INTERNATIONAL JOURNAL OF ENVIRONMENT
Volume-3, Issue-2, Mar-May 2014 ISSN 2091-2854
Received:16 May *Revised:25 May* *Accepted:31 May*

TOXICOLOGICAL EFFECTS OF A HERBICIDE – PENDINMETHALIN: A CASE STUDY OF KENANA SUGAR INDUSTRY, WHITE NILE PROVINCE, SUDAN

Muawia I. A. Abdelgadir (Elrrigieg) [1], Murwan K. Sabahelkhier[2], Mohamed A. Adris[3], Omer F. Idris[4], Shama I. Y. Adam[5] and Sulafa H.N[6]

[1] Faculty of Education, University of Bakht El – Ruda, Eld – Dueim, SUDAN
[2,4,5,6] Department of Biochemistry and molecular biology, Faculty of Science and Technology, El Neelain University, Khartoum, SUDAN
[3] Department of Biochemistry and molecular biology, Faculty of Medicine, Dungla University, Dungla, SUDAN
Corresponding author: elrrigieg.muawia@live.co.uk

Abstract

The aim of this experiment is to know the toxicity of high uses of pendimethalin as herbicide used in Kenana Sugar Industry, period of experiment is 30 days. The results were reveal that there was significantly effect of high doses of pendimethalin on the liver of Wistar rats, because increase in the dose of the pendimethalin reflected by increasing the alkaline phosphatase enzyme during increase the period of time. In addition there were histopathological medical in cells of the liver of Wistar rats, which lead to impaired function of the liver, so it is very clear observed in water collected from Kenana Sugar Industry plate two, and 375 and 750 (plate three and four) compared with plate one(free from pendimethalin treatment. This experiment indicated that high dose of pendimethalin causes toxicity.

Keywords: Pendimethalin, herbicide, liver and ALP enzyme

Introduction

Pendimethalin is an herbicide used in premergence and postemergence applications to control annual grasses and certain broadleaf weeds. It inhibits cell division and cell elongation. Pendimethalin is listed in the K1-group according to the HRAC classification and is approved in Europe, North America, South America, Africa, Asia and Oceania for different crops including cereals (wheat, barley, rye, triticale), corn, soybeans, rice, potato, legumes, fruits, vegetables, nuts as well as lawns and ornamental plants (Clarke *et al.,* 2009). Pendimethalin has been determined to be a systemic toxicant (U.S. E.P.A, 1984). An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for Pendimethalin is .005 (mg/kg body weight/day) by oral exposure (U.S.E.P.A, 1984) , Kidd and James (1991). Alkaline phosphatase (ALP, ALKP) (EC3.1.3.1) is a hydrolase enzyme responsible for removing phosphate groups from many types of molecules, including nucleotides, proteins, and alkaloids. The process of removing the phosphate group is called dephosphorylation. As the name suggests, alkaline phosphatase is most effective in an alkaline environment. It is sometimes used synonymously as basic phosphatase (Tamás *et al.,* 2002). In the Sudan, human poisoning by pesticides is attracting little public or even medical attention. Poisoning sometimes goes under recognized, undiagnosed or unreported. Hence, documentation and registration of poisoning accidents is poor (annex IV). However 22 accidents were reported in the period 1968-1992. Some of these involved a large number of people and led to several mortalities. The major cause of poisoning was found to be due to the consumption of grossly contaminated food, sorghum, wheat, sugar, dried fish etc. Consumption of treated seeds is the main reason of such accidents. In addition, food consignments are contaminated during transportation of food stuffs together with pesticides. Several surveys and periodical medical attentions on Health workers exposed to organophosphrous pesticides indicated significant cholinesterase inhibition add symptoms of Poisoning. During early surveys in the 1989 it was noted that workers were completely ignorant or new little about the hazards of the toxic chemicals which they were handling, hence precautionary measures were rarely observed. Although the situation is now improving it is still far from being satisfactory. Due to these facts, the professional and decision makers were simulated and a ministerial decease was issued in1998 to establish a poison control center which is still under establishment (El Hindi *et al.,* 2003).

Objectives of this study are to assess toxicity of high doses of pendimethalin that used in Kenana Sugar Industry as herbicides.

Materials and Methods

Experiment design and collection of blood sample

28 rats were divided into 4 groups (7 rats per each); group one served as control, group two was treated with pendimethalin – polluted water (water were collected from

Kenana Sugar Industry (drained water) which is polluted by pendimethalin that used as herbicide in KSC (Abd-algadir *et al.,* 2011), group three and four were treated with pendimethalin at rate of 375 and 750 mg/kg body weight, respectively. Animals were orally – treated for a month. Blood was collected from each group at intervals of 7^{th}, 14^{th}, ^{21th}, ^{28th} day. Then the collected blood were centrifuged at 30000 rpm for serum separation and stored at 5°C, until start the serobiochemical analysis.

