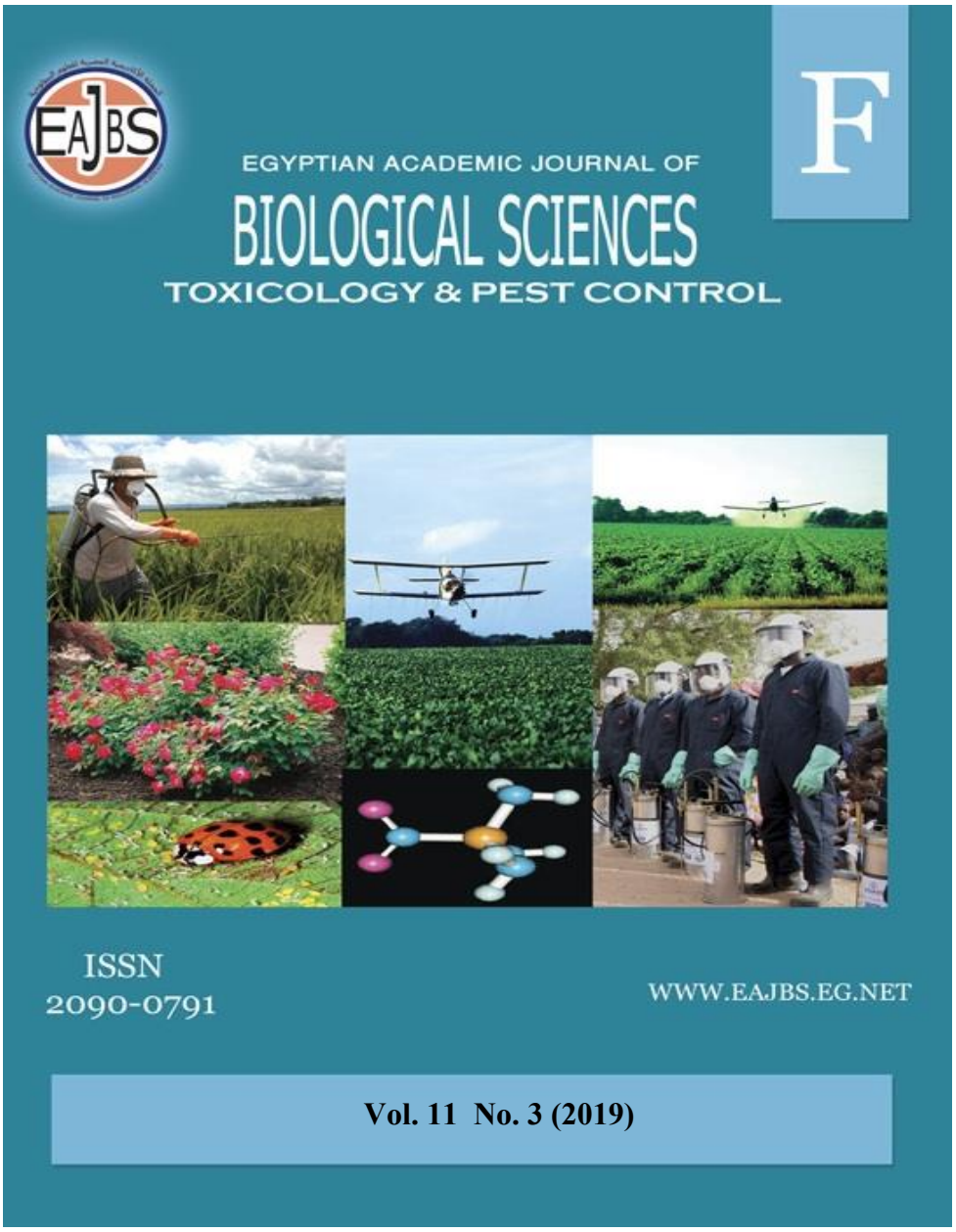


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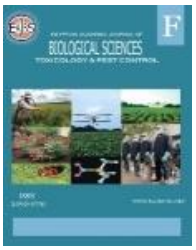

# Toxicological Aspects of Physiological and Biochemical Changes with Potassium Silicate and Silica Nano-Particles on Albino Rat

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## ABSTRACT

Naturally occurring micron-sized silica has gained enormous popularity as a physically active insecticide. Nano-sized silica [SiO2-NPs] has insecticidal property and would be needed in lesser quantity in comparison with conventional insecticides because of the huge surface to volume ratio of nanoparticles. Nano molecular has been widely used in consumer and industrial applications, such as medicine, cosmetics and foods because they exhibit unique physicochemical properties and innovative functions. However, nanomaterial can also be problematic in terms of eliciting a toxicological effect by their small size.

