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Prophylactic Efficacy of Crushed Garlic Lobes, Black Seed or Olive Oils on Cholinesterase Activity in Central Nervous System Parts and Serum of Lead Intoxicated Rabbits

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Abstract: The effect of lead on cholinesterase activity in various central nervous system (CNS) parts and in serum, and the potential of crushed fresh garlic lobes, black seed and olive oils to combat lead poisoning in rabbits were assessed. Oral administration of lead acetate elevated BLL compared to control and sodium acetate groups. This increase was a function of the experimental time. Treatment of animals with crushed fresh garlic lobes, black seed or olive oils lowered BLL, with garlic was the most effective. Lead caused progressive decrease in the activity of acetylcholinesterase in different brain regions and spinal cord allover the experimental periods examined. The enzyme inhibition is generally reached its significance ($P < 0.05$) after 10 and 20 days of lead acetate intake. Such alteration in cholinergic transmission suggests that lead is able to reach the CNS and exerts its neurotoxic effect. Serum acetylcholinesterase and butyrylcholinesterase were also inhibited. Treatment of animals with crushed fresh garlic lobes, black seed or olive oils improved the enzyme activity in the central nervous system and serum. However, garlic was the most efficient. The ability of garlic to reduce lead toxicity may relay in its antioxidant/chelating action. Supplementation of diets with garlic is recommended to improve the body burden of lead and hence to protect the organ function against lead toxicity.

Key Words: lead, cholinesterase, CNS, serum, prophylactic efficacy, garlic, black seed oil, olive oil.

Introduction

Lead is an element of risk for the environment and human health and has harmful effects that may exceed those of other inorganic toxicants. Sources of lead exposure may include air, water supplies, food, soil and industry such as lead-based paint, leaded gasoline, battery manufacture and reclamation, pottery/ceramics and eye cosmetics (1-5).

Alimentary and respiratory tracts are the major routes of lead entry into the body (6). Once in the bloodstream, lead is distributed among blood and soft and hard tissues (7,8). The toxic effects of lead on CNS functions i.e. lead neurotoxicity has been addressed (9,10). Such neurotoxicity may be a consequence of alterations in cholinergic function mediated by the enzyme acetylcholinesterase (AChE). Cholinesterases were also identified in the serum; acetylcholinesterase (SAChE) and butyrylcholinesterase (SBuChE).

A significant decrease in AChE activity in the visual cortex of lead-exposed rats was reported (11). Lower AChE activity was recorded in cerebellum, septum and olfactory tubercles in lead-exposed than in control rats (12). Cerebral and cerebellar AChE was inhibited upon lead administration to rats (13,14). On the other hand, the activity of serum cholinesterase was decreased in rabbits fed on carrot samples grown in soil of high lead content (15). Administration of lead intragastrically to rats significantly decreased the activity of cholinesterase in blood (16).

A considerable body of research has been accumulated on chemical therapy of lead poisoning (17-20). There is, however, a paucity of data about treatment of lead intoxication by natural products (21,22). The present study is aimed to through more light on the effect of lead on central nervous system as well as on serum cholinesterases and to examine the ability of natural substances (garlic lobes, black seed and olive oils) to combat lead toxicity in rabbits. The findings could be useful for humans, as these natural products probably have no side effects.

Materials and Methods

Experimental animals and dosing

Healthy adult male domestic rabbits weighing 1000-1200 gm were used throughout the study. Animals were maintained under the ambient conditions in the animal house in the Department of Biology, the Islamic University of Gaza. They were fed on a commercial balanced diet especially prepared for rabbits (Anber). The diet and tap water were lead free and offered *ad libitum* allover the experimental period. Animals were divided into six groups. Group 1 (untreated control) animals (40 animals) were maintained without any treatment. Animals of group 2 (30 animals) received orally sodium acetate (40 mg/Kg body weight/day) for 20 days. The third group of animals (30 animals) was administered orally with lead acetate (40 mg/Kg body weight/day) for 20 days. In addition to lead acetate treatment as in group 3, animals of groups 4, 5 and 6 (30 animals in each group) were administered orally with either crushed fresh garlic lobes (0.5 gm/Kg body weight/day), black seed oil (0.5 ml/Kg body weight/day) or olive oil (1 ml/Kg body weight/day) for 20 days. Oral administration was performed by using a stomach tube with a smooth tip to protect the interior lining of the oral and buccal cavity of the animal from injury. Analytical-grade lead acetate and sodium acetate were obtained from Riedel-deHaën Laborchemikalien GmbH & Co. The dose of 40 mg/Kg body weight of lead acetate was based on previous work (23). Garlic (*Allium sativum* L.) lobes were purchased from the local market and crushed in a mortar at the day of administration. Black seed (*Nigella sativa*) oil was purchased from local pharmacy; imported from El Captain Company (CAPPHARM), El abour-Cairo-Egypt. Olive (*Olea europaea* L.) oil was obtained from a private olive farm. The doses of garlic lobes, black seed and olive oils were based on other studies (22,24).

