experimental diets (15 animal in each). The 1st diet served as control, the 2nd one was contaminated with 0.50% lead acetate and the other experimental diets contained the same level of lead acetate plus 0.08% and 0.16% DL-methionine, respectively. In the 2nd experiment, seventy five growing NZW male rabbits were assigned to five experimental diets (15 animal in each). The 1st diet served as control, the 2nd one was contaminated with 0.50% lead acetate and the other experimental diets contained the same level of lead acetate plus 1, 2 and 3% fresh garlic, respectively.

Lead acetate, methionine or fresh minced garlic was added to basal diet ingredients before pelleting. Formulation and chemical composition of diets are shown in Table 1 (a and b). Animals in each trial were housed in individual cages under the same managerial, hygienic and environmental conditions allover the experimental period. Daily fresh water was available all time. At the last week of the 1st and 2nd experiments, feed intake and feces excreted of 6 rabbits from each treatment were recorded daily for digestibility trials. At the end of these experiments, rabbits slaughtered (6 rabbits of each treatment), carcass traits were determined, blood samples were collected to estimate the blood parameters. Serum total protein, albumin, aspertate amino transaminase (AST), alanine amino transaminase (ALT) and creatinine were analysed by using commerical kits purchased from Diamond Diognastics Company, Egypt. The residue of lead in liver, kidneys and muscles of hind limb of 6 rabbits of each treatment in the 1st and 2nd experiments were determined according to A.O.A.C. (1990) using Atomic Absorption Spectrophotometer (model 210 VGP, Buck Scientific, USA) with an oxidizing air acetylene flame. Proximate analysis of feed and feces were determined according to A.O.A.C. (1990). Data of the all trial alone were statistically analyzed using the General Linear Model Program of SAS (1996). Differences among means were tested by Duncan's multiple range test (Duncan, 1955).

3. Results and Discussion

3.1. First and second trial:

3.1.1. Rabbit performance (feed intake, daily body weight gain and feed conversion):

The average daily feed intake, daily body weight gain and feed conversion (Table 2 & 3) were decreased ($P<0.05$) significantly by addition of lead acetate on compared to the healthy control. The decrease of feed intake agreed with those obtained by **ATSDR (1993)** who reported that lead toxicity caused loss of appetite. Also, the decrease in body weight gain agree with the **Falke and Zwennis (1990)** who reported that lead acetate addition (0.80-1.20 µg/ kg body weight three times a week) decreased the body weight of female rabbits. Moreover, wistar rats dosed with 1% lead or 0.7% lead acetate in their diet, decreased the body weight **(Walsh and Ryden, 1984)**. Decreasing the feed intake and daily body weight gain may be due to bad effect of lead on health (metallic taste, headache, irritability, pain in muscles and joints, colic, abdominal pain, constipation, cramps, nausea, vomiting, disease of nervous, hematopoietic & cardiovascular system and liver & kidneys functions); loss of some minerals (Ca, Zn, Cu, Se and Mg) from the body **(ATSDR, 1993)**; decreasing the digestibility of nutrients **(Bersenyi *et al*., 1999 and Fekete *et al*., 2001)** and decreasing T3 & T4 hormones **(Fathi *et al*., 1999)**.

Methionine (Table 2) or garlic (Table 3) addition improved ($P<0.05$) significantly daily feed intake and daily body weight gain compared with those fed lead diet alone. The improvement in average daily body weight gain values which recorded with 0.08% and 0.16% methionine level were 59.98 and 43.21%, respectively, while with 1, 2 and 3% garlic were 51.65, 57.83 and 31.56%, respectively. The benificial effect of methionine or garlic may be due to increase of feed intake and nutritive values as a result of its content, reducing the binds of lead by sulfur groups on protein of enzymes, hormones and cell receptor by increase lead excreation in feces and urine **(Paredes *et al*.,1985 and Flora and Seth, 1999**), stimulating the immune system and function of organs by garlic **(Hanafy *et al*., 1994; Senapati *et al*., 2001 and Murugavel *et al*., 2007).**

