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Stannous chloride induces alterations in body weight and hematological parameters in male rabbit

Mariam. A. Ibrahim[1] , Eman. K. Saad[1] and Fayrouz. A. Khaled[*1]

[1]Chemistry Department, Faculty of Science, Omar Al-Mokhtar University, El -Beida-Libya

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Abstract

Stannous chloride ($SnCl_2$) is widely used in daily human life, for example, to conserve soft drink, in food manufacturing and biocial preparations. Tenth rabbits were randomly divided into two equal groups (each group five rabbits). The first group was designed as a control. The second group was used to study the effect of stannous chloride (20 mg/kg body weight) for 12 weeks. Overall means indicated that treatment with stannous chloride caused significant ($P<0.05$) decrease in body weight and relative weight of liver, kidney, spleen, testes, and heart compared to control animals. Additionally, this study indicated that treatment with stannous chloride ($SnCl_2$) caused significant increase in white blood cells (WBCs) and insignificant decrease in haemoglobin (Hb), red blood cells (RBCs), packed cell volume (PCV) and platelets. The study confirmed the detrimental effects of stannous chloride on the body weight, relative organ weight and hematological parameters on male rabbits.

Keywords: Stannous chloride, Rabbits, relative organ weight, Hematological parameters

Introduction

Tin derivatives and compounds are shown an important role in life activity.for long time it use in plated containers and alloys[1]. Inorganic tin compounds are used in a variety of industrial processes for the strengthening of glass, as a base for colors, as catalysts, as stabilizers in perfumes and soap and as dental cryogenic agents. One of the common stannous ions ,is the stannous chloride (SnCl2) salt form, is extensively used as a reducing agent to label radiotracers with technetium-99m ((99m)Tc). These radiotracers can be used as radiopharmaceuticals in nuclear medicine procedures. In this case, absorption of this complex was confirmed, because it is intravenously administered in humans, although biological effects of these agents have not been fully understood[2].

$SnCl_2$ has a lone pair of electrons, such that the molecule in the gas phase is bent. In the solid state, crystalline $SnCl_2$ forms chains linked via chloride bridges as shown in figure 1. The dihydrate is also three-coordinate, with one water coordinated on to the tin and second water coordinated to the first. The main part of the molecule stacks into double layers in the crystal lattice, with the "second" water sandwiched between the layers[3] .

***Corresponding Author**
E.mail: faylzobair@yahoo.com

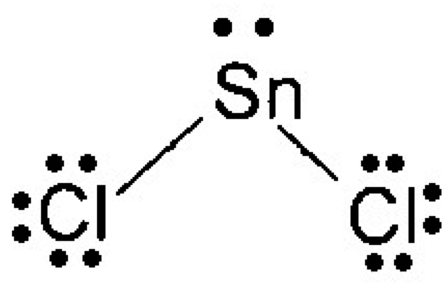

Figure 1. Chemical structure of stannous chloride [3]