Blood sampling

At each sampling date, six animals were taken randomly of each group (eight animals from the control group) and decapitated after 1, 3, 5, 10 and 20 days of administration. Five ml of blood was collected into glass vial containing 2 drops of heparin and about half of centrifuge tube without any anticoagulant was also half filled with blood from the same animal. The heparin-containing tube was agitated gently and then kept in the refrigerator for blood lead analysis. The centrifuge tube was left for about 15 min. to allow blood coagulation. Then clear serum samples were separated by centrifugation at 3000 r.p.m. for 20 min and then kept in the refrigerator for enzyme assay.

Handling of tissue samples

After decapitation, the brain and spinal cord of each animal were immediately removed and the brain was dissected on ice-cold glass plate into nine regions: cerebral cortex, caudate nucleus-putamen, thalamus and hypothalamus (fore brain), superior and inferior colliculi (mid brain) and pons, medulla oblongata and cerebellum (hind brain).

Determination of blood lead level

Blood lead level was determined according to the method described in the Pye-unicum instruction manual, 1980; using a Pye-unicum SP 90 series atomic absorption spectrophotometer based on the method described earlier (25). Atotal of 30 animals were used for each group.

Determination of cholinesterase activity

Acetylcholinesterase activity in different CNS parts and in serum was measured (26). Serum butyrylcholinesterase activity was also determined based on the same method but using Kits produced by TECO-Diagnostics company, TC, California-USA.

Data analysis

Data were computer analyzed using SPSS 8.0 for windows (Statistical Package for the social Sciences Inc, Chicago, Illinois). Means were compared by independent-samples t-test. Microsoft Excel version 6 was used for graph plotting.

Results

Blood lead level

Figure 1 illustrates blood lead level of rabbit under normal conditions, after sodium acetate administration and following oral administration of lead acetate alone or with crushed fresh garlic lobes, black seed or olive oils. Control and sodium acetate groups of animals exhibited BLL not exceeding 10 μg/dl allover the experimental intervals studied. However, administration of lead acetate caused a progressive increase in BLL till reached its maximal value of 54.8 ± 3.2 μg/dl at the end of the experiment i.e. after 20 days. Treatment of animals with

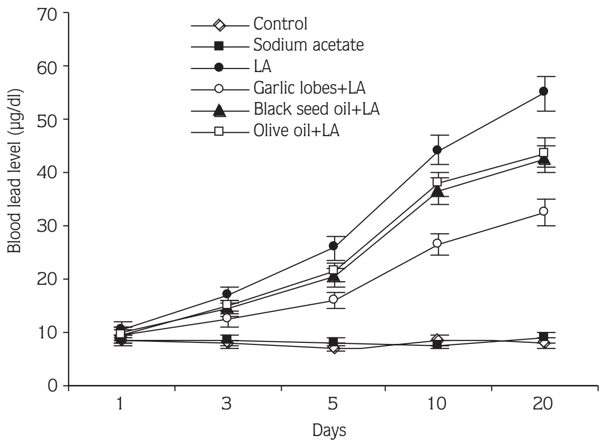

Figure 1. Blood lead level of rabbit following oral administration of lead acetate, LA (40 mg/Kg body weight) for 20 days alone or with crushed garlic lobes, black seed or oilve oils. Standard Errors are plotted as vertical bars.

crushed fresh garlic lobes, black seed or olive oils lowered BLL to values of 32.5 ± 2.4, 42.4 ± 2.5 and 43.6 ± 2.8 µg/dl, respectively at the end of the experiment.