Serobiochemical

An Automatic machine Elecsys 2010 Germany full automatic device was calibrated for measuring serum alkaline phosphatase concentrations for all animal groups by using method described by Friedman and Young (1997).

Preparation of liver plates

Liver of all groups were collected in clean, sterilized urine containers (from the autopsied rats), labeled and cleaned with distilled water, preserved in 10% formalsaline. Liver plates for all groups were prepared according to method described by Abd-algadir *et al.* (2011).

Statistical analysis

Eleven samples were taken, analyzed and averaged. Mean is average of thirty replicates. Data were assessed using Analysis of Variance (ANOVA) as described by (Gomez and Gomez (1984).

Results and discussion

Alkaline phosphatase (ALP) in rat serum

Table (1) indicated that the average value of serum ALP level for group one that received water polluted with Pendimethalin (collected from Kennan Sugar Company) was 139 u\L , while the average value of serum Alp for group two and three (received 375 and 750 g/Kg body weight Pendimethalin) were 178 and 296 u\L, respectively. These results reveal that serum ALP level was directly proportion increased with increasing the dose of Pendimethalin during 28 days. The Pendimethalin is categorized as systemic toxicant (USEPA, 1984). Therefore, histopathology changes were clearly observed in plate 2, 3 and 4 compared with plate 1 (control). In plate two, the liver of experimental rat shows atrophy and vacuolation of cytoplasm (V), plate three shows liver with vacuolation of cytoplasm (V), uneven distribution of nuclear chromatin (U) and obvious nuclei (O), but plate four shows liver with vacuolation of cytoplasm (V), dark eccentric nuclei (D) and absence of nuclei in many cells (A). Therefore, histopathological changes in livers of experimental rats were increased gradual due to increased in serum ALP level for each experimental dose which indicated by column number six in Table 1. Li-Fern and Rajasoorya (1999) stated that elevation in alkaline phosphatase is a medical condition, when the levels of alkaline phosphatase exceed the reference range, this medical condition is clearly observed in dogs that fed 50 mg/kg/day pendimethalin for 2 years, but no medical conditions were observed at dose 12.5 mg/kg/day pendimethalin (Weed Science Society of America, 1994). The medical condition were no observed at dose 40 mg/kg/day pendimethalin mg/kg/day pendimethalin for

90 day feeding study rats (USEPA, 1987).

Table (1): Showed serum ALP level (u\L) for rats once-daily orally - treated with Polluted-water, 375 and 750 mg/kg body weight of Pendimethalin

Treatment mg/kg body weight	7^{th} day	14^{th} day	21^{th} day	28^{th} day	Average
Polluted-water	135.7	138.0	ND	141.3	139
375	142.3	176.33	ND	212.0	178
750	267.7	299.0	ND	322.0	296

ND = Not Determine

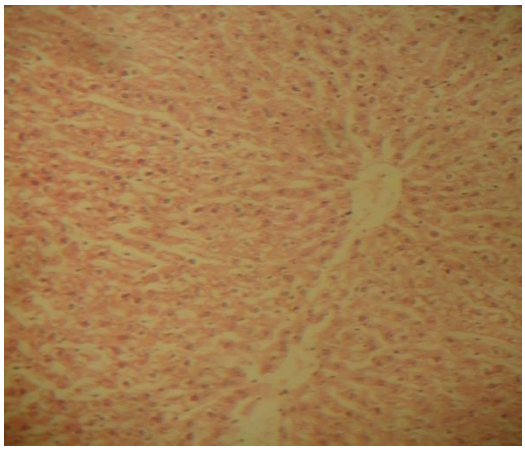

Plate No.1: T.S through rat liver group 1, shows rat liver control. (H&E × 250).

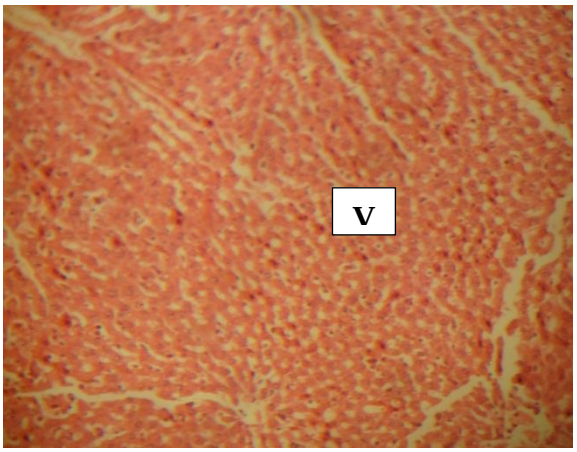

Plate No. 2: T.S through rat liver group 2, shows Atrophy and vacuolation of cytoplasm (**V).** (H&E × 250).