The present study was designed to examine the toxic effect of orally administered pesticide Sil-matrix 29 % (Potassium Silicate) and Silica nanoparticles ($SiO_2$-NPs) using male albino rats, at sublethal doses [2/5, 1/4 and 1/8 $LD_{50}$], relative to control on [body, organs weight such as liver, kidney, heart, spleen, and cytotoxic effect (such as total protein content levels as biochemical aspects)] for 28- and 45-days time exposure period.
Orally ingested of Sil-matrix 29 % and Silica nanoparticles ($SiO_2$-NPs) [2/5, 1/4 and 1/8 $LD_{50}$], was not associated with significant changes in the average gain of body weight, organs weight. On the other hand, total protein content value after ingestion with Sil-matrix and ($SiO_2$-NPs) for all doses and treatments time period were increased significantly in a pattern similar to control rats.

Our results suggested that the well-dispersed nano-silica cytotoxic effect and caused systemic exposure in mouse**,** and induced mutagenic activity**.** Our information indicated that further studies of the relation between physicochemical properties and biological responses are needed for the development and the safer form of nanomaterial (NMs).

## INTRODUCTION

Nanoparticles (NPs) are defined as material with a particle size less than 100 nm and one dimension. During particle synthesis, the physicochemical properties, such as shape, size and surface charge, can be adjusted easily Roduner E. (2006).

The characteristics of nanoparticles (NPs) provide many benefits, on the other hand, entail several risks. Thus, the toxicity of nanoparticles has been evaluated for the

risk assessment of nanoparticles species. As nanoparticles and viruses are of similar size Buzea C, *et al.,* (2007) it is likely that nanoparticles can overcome selected barriers of the body, such as skin, lung and get access to the body. The skin as the largest organ of the body with up to 10 % of the body mass is an important interface between the organism and nanoparticles regardless of their intended or unintended exposure Crosera M, *et al*., (2019). The penetration of nanoparticles through healthy skin has been discussed in recent years, depending on the type and size of the nanoparticles Labouta HI, and Schneider M. (2013).

Furthermore, the role of disturbed skin barrier on the penetration of nanoparticles remains to be elucidated, although some authors suggested that particle penetration might be favored Prow T. (2011). The widely spread use of nanoparticles in biomedical as well as commercial applications, *i.e.,* cosmetics or sunscreens, increases the risk of exposure of nanoparticles to healthy and diseased human skin. The inhalation of particles is in workplaces and the environment Donaldson K, and Seaton A. (2012). Due to their small size, nanoparticles may reach the deep respiratory tract in a considerable high percentage with up to 50 % of inhaled particles. Nanoparticles might cross epithelial cells to enter the systemic circulation Oberdorster G, *et al.,* (2005).

However, the interaction of nanoparticles (NPs) with cells of a living organism is a critical process; Nanoparticles should enter cells to execute their function in vivo. On the other hand, this cellular uptake raises concerns on potential risks, meaning toxic effects, of nanoparticles (NPs) applications. In light of the expected worldwide distribution of human health might be affected by inhalation, ingestion and/or dermal contact of nanomaterial Park EJ, *et al.,* (2018).

Several human diseases are known for a long time to be induced by nanoparticles, inducing lung fibrosis, lung cancer and mesothelioma (lung disease called silicosis) Donaldson K, and Seaton A. (2012).

Furthermore, an increased engineered nanoparticle for certain purposes into the environment can be assumed from their extensive use. Thus, the risk of human exposure to nanoparticles is more than likely. As a consequence, the discipline of nanotoxicology has emerged. The effects of mainly engineered (NP) exposure to living organisms are the main focus of this discipline.

## MATERIALS AND METHODS

### 1. Silica nanoparticles characterization:

Silicon dioxide nanoparticles ($SiO_2$-NPs), also known as silica nanoparticles or nanosilica, are the basis for a great deal of biomedical research due to their stability, low toxicity and ability to be functionalized with a range of molecules and polymers.

### 2. Sil-matrix:

Sil-matrix is a broad-spectrum preventative fungicide recommended for agricultural crops, fruits, nuts, vines, turf and ornamentals. Optimum disease control is obtained when the fungicide is applied on a regularly scheduled preventative spray program. Sil-matrix also provides control of mites, aphids, whiteflies and other insects. Optimum performance is achieved using a sufficient volume of water to ensure complete coverage of all stems and foliage.