Central nervous system acetylcholinesterase

Brain acetylcholinesterase

Normal brain AChE activity (µMSH/hr/g fresh tissue) showed regional variation in different brain areas examined, with the highest activity occurring in the superior colliculus and the lowest in the cerebellum. As indicated in Tables 1 and 2, no significant change was found in AChE activity between control and sodium acetate groups of animals in the fore brain regions studied. Administration of lead acetate caused a progressive decrease of AchE activity in the different fore brain regions of rabbit as compared to controls. In general, this decrease became significant ($P < 0.05$) and highly significant ($P < 0.01$) in cerebral cortex and caudate-putamen after 10 and 20 days, respectively. Thalamus and hypothalamus showed highly and more highly significant decreases ($P < 0.01$ and $P < 0.001$) in AChE activity after 10 and 20 days of lead acetate administration, respectively. Administration of crushed fresh garlic lobes or black seed oil generally improved the enzyme activity in the fore brain regions recording no significant variation when compared to control levels. Olive oil was less efficient and significant decrease ($P < 0.05$) still recorded in AchE activity of thalamus and hypothalamus after 20 days of treatment as compared to control values.

Table 3 also showed no significant change in AChE activity of mid brain regions between control and sodium acetate groups of rabbits. Lead acetate administration resulted in highly significant ($P < 0.01$) and more highly significant decreases ($P < 0.001$) of AChE activity in superior colliculus at 10 and 20 days, respectively as compared to control animals. In the inferior colliculus the

Table 1. Acetylcholinesterase activity (µMSH/hr/g fresh tissue) in fore brain regions (cerebral cortex and caudate – putamen) of rabbit administered lead acetate (40 mg/kg body weight) alone or with crushed garlic lobes, black seed or olive oils at different time intervals.

		Experimental groups					
For brain region	Time Interval (Day)	Control	Sodium acetate	Lead acetate	Lead acetate + garlic lobes	Lead acetate + Black seed oil	Lead acetate + Olive oil
Cerebral Cortex	1	1484 ± 48.5	1462 ± 44.5	1454 ± 41.8	1456 ± 25.1	1446 ± 31.9	1468 ± 43.2
	3	1490 ± 45.2	1474 ± 29.9	1398 ± 31.0	1412 ± 28.8	1404 ± 39.0	1430 ± 31.4
	5	1444 ± 42.1	1464 ± 44.1	1380 ± 16.0	1428 ± 39.4	1426 ± 37.0	1424 ± 48.3
	10	1450 ± 40.2	1474 ± 42.1	1246 ± 43.4**	1424 ± 27.1	1414 ± 23.3	1398 ± 50.0
	20	1474 ± 40.3	1506 ± 38.0	1228 ± 25.0**	1420 ± 31.8	1406 ± 34.5	1394 ± 47.6
Caudate - Putamen	1	1354 ± 39.4	1332 ± 55.0	1344 ± 51.1	1360 ± 41.8	1342 ± 37.0	1320 ± 52.4
	3	1376 ± 41.6	1392 ± 44.0	1326 ± 49.4	1368 ± 35.8	1346 ± 37.1	1336 ± 39.2
	5	1388 ± 40.7	1358 ± 30.0	1312 ± 44.9	1360 ± 39.0	1330 ± 43.8	1328 ± 30.2
	10	1378 ± 49.3	1382 ± 52.8	1188 ± 50.3*	1332 ± 38.1	1320 ± 38.3	1316 ± 41.3
	20	1397 ± 42.7	1389 ± 45.4	1166 ± 31.5**	1342 ± 43.7	1314 ± 41.9	1306 ± 46.0

The number of animals was 6 in each experimental interval except for control it was 8.
All values were expressed as mean ± S.E.
* Significant differences at $P < 0.05$ and ** Highly significant differences at $P < 0.01$

Table 2. Acetylcholinesterase activity (μMSH/hr/g fresh tissue) in fore brain regions (thalamus and hypothalamus) of rabbit administered lead acetate (40 mg/kg body weight) alone or with crushed garlic lobes, black seed or olive oils at different time intervals.

