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EFFECT OF LEAD EMISSIONS ON SHEEP GRAZING IN HEAVY INDUSTRIZED AREA IN HELWAN, EGYPT

(With 3 Tables)

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تأثير انبعاث الرصاص على الاغنام فى المناطق الصناعية الكثيفة بحلوان ، مصر

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أجريت هذه الدراسة على عشرين حيوان من الاغنام البلدية التى ترعى بالقرب من منطقة حلوان الصناعية الملوثة بعوادم الرصاص وكذلك على عدد مماثل من الاغنام التى ترعى فى مناطق زراعية بعيده عن مصادر التلوث الصناعى كمجموعة ضابطه وذلك لتقييم التلوث الصناعى بالرصاص وآثاره على هذه الحيوانات. تم اخذ عينات دم من الاغنام التى ترعى بالمناطق الملوثة وكذلك الاغنام فى المجموعة الضابطة لتحديد نسب كل من البروتين الكلى، الالبيومين، الجلوبيولين، الدهون الكلية، البيليروبين وانزيمات الفوسفاتيز القلوى، الاسبرتيت امينو ترانسفيرير والالينين امينوترا نسفيريز بالاضافة الى اخذ عينات من المياه، والاعشاب،والتربة من كل من المناطق الملوثة والغير ملوثة والتى ترعى عليها هذه الحيوانات. اظهرت النتائج ارتفاع نسبة الرصاص فى امصال، البان،وصوف الاغنام المعرضة لانبعاث الرصاص فى المناطق الصناعية ارتفاعاً بيناً، كما ارتفع تركيز الرصاص فى عينات المياه،والتربة،والاعشاب فى المناطق الصناعية الملوثة عنها فى المناطق الغير ملوثة. أيضاً كما أظهرت النتائج وجود نقص حاد فى البروتين الكلى، والذى صاحبه انخفاض فى كل من الالبيومين، والجلوبيولين، وكذلك معدلات الدهون الكلية فى الاغنام المعرضه للتلوث. كما انخفضت معدلات انزيمات الاسبرتيت امينوترا نسفيريز، والالينين امينوترانسفيزيز والفوسفاتيز القلوى عنها فى الاغنام المعرضة للتلوث الصناعى عنها فى المجموعة الضابطة. مما سبق يتضح الدور الخطر الذى يلعبه التسمم بمركبات الرصاص من اثار سلبية على صحة الحيوانات القاطنه بالأماكن الصناعية وان كانت الخطورة تكمن من تلك الاثار المدمرة نتيجة لاستهلاك البان ولحوم هذه الحيوانات لما للرصاص من قدرة على التراكم واحداث التسمم المزمن والذى يترتب عليه العديد من الاضرار، مما يستوجب

التحذير من تواجد المناطق السكنية أو الصناعية معاً فى منطقة واحدة أو الرعى فـــى تلـــك الاماكن أو استخدام هذه الحيوانات أو لحومها أو منتجاتها.

SUMMARY

Twenty animals from a sheep flock grazing in a heavy industrized area with lead smelters and battery factories near Helwan were examined for elemental lead pollutants. Equal number of sheep grazing in a rural area far away from any industrised regions were examined and served as controls. Blood samples were drawn form the jugular vein of the investigated and control sheep. The total protein, albumin, globulin, total lipids, bilirubin as well as alkaline phosphatse, aspartate amino-transferase (AST) and alanine aminotransferase (ALT) enzymes were estimated. Samples from water, vegetations and soils were collected from the study areas. The results revealed that the mean values of lead in serum, milk and wool of sheep exposed to industrial lead emissions were higher than that in sheep grazing in unpolluted area. Also, lead level in water, soil and vegetation in polluted area were higher than controls. Moreover, there was a hypoproteinaemia, albuminaemia, globulinaemia as well as decrease in the total lipids in sheep exposed to industrial emissions. The mean level of AST, ALT and alkaline phosphatase were lower in sheep exposed to industrial emissions than in control animals.

***Keywords:** Lead Emissions, Grazing Helwan.*

INTRODUCTION

Environmental pollution is a major problem of today's life affecting health and production of livestock. Atmospheric emissions of pollutants are mainly caused by human activities due to increased industrization in many parts of the world (Wayne et al., 1995).

Sources of air pollution are diverse and it is often impossible to distinguish between them. Industrial sources contribute to a significant amounts and types of environmental pollutants. Burning of coal and fossil fuel-based power generation contribute to high proportion of air pollutants. In addition, emissions from automobile exhaust constitute a great addition to air pollution problem facing human and animal life (Watkins, 1981).

Damage caused by pollutants on inanimate materials is evident, but the biological effects of pollutants directly upon animals is more significant. Moreover, biological effects are detected faster and at lower concentrations than those upon non-living materials. Although damage to inanimate materials has a huge economic costs, it has always been accepted that health hazard to animals was the main reason for air pollution control programs. More recently, especially in the case of air pollution, control programs have been imposed to protect vegetation and other biological ecosystems upon which livestock depend (Wellburn, 1994).