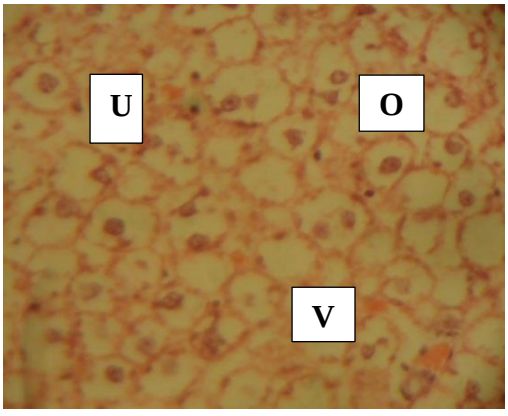

Plate No.3, T.S through rat liver group 3, shows vacuolation of cytoplasm (**V**), uneven distribution of nuclear chromatin (**U**) and obvious nuclei (**O).** (H&E × 400).

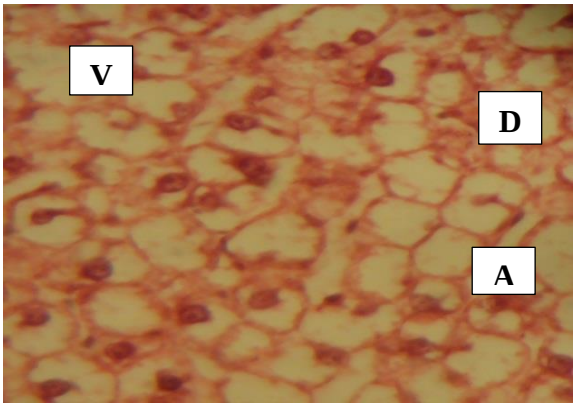

Plate No.4, T.S through rat liver group 3, shows vacculation of cytoplasm (**V**), dark eccentric nuclei (**D**) and absence of nuclei in many cells (**A).** (H&E × 400).

References

Abd-Algadir, Idrris O .F.and Sabahelkhier, M.K., 2011. Effect of Pendimethalin Herbicide on Fish (Tilapia nilotica) Skeletal Muscles, Gills and its Influence on Human. World J Life Sci. and Medical Research.pp:1:5. ISSN 2249-0574.

Clarke, Wynn, Twinning, Berry, Cook, Ellis and Gladders. 2009. Pesticide availability for cereals and oilseeds following revision of Directive 91/414/EEC; effects of losses and new research priorities. *In: HGCA Research Review*. Nr. 70,).

El Hindi A. M., Dukeen M. H. and Ahlam H. A., 2003. Management of Public Health Pesticides In Sudan. Inter-Country Workshop On Public Health Pesticides Management In The Context of The Stockholm Convention On Persistent Organic Pollutants (POPs). Amman, Jordan.

Friedman and Young, 1997. Effects of disease on clinical laboratory tests , 3th ed . AACC Press. LDH and ALP estimation.

Kidd, H. and James, D. R., 1991. The Agrochemicals Handbook, Third Edition. Royal Society of Chemistry Information Services, Cambridge, UK, 1991 (As Updated).10-2.

Li-Fern H and Rajasoorya, C., 1999. "The elevated serum alkaline phosphatase--the chase that led to two endocrinopathies and one possible unifying diagnosis". Eur. J. Endocrinol. 140 (2):143–7. doi:10.1530/eje.0.1400143. PMID 10069658.http://eje-online.org/cgi/pmidlookup?view=long&pmid=10069658.

Tamás L, Huttová J, Mistrk and Kogan, G., 2002. "Effect of Carboxymethyl Chitin-Glucan on the Activity of Some Hydrolytic Enzymes in Maize Plants". Chem. Pap. 56 (5): 326–329. http://www.chempap.org/papers/565a326.pdf

USEPA. 1984. Unit State of Environmental Protection Agency, Washington, D.C., EPA/600/X-84/211 (NTIS PB88129630), 1984.

USEPA. 1987. Unit State of Environmental Protection Agency, Pesticide tolerance for pendimethalin. Fed. Regist. 52: 47734 5,10-117.

USEPA. 1997. Unit State of Environmental Protection Agency. Office of Pesticide Programs; Registration Eligibility Decision Document - Pendimethalin p.12 EPA 738-R-97-007. Available from, as of June 11, 2010: http://www epa. gov/pesticides /reregistration/status.htm.

Washington Department of Agriculture. 2004. Washington State Pendimethalin Use Summary. Olympia, Washington: Washington Department of Agriculture.

Weed Science Society of America. 1994. Herbicide Handbook, Seventh Edition. Champaign, IL,10-59.