		Experimental groups					
For brain region	Time Interval (Day)	Control	Sodium acetate	Lead acetate	Lead acetate + garlic lobes	Lead acetate + Black seed oil	Lead acetate + Olive oil
Thalamus	1	1340 ± 29.8	1324 ± 37.6	1306 ± 42.8	1318 ± 36.8	1306 ± 27.7	1326 ± 37.0
	3	1348 ± 34.1	1326 ± 47.2	1278 ± 29.2	1294 ± 36.0	1310 ± 45.9	1292 ± 45.0
	5	1336 ± 32.1	1312 ± 28.4	1240 ± 26.4*	1288 ± 37.9	1282 ± 42.8	1270 ± 46.4
	10	1332 ± 29.4	1342 ± 34.6	1094 ± 49.0**	1274 ± 28.9	1280 ± 30.9	1234 ± 39.8
	20	1350 ± 39.2	1340 ± 29.2	1072 ± 30.2***	1266 ± 27.1	1252 ± 29.2	1230 ± 33.8*
Hypothalamus	1	1446 ± 27.0	1448 ± 32.7	1428 ± 35.0	1434 ± 43.4	1440 ± 46.2	1430 ± 42.9
	3	1450 ± 28.3	1456 ± 27.3	1396 ± 32.7	1406 ± 29.9	1400 ± 39.0	1396 ± 34.4
	5	1442 ± 35.8	1432 ± 31.7	1378 ± 29.8	1402 ± 38.8	1388 ± 30.1	1380 ± 37.8
	10	1422 ± 33.7	1408 ± 38.4	1172 ± 47.9**	1342 ± 46.4	1346 ± 41.4	1318 ± 38.0
	20	1448 ± 39.4	1454 ± 31.6	1140 ± 36.4***	1326 ± 43.3	1310 ± 44.2*	1296 ± 38.0*

The number of animals was 6 in each experimental interval except for control it was 8.
All values were expressed as mean ± S.E.
* Significant differences at P < 0.05, ** Highly significant differences at P < 0.01 and *** More highly significant differences at P < 0.001.

Table 3. Acetylcholinesterase activity (μMSH/hr/g fresh tissue) in mid brain regions (superior and inferior colliculi) of rabbit administered lead acetate (40 mg/kg body weight) alone or with crushed garlic lobes, black seed or olive oils at different time intervals.

		Experimental groups					
Mid brain region	Time Interval (Day)	Control	Sodium acetate	Lead acetate	Lead acetate + garlic lobes	Lead acetate + Black seed oil	Lead acetate + Olive oil
Superior Colliculus	1	1670 ± 38.0	1684 ± 31.4	1662 ± 34.7	1660 ± 31.9	1654 ± 40.1	1664 ± 44.3
	3	1658 ± 34.1	1668 ± 44.7	1624 ± 30.4	1664 ± 27.6	1660 ± 27.0	1640 ± 41.0
	5	1668 ± 30.4	1660 ± 34.3	1608 ± 37.1	1628 ± 39.9	1632 ± 44.7	1636 ± 34.0
	10	1678 ± 39.4	1690 ± 37.5	1448 ± 42.2**	1610 ± 29.7	1590 ± 30.5	1578 ± 43.1
	20	1684 ± 38.2	1692 ± 33.2	1402 ± 33.9***	1612 ± 44.4	1560 ± 40.1*	1574 ± 44.6
Inferior Colliculus	1	1330 ± 34.8	1312 ± 27.6	1314 ± 43.2	1318 ± 39.9	1302 ± 41.2	1308 ± 39.0
	3	1334 ± 37.3	1310 ± 40.2	1260 ± 37.7	1322 ± 44.4	1296 ± 40.9	1282 ± 41.8
	5	1326 ± 33.0	1320 ± 43.2	1232 ± 26.4*	1286 ± 42.1	1280 ± 39.9	1276 ± 44.3
	10	1322 ± 39.4	1314 ± 36.8	1148 ± 39.2*	1270 ± 31.5	1278 ± 32.4	1252 ± 36.3
	20	1326 ± 34.7	1338 ± 37.0	1116 ± 34.0**	1258 ± 43.5	1246 ± 41.9	1234 ± 36.8

The number of animals was 6 in each experimental interval except for control it was 8.
All values were expressed as mean ± S.E.
* Significant differences at P < 0.05, ** Highly significant differences at P < 0.01 and *** More highly significant differences at P < 0.001.

decrease in the enzyme activity was significant (P < 0.05) at 5 and 10 days and highly significant (P < 0.01) at day 20 of lead acetate administration. Again treatment with crushed fresh garlic lobes was more efficient in ameliorating the toxic effect of lead than black seed or olive oils.