The adverse effects caused by pollutants on human and animal health are best exemplified by acute episodes of air pollution in specific localities (Harrison, 1983). The health hazards of air pollution can be explained best by employing a comparable laboratory animals (Stockinger, 1981).

The objective of this paper was to study the problem of industrial lead pollution and to investigate its effects on the health of sheep grazing near an industrized area in Helwan.

MATERIALS and METHODS

Animals:

Twenty animals from a sheep flock grazing in a heavy industrized area which has lead smelters and battery factories near Helwan were examined for elemental pollutants. Equal number of sheep grazing in a rural area far away from any industrized regions (Shibin El-Kanater, 60 km North Helwan) were examined and served as controls.

Sampling:

Total protein, albumin, globulin, total lipids, bilirubin as well as alkaline phosphatase (AP), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) enzymes were estimated in serum samples by using test kits supplied by (Bio-Merieux, France). Also, ten samples each from river Nile water, vegetations and soils were collected from the investigated and control areas. The sampling technique was conducted according to the recommendations of the American Public Health Association (APHA, 1989). Water samples were acidified with nitric acid and stored at 4°C till analysis.

Preparation of samples:

Vegetation samples were finely chopped and soil samples were finely ground, sieved and all samples were placed in clean acid washed glass bottles and stored at -20°C till subsequent digestion and analysis. Milk and wool samples from the investigated and control sheep were also collected to record the level of elemental pollutants. Milk samples were stored at 4°C till analysis, while wool samples were finely minced and stored at -20C till subsequent digestion and analysis.

Analysis of samples:

All the collected water, milk, serum, vegetation and soil samples were transferred to 10 ml of digestion tubes to apply analysis by atomic absorption spectrophotometer (Perkin Elmer,USA). The prepared sample solutions after filtration with ashless filter papers were aspirated into air-acetylene flame. The absorbance and concentrations were recorded directly on the digital scale of the spectrophotometer and the level of the elemental metals can be estimated (Analytical methods for atomic absorption spectrophotometer, 1982).

RESULTS and DISCUSSION

The results of chemical analysis of elemental lead pollutant in serum, milk and wool samples collected from investigated and control sheep were recorded in Table (1). The mean value of lead in serum and milk samples of sheep grazing in polluted area was significantly higher (P<0.01) than that in control sheep grazing in unpolluted area in serum being 0.86 ± 0.05 and 0.22±0.02 ppm, while in milk reached 0.13 ± 0.02 ppm and 0.04 ± 0.01 ppm, respectively. The mean values of lead in wool of animals grazing in contaminated area was significantly higher (75.69 ± 2.55 ppm) than in that of control animals (18.54 ± 0.96 ppm). These findings were agreed with the results obtained by Dey et al., (1996) & (1997) who reported that higher concentrations of lead was found in the blood, milk of the affected animals and in forage and leaf samples of Eucalyptus globulus from the polluted area in India. Lead like many other heavy metals shows a biocumulative tendency (Stockinger, 1981). A significant increase in the concentration of lead in exposed sheep versus controls was recorded as well as cummulations of high level of lead from industrized emission in the wool of exposed sheep was also reported by Bires et al., (1991). A higher lead residues have been reported in the blood and milk of animals exposed to lead (Stern, 1977 and Harrison, 1983).

It was specially interesting to notice that sheep exposed to industrial pollution had lead concentration higher than 0.8 ppm in serum which is considered harmful for livestock (Radostits et al., 1994). This suggested that sheep may have a high tolerance to lead. There was a significant increase of lead in sheep grazing alongside the motor way of London in comparison with the controls and the mineral content of wool samples were also significantly higher than controls (Bires and Vrzjula, 1990 &Wood and Savage, 1994). Bires et al. (1991) reported that a high concentration of lead was detected in the kidneys and wool of sheep exposed to industrial emissions. Moreover, Braun et al. (1997) found that the lead concentration in serum of calves pastured near a lead polluted area was 0.94 ppm, while it was 30 mg/kg in the liver and 38 mg/kg in the kidney. On the other hand, Boroskova et al. (1994) found no differences in the metal concentrations between sheep gazing in polluted and unpolluted area, as well as in serum of both groups of sheep.

The results displayed in Table (2) showed that the mean values of lead in water samples collected from the industrized area was significantly higher ($P<0.01$) than that collected from unpolluted area being 0.32 $\pm$ 0.05 ppm and 0.06 $\pm$ 0.01 ppm, respectively. Considerably higher level of lead was estimated in soil samples collected from industrized area as compared to that collected from unpolluted area being 272.67 $\pm$ 22.61 ppm and 63.71 $\pm$ 8.09 ppm, respectively. Much higher level of lead was recorded in vegetation samples collected from industsrized area than that of samples collected from unpolluted area being 183.5 $\pm$ 7.55 ppm and 56.04 $\pm$ 7.13 ppm, respectively. These results substantiated by Braun et al. (1997) and Dey et al. (1996) who recorded a much higher concentration of lead in the dry matter of a grass and soil from a contaminated pasture than that from unpolluted area.