Tin(II) chloride, also known as stannous chloride, is a white crystalline solid with the formula $SnCl_2$. It forms a stable dihydrate, but aqueous solutions tend to undergo hydrolysis, particularly if hot. $SnCl_2$ is widely used as a reducing agent (in acid solution), and in electrolytic baths for tin-plating. $SnCl_2$ should not be confused with the other chloride of tin; tin(IV) chloride or stannic chloride ($SnCl_4$). In the last 25 years, considerable efforts have been made to understand the effect of tin, tin compounds and Sn^{2+} on human cells[4] . and in the environment The food industry uses stannous chloride as apreservative (e.g., in soft drinks) and in some fluoridetoothpastes[5]. Possible joint consumption of these compounds,therefore, makes relevant information on their effect, isolated or in interaction, even with other organisms used as indicators [6]. The nano tin compounds effect on human health and the environment are under investigation due to the complexity of measuring the biological effect of nanoparticles/nanomaterials. In the environment , the size and state of agglomeration/aggregation vary, affecting the bioavailability of the nanoparticles and their access and accumulation in cells or their release from the body[7]. Stannous is used for the treatment of rheumatoid arthritis and other inflammatory diseases [8]. With the use of stannous ointment, the local metal exposure can reach 0.15 g day_1. Humans are exposed to stannous mostly through tin-lined cans but also through toothpaste, perfumes and food additives or to organotin compounds via plastic pipes, paints and pesticides. Stannous overload can cause anima as well as liver and kidney problems [9]. Stannous chloride induced a dose-dependent increase in the MN frequency in peripheral erythrocytes of adult zebra fish (Daniorerio) after 120 exposures to doses $\geq$ 50 lM [10]. The use of herbal products is gaining popularity around the world. as they are considered to be effectual and to have few side-effects [11]. Variation in blood constituents gives a rapid and good picture reflecting the physiological status of the organism because these changes develop more quickly in response to toxicants than any apparent morphological changes [12]. Janssan *et al.* investigated the effect of stannous chloride at 0,250,500 ppm Sn^{+2}. They found that haemoglobin decreased significantly[13]. Rader and his group, studied the anti-nutritive effect of dietary tin. He reported that a variety of effects of tin including variations in the activity of heme oxygenause and δ- aminolevulinic acid dehydrates and also tin has adverse effects on metabolism of essential trace minerals including iron[14].

Material and Methods

In this study stannous chloride ($SnCl_2$) was used. $SnCl_2$ (purity 400g/L) was brought from chemistry department, faculty of science, Omar Al-Mokhtar University, El -Beida-Libya. Mature male New Zealand White rabbits age of 6 months and initial weight of (1.891 ± 27.6 Kg) were used. Animals were individually housed in cages and weighed weekly throughout 3-months experimental period. The first group was used as control, while, groups 2 were treated with $SnCl_2$ by gavage at a dose of 20 mg/kg B.W/day (1/50 of $SnCl_2$) lethal dose [15]. At the end of the experimental period body weight of rabbits were recorded. Animals were sacrificed by decapitation and liver, lung, kidney, testes and brain were immediately removed and weighed then the organs weight ratio was calculated. The relative weight of organs (%) was calculated as g/100 g body weight. The blood samples were collected in two tubes: one containing EDTA (anti-coagulant) and the other containing Heparin (anti-coagulant). No coagulated blood by EDTA was tested shortly after collection by Particle counter (from ERMA INC.-Tokyo. Model PCE-210) for measuring total leukocyte counts (TLC), total erythrocyte count (TEC), platelet count (PLT), haemoglobin (Hb), packed cells volume (PCV). Statistical analysis. Where applicable, statistical analysis was carried out in Minitab software; statistical significance was assessed using one way ANOVA analysis.

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Results and Discussion

Effect of stannous chloride ($SnCl_2$) on body weight and relative organ weights

The changes in body weight (BW) and the relative weights of liver, kidney, lung, spleen, testes, and heart of male rabbits. The relative organ weights (%) were calculated as g/100 g body weight throughout the 12week experimental period of rabbits treated with Stannous chloride ($SnCl_2$) were summarized in (Table 1). Overall means indicated that treatment with $SnCl_2$ caused significant ($P<0.05$) decrease in BW and relative weight of liver, kidney, spleen, testes, and heart compared to control animals.

Table 1. Body weight (BW) and relative weight of kidney, liver, lung, brain, heart, testes and spleen of male rabbits treated with stannous chloride ($SnCl_2$)

Parameter	Control	$SnCl_2$
BW (gm)	1.891± 35.64^{a}	1.756 ± 58.65^{a}
Kidney (g/100gm)	11.84± 1.275^{a}	10.34± 0.382^{a}
Liver (g/100gm)	42.78 ± 0.697^{a}	39.10 ± 1.453^{a}
Lung (g/100 gm)	8.520 ± 0.736^{ab}	7.600 ± 0.510^{b}
Heart (g/100 gm)	6.400 ± 0.872^{a}	5.900 ± 0.332^{a}
Testes (g/100 gm)	4.080 ± 0.972^{a}	3.604 ± 0.713^{a}
Spleen (g/100 gm)	4.080 ± 0.972^{a}	3.604 ± 0.713^{a}

Values are expressed as means ± SE; n = 5 for each treatment group. Mean values within a row not sharing a common superscript letters (a, b) were significantly different, p<0.05.