As depicted from Tables 4 and 5, animals taken sodium acetate exhibited no significant change in AChE activity of hind brain regions when compared to control animals. Upon lead acetate administration, a progressive inhibition of the enzyme activity in the different hind brain regions was observed towards the end of the experiment. Pons and medulla oblongata showed highly and more highly significant inhibition (P < 0.01 and P < 0.001) in AChE activity after 10 and 20 days of lead administration, respectively. Significant and highly significant decrease (P < 0.05 and P < 0.01) of the enzyme activity in the cerebellum was observed after 10

Table 4. Acetylcholinesterase activity (μMSH/hr/g fresh tissue) in hind brain regions (pons and medulla oblongata) of rabbit administered lead acetate (40 mg/kg body weight) alone or with crushed garlic lobes, black seed or olive oils at different time intervals.

		Experimental groups					
Hind brain region	Time Interval (Day)	Control	Sodium acetate	Lead acetate	Lead acetate + garlic lobes	Lead acetate + Black seed oil	Lead acetate + Olive oil
Pons	1	1456 ± 26.1	1488 ± 27.7	1444 ± 33.6	1440 ± 29.8	1452 ± 30.7	1430 ± 37.3
	3	1476 ± 30.8	1490 ± 40.3	1398 ± 41.3	1446 ± 33.3	1434 ± 41.8	1422 ± 43.5
	5	1452 ± 35.6	1448 ± 31.4	1362 ± 37.5	1430 ± 29.2	1438 ± 43.1	1404 ± 40.2
	10	1474 ± 38.8	1456 ± 43.0	1256 ± 44.1**	1422 ± 39.4	1436 ± 32.3	1378 ± 41.1
	20	1486 ± 39.2	1474 ± 42.9	1228 ± 31.0***	1426 ± 45.0	1430 ± 40.7	1364 ± 36.5*
Medulla Oblongata	1	1448 ± 34.9	1456 ± 38.5	1430 ± 31.2	1424 ± 34.7	1442 ± 41.2	1428 ± 42.4
	3	1440 ± 36.4	1462 ± 38.8	1372 ± 28.3	1434 ± 38.9	1420 ± 40.9	1402 ± 32.3
	5	1458 ± 36.8	1436 ± 37.1	1360 ± 30.3	1418 ± 44.7	1406 ± 46.4	1390 ± 39.5
	10	1470 ± 37.2	1460 ± 43.3	1242 ± 45.7**	1396 ± 48.4	1388 ± 45.0	1372 ± 36.2
	20	1462 ± 37.8	1468 ± 33.2	1180 ± 40.2***	1384 ± 38.2	1366 ± 42.2	1344 ± 32.3*

The number of animals was 6 in each experimental interval except for control it was 8.
All values were expressed as mean ± S.E.
* Significant differences at $P < 0.05$, ** Highly significant differences at $P < 0.01$ and *** More highly significant differences at $P < 0.001$.

Table 5. Acetylcholinesterase activity (μMSH/hr/g fresh tissue) in hind brain region (Cerebellum) and spinal cord of rabbit administered lead acetate (40 mg/kg body weight) alone or with crushed garlic lobes, black seed or olive oils at different time intervals.

		Experimental groups					
CNS region	Time Interval (Day)	Control	Sodium acetate	Lead acetate	Lead acetate + garlic lobes	Lead acetate + Black seed oil	Lead acetate + Olive oil
Cerebellum	1	1234 ± 35.9	1232 ± 29.6	1228 ± 39.0	1242 ± 26.5	1224 ± 39.3	1216 ± 37.4
	3	1256 ± 29.5	1238 ± 25.6	1206 ± 41.5	1236 ± 27.5	1240 ± 39.0	1224 ± 39.5
	5	1262 ± 41.1	1246 ± 43.7	1184 ± 38.3	1244 ± 35.7	1238 ± 37.5	1220 ± 37.2
	10	1250 ± 38.2	1240 ± 39.6	1072 ± 43.0*	1212 ± 38.1	1190 ± 42.4	1176 ± 44.8
	20	1242 ± 36.3	1248 ± 40.9	1010 ± 41.8**	1178 ± 34.2	1172 ± 35.6	1164 ± 34.5
Spinal Cord	1	1022 ± 39.1	1040 ± 44.1	1008 ± 37.9	1028 ± 27.3	1006 ± 37.5	1016 ± 29.0
	3	1014 ± 32.3	1026 ± 36.0	972 ± 34.0	1012 ± 39.4	988 ± 38.4	1020 ± 30.0
	5	1020 ± 37.9	1036 ± 40.1	944 ± 28.5	994 ± 30.0	974 ± 28.3	992 ± 39.5
	10	1034 ± 34.4	1028 ± 36.0	852 ± 39.1**	992 ± 32.1	968 ± 30.3	960 ± 37.1
	20	1028 ± 33.1	1038 ± 40.8	816 ± 30.5**	980 ± 31.8	952 ± 35.0	946 ± 35.5