It was evident from Table (3) that the mean concentrations of the total protein, albumin, globulin, total lipids were generally lower in serum of sheep grazing in polluted area than that estimated in sheep grazing in unpolluted area. This decrease was highly significant ($P<0.01$) in sheep grazing in polluted area. The mean values were 5.37 $\pm$ 0.12, 2.43 $\pm$ 0.05, 2.91 $\pm$ 0.16 g% and 175.68 $\pm$ 2.59 mg% for total protein, albumin, globulin and total lipids in serum of sheep grazing in polluted area, respectively, whereas it was 7.42 $\pm$ 0.13, 3.42 $\pm$ 0.06, 3.99 $\pm$ 0.15 and 260.11 $\pm$ 3.50 in serum of control sheep, respectively. The mean concentration of bilirubin was nearly similar in serum of investigated and control sheep being 0.33 $\pm$ 0.01 and 0.30 $\pm$ 0.01, respectively. There was highly significant decrease ($P<0.01$) in the concentration of AST, ALT and AP in serum of investigated sheep grazing in polluted area (44.12 ± 1.71, 32.09 ± 0.58, 25.85 ± 0.81 l respectively), in comparison with control animals (59.81 ± 0.98, 41.42 ± 0.78 and 30.97 + 0.78 l respectively). These results were in accordance with those reported by (Jazbec, 1994 and Kotterova & Korenekova, 1996). Moreover, Weissova et al. (1996) reported that a marginal hypoproteinaemia and hypoglobulinaemia were recorded in sheep flocks exposed to industrial emission. The levels of aspartate aminotransferase and alanine aminotransferase were within a normal limits, however serum glutamyl transpeptidase and alkaline phosphatase were outside the normal range and animals developed hyperbilirubinaemia. Furthermore, Kostova et al. (1995) and Lenartova et al. (1996) revealed that the glutathione s-transferase (GST) coenzyme and glucose-6-phosphate dehydrogenase could be a useful biomarkers of exposure to environmental pollution in sheep.

The source of pollution in the present study was smelting units extracting lead from the plates of old batteries by burning a mixture of wood charcoal and battery scarps. Airborne particles discharged in the smoke emanating from the burning charcoal and battery scarp mixture must have settled over the vegetation and animal fodder grown the nearby fields.

In conclusion, the dangerous effects of industrial pollution that arise from lead smelters and battary factories near Helwan was obvious. Water sources, feed stuffs and soil had a main significant role in the allivation and level of lead in animal tissues. Wool analysis of this toxicant is of great value in determination of poisoning in comparison with serum analysis. The consumption of polluted milk, meat and organs with lead has a dangerous and hazarderous effects on human health even if they retain very small concentrations on the long run. Rearing of these animals must be far away from these factories and human habitations.

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Table 1: Mean level of lead pollutant in serum, milk and wool of investigated and control sheep

Sample	Concentration in ppm ± S. E.		
	Investigated sheep	**Control sheep**	**Permissible limit (WHO, 1983)**
Serum	0.86± 0.05*	0.22 ± 0.02	0.1
Milk	0.13± 0.02*	0.04 ± 0.01	-----
Wool	75.69 ± 2.55*	18.54 ± 0.96	----

*: P<0.01

Table 2: Mean level of lead pollutant in water, soil and egetation in industrized and control areas

Samples	Concentration in ppm ± S.E.		
	Industrized area	Control area	Permissible limit (WHO, 1984)
Water	0.32 ± 0,05*	0.06 ± 0.01	0.05
Soil	272.57 ± 22.61*	63.71 ± 8.09	------
Vegetation	183.5 ± 7.55*	56 .04 ± 7.13	------

* P<0.01

Table (3): Mean values of some biochemical and enzyme levels in serum of investigated and control sheep

Sheep	Mean values ± S. E.								
	Total proteins (g%)	Albumin (g%)	Globulin (g%)	A/G Ratio	Total lipids (mg%)	Bilirubin (mg%)	AST (µ/L)	ALT (µ/L)	AP (µ/L)
Investigated	5.37± 0.12*	2.43± 0.05*	2.91± 0.16*	0.835	175.68± 2.59*	0.33± 0.01*	44.12 1.71*	32.09± 0.58*	25.85± 0.81*
Control	7.42± 0,13	3.42± 0.06	3.99± 0.15	0.855	260.11± 3.50	0.30± 0.01	59.81± 0.98	41.42± 0.78	30.97± 0.78

A/G ratio = Albumin / Globulin ratio, * P < 0.01