Also, lead acetate had bad significant effect on feed conversion (Table 2 &3). These results was in accordance with **Fathi *et al*., (1999)** who reported that 200-400 ppm lead chloride in feed of broiler chicks led to poor feed conversion. Methionine or garlic addition improved significantly feed conversion. These results of methionine agreed with those reported by **Hassan *et al*., (2003)** on poultry and **El-Sayiad *et al*., (2003)** on rabbits. The improvement in feed conversion by methionine or garlic may be due to better efficiency of feed utilization, reducing animal pain and improve organs function. The best results of feed conversion were recorded with 0.08% methionine or 1% garlic.

3.1.2. Digestibility and nutritive values:

Lead addition in both 1st and 2nd trials decreased ($P<0.05$) significantly the digestibility of most nutrients and nutritive values (Table 2 and 3). These results agreed with those obtained by **Bersenyi *et al*., (1999)** who reported that crude protein (CP) digestibility decreased when rabbits fed carrot contain high level of lead. Also, **Fekete *et al*., (2001)** reported decrease in digestibility of organic matter (OM) and nitrogen free extract (NFE) in rabbits fed potato and beetroot containing high level of lead. Decreasing the digestibility of nutrients by lead may be due to disruption of the metabolism of protein, carbohydrate & lipids, displace manganese and copper (both require for optimal adrenal function) **(ATSDR, 1993)**, decrease T3 hormones & liver function **(Fathi *et al*., 1999)**, increase lipid peroxidation which indicate to oxidative damage in organs (liver, kidney and brain) **(Patra *et al*., 2001)**,

killing beneficial bacteria (this may be the reason of decreasing CF digestibility).

Addition of methionine or garlic with different levels improved significantly (P<0.05) DM, OM, CP and CF digestibilities and nutritive values as total digestible nutrient (TDN%) and digestible crude protein (DCP%). These results may be due to restore of importent protein which play important role in digestion of nutrients, increase glutathione enzymes in the liver which protects the cells from oxidative damage and play vital role in detoxification, inhibit lipid peroxidation, improve organs function and immunty **(Patra *et al*., 2001 and Shehata *et al*., 2003).**

3.1.3. Blood parameters:

As shown in Table (2 and 3), serum total protein, albumin and globulin values were decreased significantly (P<0.05) as a result of lead toxicity. These findings agreed with those reported by **Fathi *et al*., (1999)** who reported that lead chloride decrease total protein in serum of broiler chicks. Also, **Falke and Zwennis (1990)** reported that lead caused anemia in female rabbits (lead inhibit of key enzymes involved in the synthesis of heme). Decrease of serum protein may be attributed to the inhibition of protein synthesis caused by lead. Since lead destroying improtent proteins and the erythrocytic delta-aminolaevulininc dehydratase (ALA-D) activity (an important enzyme in the heme synthesis pathway). Also, glutathione level was significantly reduced by lead which decrease liver function **(Saxena and Flora, 2004)**. The decreased of globulin concentration by lead may indicate an immunodepressive response **(Shehata *et al*., 2003)**. The activities of AST and ALT enzymes were significantly (P<0.05) decreased by lead acetate (Table 2 & 3). Reduction of AST activity may be due to toxic hepatosis **(Abd El-Hamid and Dorra, 1993)**. The creatinine values were higher (P<0.05) in serum of rabbits fed lead diet in compared with control. These results agreed with **Fathi *et al*., (1999)** who reported that lead had bad effect on histopathology of kidney and reduced its function. The increase in serum creatinine may be due to inhibition of excretory function of the kidneys or increase it synthesis by liver from ammonia. Also, the increase in creatinine is related to muscular atrophic changes **(Abd El-Hamid and Dorra, 1993)**.