• Active Ingredient: Potassium Silicate 29 %

• Ingestion: All symptoms of acute toxicity are due to high alkalinity. The material will cause irritation. Oral $LD_{50}$ (rat) > 5000 mg/kg bw.

• Inhalation: All symptoms of acute toxicity are due to high alkalinity. Mist is irritant to the respiratory tract. Inhalation $LC_{50}$ (rat) > 2.06 g/m³.

• Skin Contact: Repeated and/or prolonged skin contact may cause slight irritation. Dermal $LD_{50}$ (rat) > 5000 mg/kg bw.
• Eye Contact: Liquid or mist may cause discomfort and mild irritation.

**Methods of Sil-Matrix and Silica Nano-Particles Application:**

**1. Subchronic Toxicity:**

Health adult's male albino rats (35 animals) *Rattus norvigicus,* 120-150 gm., were obtained from the animal house of nutrition institute, and housed in laboratory animal center, The animal was kept under normal health laboratory conditions for two weeks in their cages prior to the experiment of acclimatization. Rats were housed individually in a room maintained at 20 $^0$C with a 12 hr. light/12 hr. dark cycle with good air under hygienic conditions. They were allowed free access to tap water and fed on a diet consisting of a mixture casein 20 %, cottonseed oil 10 % and cellulose 5% salts mixture 4**%** Schneeman Bo, Rice R, and Richter BD. (1989) vitamin mixture 1% Philip, GR, Forrest HN, and George CF (1993), and starch 30 % Lane-Pert W and Pearson AE. (1971). All experiments were performed in accordance with the "Guide for the Care and Use of Laboratory and approved by the local Ethics Committee.

**2. Nano-silica Particles Treatment:**

Rats were divided into 7 groups (5 rats for each), the first (1$^{st}$) group served as normal health control. The second (2$^{nd}$), third (3$^{rd}$) and fourth (4$^{th}$) groups were ingested orally with a sublethal dose of sil-matrix 29 % [2/5, 1/4 and 1/8 $LD_{50}$]. The fifth (5$^{th}$), sixth (6$^{th}$) and seventh (7$^{th}$) groups were ingested orally with $SiO_2$-nanoparticles [2/5, 1/4 and 1/8 $LD_{50}$] for 28 and 45 days respectively. Sil-matrix and nano-silica formulation or technical doses were mixed with 0.5 ml corn oil. One dose was induced every two days during the experimental period. Food and water were supplied ad *Libitium* for all groups during the experimental period. Each rat was weighed every week and its daily food intake was determined. Feed efficiency was calculated as the following equation (body weight gain/food intake).

Estimation of body weight gain and internal organ to body weight ratio. Vital organs were removed after dissecting each rat through a central incision on the abdomen. The Liver, kidney, heart and spleen were removed and weighed immediately and their weight was recorded.

**3. Blood Collection and Organ/Body Weight Ratio:**

Each rat was weighed before and after treatment. Bodyweight changes in male rats were recorded weekly during the experiment period. Blood was collected from all animals under ether anesthesia by puncturing the retro-orbital Venus plexus of the animals with a fine sterilized glass capillary. Within 30 min of blood collection, sera or plasma were isolated by centrifugation at 3500 rpm for 10 min at 4 $^0$C. At the end of the experiment, animals were killed by decapitation after 24 hr. from the last treatment. The following tissues were investigated [liver, kidney, heart and spleen]. They were removed after dissecting each rat through a central incision on the abdomen and weight immediately. Then they froze in the freezer until analysis. Tissue samples were homogenized in a saline solution (0.9 NaCl). The homogenate was collected and then centrifuged at 3000 rpm at 0 $^0$C; this method is according to the method of Bergmeyer UH. (1974). The organs/body weight ratio was calculated, using the following formula: Relative weight (%) = [organs weight (g)/body weight (g)] x 100.

**4. Statistical Analysis:**

All data recorded through the present studies were analyzed using the General Linear Model procedures (GLM) of the statistical analysis system SAS Users Guide (1982).The significance of the differences among treatment groups was tested using

Waller-Duncan k-ratio Waller RA, and Duncan DB. (1969). All statements of significance were based on a probability of $P > 0.05$.

## RESULTS AND DISCUSSION

### 1. Physiological Studies:

### 1.1. Effect on Body Weight and Feed Efficiency:

#### 1.1.1. Animal Body Weight:

Rat weights were taken before and after the experiment to know the effect of ingested formulations on rat weight through its effect on rat feeding habits. The effect on body weight could be determined thought comparing the weights of the treated groups and the control group. Bodyweight in treated animals recorded over a period of 28 and 45 days is shown in Table (1) and Figure (1). During the observation period, the bodyweight of the rats, ingestion with Sil-matrix 29 % and ($SiO_2$-NPs) at doses of [2/5, 1/4 and 1/8 $LD_{50}$] either over a period of 28 and 45 days increased significantly in a pattern similar to control rats. This data indicating that the rats continued to mature without any significant toxic effects.