The number of animals was 6 in each experimental interrval except for control it was 8.
All values were expressed as mean ± S.E.
* Significant differences at $P < 0.05$ and ** Highly significant differences at $P < 0.01$.

and 20 days of lead acetate drinking. When animals treated with crushed garlic lobes, black seed or olive oils, improvement of AChE activity was achieved in the different hind brain regions. However, olive oil therapy was less efficient as it still record significant decrease ($P < 0.05$) of the enzyme activity in pons and medulla oblongata at day 20 of the experiment.

Spinal cord acetylcholinesterase

The normal activity of spinal cord AChE exhibited no significant change upon sodium acetate administration (Table 5). However, a progressive decrease in the enzyme activity was recorded following lead acetate drinking. This decrease reached its significance ($P < 0.01$) after 10 and 20 days of the experiment. Crushed fresh garlic lobes, black seed or olive oils displayed anti lead activities, with garlic treatment was the most efficient.

Serum cholinesterases

It is obvious from Table 6 that the normal activity of serum acetylcholinesterase (SAChE) in rabbit is about half less than that of serum butyrylcholinesterase (SBuChE). No significant change was observed in the normal activities of these enzymes compared to those in animals treated with sodium acetate. Lead acetate administration provoked significant and highly significant inhibition ($P < 0.05$ and $P < 0.01$) in SAChE and SBuChE activities after 10 and 20 days of the experiment, respectively. Upon natural product treatment, olive oil generally exhibited lesser protective efficacy against lead toxicity than that of crushed garlic lobes or black seed oil in particular for SBuChE, where $P < 0.05$ after 20 days of olive oil treatment.

Cholinergic symptoms and Moralities

The author observed no signs of cholinergic symptoms in lead intoxicated rabbits. Also, no moralities were recorded throughout the current study.

Discussion and Conclusion

Daily oral administration of lead acetate caused a progressive elevation of BLL over the time of the experiment implying that lead concentration in blood could be used as a direct indicator of lead exposure. It was concluded that none of the heme pathway parameters was judged a satisfactory substitute for direct blood lead measurement as an indicator of lead exposure in rats (27). Increment of BLL following lead acetate administration was demonstrated in the experimental animals (28).

Treatment of rabbits with crushed fresh garlic lobes, black seed or olive oils lowered BLL. However, garlic was the most efficient. The potential activity of garlic in reducing BLL was documented (24). Garlic contain natural sulfur compounds that may act as anti lead active substances (29,30). Meanwhile, the lesser anti lead mechanism of black seed or olive oils is not clear.

An important aspect in the study of the cholinergic neurotransmission in the CNS is the measurement of the activity of AChE essential for such process. Alterations in the enzyme activity may lead to disturbances in the CNS function. Upon lead acetate administration a progressive decrease in the activity of AChE in different CNS parts was observed with time. Similar results were reported (31,32). In general, this decrease reached its significance after 10 days of lead intubation indicating that lead neurotoxicity may require a while before the actual effect commences. Decreased activity of AChE observed after

Table 6. Serum acetylcholinesterase (SAChE) and serum butyrylcholinesterase (SBuChE) activities (U/L) in rabbit administered lead acetate (40 mg/kg body weight) alone or with crushed garlic lobes, black seed or olive oils at different time intervals.