Data in Table 2 & 3 showed that addition of methionine or garlic, respectively improved all serum tested parameters. These results agree with those obtained by **Hassan *et al*., (2003)** who reported that methionine increased total protein and albumin serum of laying hens and improved its immune respone to Newcastle Disease Virus (NDV). Also, **Patra *et al*., (2001)** reported that methionine inhibit the oxidative damage in liver, kidney and brain which increased by lead. Garlic had some constituents, which may play a role in stimulating the immunity system and function of organs related to blood cells formation such as thmus, spleen and bone marrow **(Ali *et al*., 2000)**.

3.1.4. Mortality rate:

There is no any effect on lead, methionine or garlic addition on the mortality rate in all experimental groups in the 1st and 2nd experiments.

3.1.5. Carcass traits:

The dressing % in rabbit treated with lead was significantly (P<0.05) lower in comparison with treated with lead plus additives, on the other hand, the weight of kidneys and heart as % of live body weight increased (P<0.05) with lead acetate addition (Table 2 & 3). These results agreed with **Fathi *et al*., (1999)** who reported that 200-400 ppm lead chloride in broiler diets decreased (P<0.05%) the dressing % and increased (P<0.05) heart as % of live body weight.

3.1.6. Residue of lead:

The residue of lead in liver, kidneys and muscles was significantly (P<0.05) lower in rabbits fed diet supplemented with lead acetate plus methionine and garlic in comparison with rabbits fed diet polluted with lead acetate only (Table 2 & 3) respectively. These results agreed with **Paredes *et al*., (1985)** and **Flora and Seth, (1999)** who reported that S-adenosyl-L-methionine decreased accumulation of lead in blood, liver and kidney of mice treated by lead to near control group. **Patra *et al*., (2001)** reported that rats exposed to lead at a rate of 1 mg / kg body weight daily for 30 days, then treated by 100 mg / kg body weight orally L-methionine for 4 days decresed blood lead by 32%. **Hanafy *et al*., (1994)** reported that lead concentration in muscle and liver tissues of chickens decreased by garlic addition. Who reported that garlic contain chelating compounds capable of enhancing elimination of lead.

The present study demonstrate that adding methionine at 0.08% more than the optimium requirements or 2% garlic to a diet contaminated with 0.5% lead acetate provide a safe and practical method to minimize of lead toxicity in rabbit diet.

Corresponding author
Shehata, S.A.
Department of Animal Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.
sashehata@zu.edu.eg

Table 1a. Formulation and chemical composition of 1st trial diets.

Ingredients (%)	Basal diet	0.5% lead acetate	0.5% lead acetate + 0.08% methionine	0.5% lead acetate + 0.16% methionine
Yellow corn	17.00	17.00	17.00	17.00
Clover hay	35.00	35.00	35.00	35.00
Wheat bran	20.00	20.00	20.00	20.00
Barley	10.00	9.50	9.50	9.50
Soybean meal	13.00	13.00	12.92	12.84
Molasses	3.00	3.00	3.00	3.00
Sodium chloride	0.20	0.20	0.20	0.20
Vitamin and minerals	0.40	0.40	0.40	0.40
Bone meal	1.00	1.00	1.00	1.00
Limestone	0.40	0.40	0.40	0.40
Lead acetate	0.0	0.50	0.50	0.50
methionine	0.0	0.0	0.08	0.16
	100	100	100	100
Chemical composition (DM)				
OM	89.63	89.18	89.18	89.18
CP	17.31	17.22	17.26	17.31
CF	16.33	16.25	16.24	16.24
EE	2.13	2.12	2.12	2.12
NFE	53.86	53.59	53.56	53.51
Ash	10.37	10.82	10.82	10.82

Table 1b. Formulation and chemical composition of 2nd trial diets.