**Table 1:** Effect of sil-matrix and silica nano-particles on body weight gain and feed efficiency of male albino rats**.**

| Treatment | Dose: $LD_{50}$ | Treatment Period 28 days | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Body Weight (g) | | | | Food Intake (g) | Feed Efficiency (FE) | | |
| | | Initial body weight (g) | Final body weight | Body weight gain | Gain % to normal control | | Value | 100 (FE) | Feed efficiency % to normal control |
| Control | | 134 ± 12 | 182 ± 29 | 48 ± 23 | 100.0 | 426 ± 10 | 0.11 ± 04 | 11.0 | 100.0 |
| Sil-matrix 25% | 2/5 | 139 ± 47 | 175 ± 17 | 36 ± 83 | 75.05 | 439 ± 44 | 0.08 ± 01 | 08.0 | 80.00 |
| | 1/4 | 128 ± 12 | 178 ± 21 | 50 ± 17 | 104.16 | 431 ± 28 | 0.11 ± 07 | 11.0 | 100.0 |
| | 1/8 | 140 ± 33 | 183 ± 11 | 43 ± 39 | 89.58 | 420 ± 10 | 0.10 ± 03 | 10.0 | 90.90 |
| $SiO_2$-NPs | 2/5 | 139 ± 23 | 179 ± 71 | 40 ± 15 | 83.33 | 418 ± 15 | 0.09 ± 01 | 9.0 | 81.00 |
| | 1/4 | 137 ± 15 | 181 ± 27 | 44 ± 09 | 91.66 | 421 ± 11 | 0.10 ± 05 | 10.0 | 90.00 |
| | 1/8 | 141 | 185 | 44 | 91.66 | 435 | 0.10 | 10.0 | 90.90 |

| treatment | Dose: $LD_{50}$ | Treatment time Period 45 days | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Body Weight (g) | | | | Food Intake (g) | Feed Efficiency (FE) | | |
| | | Initial body weight (g) | Final body weight | Body weight gain | Gain % to normal control | | Value | 100 (FE) | Feed efficiency % to normal control |
| Control | | 140 ± 15 | 198 ± 15 | 58 ± 15 | 100.0 | 635 ± 50 | 0.09 ± 03 | 9.0 | 100.0 |
| Silmatrix 25% | 2/5 | 135 ± 26 | 181 ± 19 | 46 ± 20 | 79.11 | 614 ± 39 | 0.07 ± 06 | 7.0 | 77.00 |
| | 1/4 | 138 ± 29 | 189 ± 18 | 51 ± 06 | 87.13 | 622 ± 65 | 0.08 ± 01 | 8.0 | 88.00 |
| | 1/8 | 128 ± 17 | 191 ± 09 | 63 ± 11 | 1.08 | 629 ± 12 | 0.10 ± 03 | 10.0 | 111.0 |
| $SiO_2$-NPs | 2/5 | 141 ± 15 | 185 ± 27 | 44 ± 18 | 0.75 | 623 ± 38 | 0.07 ± 01 | 7.0 | 77.00 |
| | 1/4 | 136 ± 11 | 193 ± 15 | 57 ± 12 | 0.98 | 615 ± 22 | 0.09 ± 05 | 9.0 | 100.0 |
| | 1/8 | 139 ± 23 | 201 ± 14 | 62 ± 27 | 1.06 | 641± 16 | 0.09 ± 02 | 9.0 | 100.0 |

(%) Relative to control. Each value represented the mean of 6 rats (mean ± SD). Means in the same column followed by the same letter are not significantly different at $P > 0.05$.