Enzyme	Time Interval (Day)	Experimental groups					
		Control	Sodium acetate	Lead acetate	Lead acetate + garlic lobes	Lead acetate + Black seed oil	Lead acetate + Olive oil
SAChE (U/L)	1	204.3 ± 9.3	198.7 ± 7.1	195.0 ± 7.0	194.0 ± 6.2	194.7 ± 8.8	197.0 ± 9.9
	3	202.7 ± 10.2	204.3 ± 8.8	187.0 ± 8.4	196.7 ± 9.5	193.0 ± 9.0	196.3 ± 8.7
	5	201.7 ± 7.0	205.7 ± 7.8	180.7 ± 8.1	193.3 ± 7.4	193.3 ± 7.7	192.3 ± 8.4
	10	206.0 ± 7.0	200.3 ± 8.7	174.0 ± 7.7*	191.3 ± 6.1	189.0 ± 6.5	189.3 ± 6.9
	20	208.7 ± 6.9	206.7 ± 6.5	168.3 ± 6.7**	190.7 ± 7.1	188.7 ± 7.1	186.3 ± 7.6
SBuChE (U/L)	1	473.2 ± 18.9	466.7 ± 16.4	462.2 ± 14.3	470.0 ± 20.8	471.0 ± 21.4	470.7 ± 18.3
	3	484.2 ± 22.9	486.2 ± 17.5	457.7 ± 20.8	471.0 ± 17.6	473.7 ± 20.8	472.0 ± 19.4
	5	479.0 ± 19.0	471.7 ± 20.4	434.8 ± 21.9	460.8 ± 20.0	465.2 ± 18.4	461.8 ± 17.9
	10	486.7 ± 18.5	489.2 ± 20.8	407.5 ± 22.4*	454.0 ± 19.0	450.8 ± 21.9	440.2 ± 17.7
	20	491.0 ± 19.4	483.8 ± 22.3	387.0 ± 20.4**	446.8 ± 22.5	439.7 ± 22.3	427.0 ± 20.5*

The number of animals was 6 in each experimental interval except for control it was 8.
All values were expressed as mean ± S.E.
* Significant differences at $P < 0.05$ and ** Highly significant differences at $P < 0.01$.

lead treatment confirms the idea that lead is able to reach the CNS and impair its function by neurochemical changes (10). However, such changes seem not to be enough to induce signs of cholinergic symptoms. Lead-induced peroxidative damages to the membranes may nominate it as a neurotoxicant (31,33).

Treatment experiments with natural products revealed pronounced improvement in the activity of AChE in different brain regions as well as in the spinal cord particularly in rabbits taken crushed fresh garlic lobes. The prophylactic efficacy of garlic against lead toxicity could be attributed to the antioxidant/chelating action of its sulfhydryl groups. Although olive and black seed oils containing some antioxidant compounds (34,35), the mechanism underlying their ameliorating action against lead toxicity needs to be clarified. One can say that the prophylactic efficacy of the natural products used here is in the order of: crushed garlic lobes>>black seed oil>olive oil.

The gradual decrease that observed in the activity of serum AChE and BuChE following lead administration also reached its significance after 10 days of the experiment. This does not necessary mean that the change in serum acetylcholinesterase activity mirror that in the brain. Decrease of blood cholinesterases activity as a result of lead exposure was reported (15,16). It is known that blood cholinesterases are synthesized in the liver (36). Therefore, inhibition of serum cholinesterases activity recorded in here may be attributed to lesions in the liver due to oxidative stress induced by lead poisoning.

In treatment experiments, crushed fresh garlic lobes provided better recoveries of both serum cholinesterases than black seed or olive oils. It was demonstrated that oral feeding of minced fresh garlic during intraperitoneal injection of lead acetate significantly decreased the accumulation of this toxic metal and prevented the metal sensitive biochemical alterations in blood and liver (21). The ability of garlic to provide sulfur compounds and its antioxidant properties appear to protect against oxidative damage provoked by lead. Black seed and olive oils may have some antioxidant role.

In conclusion, oral administration of lead acetate elevated BLL in rabbits. Lead alters some biochemical parameters associated with CNS and liver functions. Treatment of animals with crushed fresh garlic lobes, black seed or olive oils reduced lead in blood and hence ameliorated such changes. However, the prophylactic efficacy of such compounds is in the order of: garlic>>black seed oil>olive oil. The regular intake of garlic may be beneficial in reducing the toxic effects of lead in the exposed population. Further research is recommended to test the ability of other natural products to combat lead toxicity.

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