Ingredients (%)	Basal diet	0.5% lead acetate	0.5% lead acetate + 1% fresh garlic (0.4% dry garlic)	0.5% lead acetate + 2% fresh garlic (0.8% dry garlic)	0.5% lead acetate + 3% fresh garlic (1.2% dry garlic)
Yellow corn	17.00	17.00	17.00	17.00	17.00
Clover hay	35.00	35.00	35.00	35.00	35.00
Wheat bran	20.00	20.00	20.00	20.00	20.00
Barley	10.00	9.50	9.10	8.70	8.30
Soybean meal	13.00	13.00	13.00	13.00	13.00
Molasses	3.00	3.00	3.00	3.00	3.00
Sodium chloride	0.20	0.20	0.20	0.20	0.20
Vitamin and minerals	0.40	0.40	0.40	0.40	0.40
Bone meal	1.00	1.00	1.00	1.00	1.00
Limestone	0.40	0.40	0.40	0.40	0.40
Lead acetate	0.0	0.50	0.50	0.50	0.50
*Garlic	0.0	0.0	0.4	0.8	1.20
	100	100	100	100	100
Chemical composition (DM)					
OM	89.63	89.18	89.16	89.12	89.10
CP	17.31	17.22	17.22	17.21	17.21
CF	16.33	16.25	16.24	16.23	16.22
EE	2.13	2.12	2.12	2.11	2.11
NFE	53.86	53.59	53.58	53.57	53.56
Ash	10.37	10.82	10.84	10.88	10.90

*Fresh garlic contain 40% dry matter. The proximate analysis on dry matter basis, 95.50% OM, 11.00% CP, 8.25% CF, 3.25% EE, 73.00% NFE and 4.50% ash

Table 2. Effect of lead acetate and methionine addition on rabbits (1st trial).

Items	Control	0.5% lead acetate	0.5% lead acetate + 0.08% methionine	0.5% lead acetate + 0.16% methionine
Rabbit performance:				
Feed intake (g)	$123.29^{a} \pm 3.80$	$80.46^{c} \pm 1.31$	$90.79^{b} \pm 1.55$	$97.18^{b} \pm 3.42$
Daily body weight gain (g)	$22.04^{a} \pm 1.82$	$10.97^{c} \pm 1.58$	$17.55^{b} \pm 1.63$	$15.71^{b} \pm 1.71$
Feed conversion (feed/gain)	$5.71^{b} \pm 0.31$	$7.42^{a} \pm 0.19$	$5.35^{b} \pm 0.10$	$6.24^{b} \pm 0.24$
Digestibility (%):				
DM	$68.21^{a} \pm 1.56$	$56.09^{c} \pm 0.70$	$60.55^{b} \pm 0.78$	$59.86^{b} \pm 1.87$
OM	$69.89^{a} \pm 1.55$	$61.42^{c} \pm 1.9$	$63.20^{b} \pm 0.9$	$62.97^{b} \pm 1.29$
CP	$75.67^{a} \pm 1.43$	$67.57^{c} \pm 1.46$	$71.59^{b} \pm 0.92$	$70.92^{b} \pm 0.74$
CF	$37.57^{a} \pm 1.40$	$11.62^{c} \pm 1.09$	$17.13^{b} \pm 1.72$	$15.05^{b} \pm 1.70$
EE	93.58 ± 1.72	89.32 ± 2.77	92.22 ± 1.09	91.63 ± 1.14
NFE	$76.90^{a} \pm 3.00$	$69.12^{b} \pm 1.66$	$70.00^{b} \pm 1.27$	$70.91^{b} \pm 0.58$
Nutritive values (%)**:				