Effect of ginseng, stannous chloride and their combination on hematological parameters.

Table.2 presents the hematological parameters of male rabbits treated with ginseng, $SnCl_2$ Results indicated that treatment with stannous chloride ($SnCl_2$) caused significant increase in white blood cells (WBCs) and insignificant decrease in haemoglobin (Hb), red blood cells (RBCs), packed cell volume (PCV) and platelets. Similar effects were observed with values of MCV and MCH in $SnCl_2$. While values of MCHC was not showed any significant deference.

Table 1: Changes Complete blood counts Red blood cells (RBC), white blood cells (WBC), packed cell volume (PCV), platelets count (PLT), hemoglobin (Hb), of male rabbits treated withstannous chloride ($SnCl_2$).

Parameters	Control	$Sncl_2$
RBC ×10^{6} (µl)	5.58± 0.374^{ab}	4.55±0.096^{c}
Hb (g/dl)	13.27±0.20^{ab}	12.08±0.31^{c}
PCV×10^{3}(µl)	40.64±0.252^{a}	36.70±0.844^{b}
WBC ×10^{3}(µl)	8.63± 0.47^{b}	7.47± 0.27^{c}
PLT ×10^{3}(µl)	273.2±9.35^{a}	177.6±7.45^{b}
MCV (fl)	75.44±2.35^{ab}	81.18±1.91^{a}

MCH (pg)	24.45±2.23[b]	29.46±0.42[a]
MCHC (dl)	32.69± 0.45[a]	32.82±0.57 [a]

Values are expressed as means ± SE; n = 5 for each treatment group. Mean values within a row not sharing a common superscript letters (a, b) were significantly different, $p<0.05$.

In this study, was confirmed the treatment with $SnCL_2$ caused significant reductions in body weight (BW) and relative organs weight (ROW) (Table 1). The reduction in BW and ROW of the SnCl2 treated rabbits is in agreement with the finding of [16]**.** Relative organs weight (ROW) were reduced by $SnCl_2$ treatment. Similar results were obtained by Beynen et al**.,** Yu and Beynen and Omura et al. in rabbits[17,18,19]. Also, testicular degeneration was observed in rats receiving 10 mg of tin(II) chloride per kg in the feed for 12 weeks [20]**.**

The present study showed that SnC_{l2} caused decrease RBCS, Hb, PCV and PLT (Table 2) agreement with Beynen et al**,** who found that iron status (tissue iron, haemoglobin, hematocrit, red blood cell count, plasma iron, total iron binding capacity and transferrin saturation) in rabbits was not influenced by dietary tin concentrations < 100 mg Sn/kg diet as $SnCl_2$ for 28 days. Higher dietary intake of tin caused a decrease in these parameters [17]. Food intake and body weights were not reported. A study in waster rabbits fed on diets containing various concentrations of tin (1, 10, 50, 100 and 200 mg Sn/kg as $SnCl_2$) for 28 days showed that iron, copper and Zink tissue and plasma concentrations were seemingly unaffected at 1 mg and slightly decreased at 10 mg Sn/kg diet (~ 0.7 mg Sn/kg body weight/day). Greater effects were reprted at 50 mg/kg diet (~ 3.5 mg Sn/kg body weight/day). The blood haemoglobin concentration and percentage transferrin saturation decreased in a linear manner as the level of dietary Sn increased. Janssen *et al*. Investigated the effects of 0, 250 or 500 mg Sn/kg diet (as $SnCl_2$) in a 4-week study on weanling Wistar rabbits, Haemoglobin was decreased and body weights reduced in a dose-related way in the tin-fed groups. Crypt depth, villus length and cell turnover were increased in parts of the intestine. In week 4, the estimated doses of tin were about 25 and 50 mg Sn/kg body weight/day, respectively [13].

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