TDN	65.14^{a} ± 0.64	54.83^{c} ± 1.10	57.03^{b} ± 0.58	57.04^{b} ± 0.78
DCP	13.10^{a} ± 0.25	11.64^{c} ± 0.25	12.36^{b} ± 0.09	12.28^{b} ± 0.13
Blood parameters:				
Total protein (g/dl)	6.50^{a} ± 0.23	5.70^{b} ± 0.14	6.63^{a} ± 0.19	6.71^{a} ± 0.15
Albumin (g/dl)	4.75^{a} ± 0.10	4.37^{b} ± 0.07	4.82^{a} ± 0.07	4.66^{a} ± 0.15
Globulin (g/dl)	1.75^{a} ± 0.3	1.33^{b} ± 0.21	1.81^{a} ± 0.21	2.06^{a} ± 0.03
AST (u/l)	30.00 ± 1.73	23.00 ± 1.45	29.00 ± 1.45	27.00 ± 1.15
ALT (u/l)	20.67^{a} ± 0.08	13.33^{b} ± 2.03	19.00^{a}±1.0	17.33^{a}±1.3
Creatinine (mg/dl)	0.85^{b} ± 0.03	1.03^{a} ± 0.03	0.88^{b} ± 0.1	0.83^{b} ± 0.09
Mortality rate (%):	0.0	0.0	0.0	0.0
Carcass traits (%) :				
Dressing	57.50^{a} ± 1.15	53.40^{b} ± 0.99	56.50^{a} ± 1.13	56.00^{a} ± 1.17
Liver	3.38 ± 0.06	3.73 ± 0.14	3.44 ± 0.13	3.54 ± 0.08
Kidneys	0.76^{c} ± 0.05	1.21^{a} ± 0.03	0.98^{b} ± 0.02	1.03^{b} ± 0.03
Lungs	0.77 ± 0.10	0.78 ± 0.12	0.80 ± 0.15	0.81 ± 0.15
Hearts	0.38^{b} ± 0.02	0.50^{a} ± 0.06	0.39^{b} ± 0.05	0.41^{b} ± 0.04
Testis	0.20 ± 0.05	0.21 ± 0.05	0.24 ± 0.02	0.22 ± 0.02
Residue of lead (ppm):				
Liver	-	15.20^{a} ± 1.75	8.10^{b} ± 1.80	-
	-	100*	53.29*	-
Kidneys	-	27.00^{a} ± 2.31	13.33^{b} ± 2.03	-
	-	100*	49.37*	-
Tissues	-	10.13^{a} ± 1.21	7.00^{b} ± 0.58	-
		100*	69.10*	

a,b,c,d.. Means in the same row bearing different letters differ significantly (P<0.05).
*= lead in rabbit organs supplemented with methionine as % of treated with lead only.

Table 3. Effect of lead acetate and garlic addition on rabbits (2nd trial).

Items	Control	0.5% lead acetate	0.5% lead acetate + 1% fresh garlic	0.5% lead acetate + 2% fresh garlic	0.5% lead acetate + 3% fresh garlic
Rabbit performance:					
Feed intake (g)	126.22^{a} ± 1.41	87.42^{d} ± 1.80	98.70^{c} ± 2.0	113.83^{b} ± 1.7	103.19^{c} ± 1.50
Daily body weight gain (g)	28.99^{a} ± 1.08	16.36^{d} ± 0.40	23.48^{b}± 0.32	25.28^{b}± 1.14	21.28^{c}± 0.29
Feed conversion (feed/gain)	4.54^{bc} ± 0.18	5.55^{a} ± 0.19	4.40^{bc} ± 0.11	4.69^{bc} ± 0.20	4.89^{ab} ± 0.11
Digestibility (%):					
DM	66.35^{a} ± 1.13	58.24^{c} ± 1.50	64.54^{b} ± 0.46	64.84^{b} ± 0.46	63.99^{b} ± 0.46
OM	70.85^{a} ± 0.84	60.09^{c} ± 1.09	66.14^{b} ± 1.19	66.14^{b} ± 1.19	65.64^{b} ± 1.19
CP	76.55^{a} ± 1.82	70.14^{c} ± 0.72	76.20^{b} ± 1.26	76.82^{b} ± 1.26	76.22^{b} ± 1.26
CF	37.00^{a} ± 1.04	25.35^{c} ± 1.47	29.04^{b} ± 1.48	28.04^{b} ± 1.48	28.14^{b} ± 1.48
EE	92.50 ± 0.17	92.84 ± 2.16	88.54 ± 0.95	89.44 ± 0.95	89.34 ± 0.95
NFE	75.04± 1.48	72.35 ± 1.02	72.65 ± 1.02	72.35 ± 1.02	72.25 ± 1.02
Nutritive values (%):					
TDN	64.14^{a} ± 0.95	59.40^{c} ± 1.05	60.99^{b} ± 0.96	60.78^{b} ± 0.96	60.62^{b} ± 0.90
DCP	13.25^{a} ± 0.32	12.08^{c} ± 0.13	13.12^{b} ± 0.22	13.22^{b} ± 0.22	13.12^{b} ± 0.32
Blood parameters:					
Total protein (g/dl)	6.70^{a} ± 0.23	5.80^{b} ± 0.14	6.63^{a} ± 0.19	6.77^{a} ± 0.15	6.79^{a} ± 0.09
Albumin (g/dl)	4.75^{a} ± 0.10	4.37^{b} ± 0.07	4.72^{a} ± 0.07	4.66^{a} ± 0.15	4.67^{a} ± 0.06
Globulin (g/dl)	1.95^{a} ± 0.3	1.43^{b} ± 0.21	1.91^{a} ± 0.21	2.11^{a} ± 0.03	2.12^{a} ± 0.14
AST (u/l)	33.00^{a} ± 1.73	24.50^{b} ± 1.45	29.00^{ab} ± 1.5	29.55^{ab} ± 1.2	26.90^{ab} ± 1.5
ALT (u/l)	21.17^{a} ± 0.08	14.13^{c} ± 2.03	19.00^{ab}±1.0	19.33^{ab} ±1.3	18.00^{b} ± 1.0
Creatinine (mg/dl)	0.95^{b} ± 0.03	1.23^{a} ± 0.03	0.88^{b} ± 0.1	0.89^{b} ± 0.09	0.85^{b} ± 0.03
Mortality rate (%):	0.0	0.0	0.0	0.0	0.0
Carcass traits (%):					
Dressing (%)	58.00^{a} ± 1.10	53.70^{b} ± 1.00	57.51^{a} ± 1.20	57.61^{a} ± 1.22	57.55^{a} ± 1.12
Liver	3.35 ± 0.08	3.70 ± 0.09	3.50 ± 0.14	3.30 ± 0.10	3.40 ± 0.11
Kidneys	0.79^{c} ± 0.04	1.23^{a} ± 0.04	1.06^{b} ± 0.04	1.02^{b} ± 0.04	1.08^{b} ± 0.03
Lungs	0.79 ± 0.09	0.80 ± 0.10	0.79 ± 0.10	0.77 ± 0.12	0.79 ± 0.11
Hearts	0.41^{b} ± 0.03	0.52^{a} ± 0.04	0.42^{b} ± 0.05	0.39^{b} ± 0.07	0.41^{b} ± 0.07
Testis	0.22 ± 0.04	0.24 ± 0.03	0.24 ± 0.05	0.23 ± 0.05	0.23 ± 0.04
Residue of lead (ppm):					
Liver	-	18.20^{a} ± 2.00	-	10.84^{b} ± 2.22	-
	-	100*	-	59.56*	-
Kidneys	-	25.70^{a} ± 2.50	-	11.90^{b} ± 1.89	-
	-	100*	-	46.30*	-
Tissues	-	11.88^{a} ± 2.11	-	7.62^{b} ± 0.35	-
		100*	-	64.14*	-

a,b,c,d.. Means in the same row bearing different letters differ significantly (P<0.05).
*= lead in rabbit organs supplemented with garlic as % of treated with lead only.

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