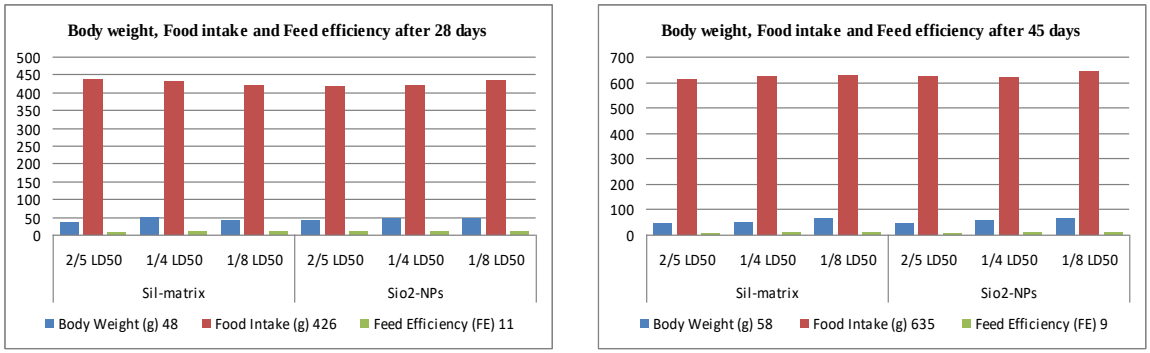


**Fig. 1:** Effect of sil-matrix and silica nano-particles on body weight gain and feed efficiency of male albino rats.

### 1.1.2. Effect on organs weight :

Organs and body weight ratio of rats ingested Sil-matrix 29 % and ($SiO_2$-NPs) are shown in Table (2) and Figure (2). The average liver weight ratio was increased by the ingestion of the studied materials with all doses [2/5, 1/4 and 1/8 $LD_{50}$] relative to control. These were significant changes in the liver weight were ranged between 112-126 % relative to control.The data indicated no significant increase in kidney weight between all doses. The kidney weight value of control was 2.009 gm. while its ratio was 0.65 gm./100 gm. body weight. The average ratio percentage of the group were ranged between 96% and 154 % relative to control, the lowest effect was observed under the influences of 1/8 $LD_{50}$, but the highest effect was found by using 2/5 $LD_{50}$ for $SiO_2$-NPs. Relative Sil-matrix 29 % and control.

The control value of heart weight was 1.03 gm and its ratio was 0.23 gm./100 gm. body weight, but under the effects of ($SiO_2$-NPs) the heart ratio ranged between 98-112 % for 1/4 $LD_{50}$, 108-128 % for 2/5 $LD_{50}$ relative to control.

The control average value of spleen weight was 1.15 gm which had a ratio of 0.39 gm./100 gm. body weight. The influences of ($SiO_2$-NPs) at doses of 2/5 and 1/8 $LD_{50}$ produced spleen ratio ranged between 97- 118 %, 84-103 % respectively relative to control ratio.

The results are in agreement with those stated by Abd-Ellah G H. (1987), Abdel-Rahim G A. (2007), Abdel-Rahim GA. (2008), they reported some marked increase in the weight of the liver, kidney, heart and spleen in intoxicated animals with pesticides. The increase in the liver and organs weight ratio under the same condition may be due to the enlargement effect on treated animals Gomes J, *et al.*, (1999), Banerjee, BD, *et al.*, (2016).

In general, the detected elevation in the organ's weight or ratio may be due to necrosis and apoptosis and could be attributed to the accumulation of lipids in the organs. The dosage necessary to cause the conditions in animals far exceeded the maximally tolerated dosages in humans.

**Table 2:** Effect of sil-matrix and silica nano-particles on organs weight of male albino rats.

| Treatments | Doses LD 50 | Treatment time Period 28 days | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Body weight (g) | Liver | | | Kidney | | | Heart | | | Spleen | | |
| | | | Weight (g) | % ratio | % | Weight (g) | % ratio | % | Weight (g) | % ratio | % | Weight (g) | % ratio | % |
| Con. | | 134.00±17 | 3.20±09 | 2.4 | 100 | 0.31±09 | 0.23 | 100 | 0.19±10 | 0.14 | 100 | 0.22±07 | 0.16 | 100 |
| Silmatrix 25 % | 2/5 | 139.10±15 | 2.78±08 | 2.0 | 83 | 0.24±01 | 0.17 | 74 | 0.15±04 | 0.11 | 79 | 0.13±01 | 0.09 | 56 |
| | 1/4 | 128.10±23 | 2.89±11 | 2.2 | 91 | 0.27±06 | 0.21 | 87 | 0.16±02 | 0.12 | 85 | 0.11±08 | 0.11 | 68 |
| | 1/8 | 140.15±26 | 3.01±02 | 2.2 | 91 | 0.28±11 | 0.20 | 91 | 0.16±09 | 0.12 | 85 | 0.18±03 | 0.12 | 75 |
| $SIO_2$-NPs | 2/5 | 139.02±14 | 2.87±09 | 2.1 | 87 | 0.28±08 | 0.20 | 87 | 0.15±07 | 0.11 | 79 | 0.16±09 | 0.11 | 56 |
| | 1/4 | 137.83±18 | 2.98±03 | 2.2 | 91 | 0.29±05 | 0.21 | 88 | 0.18±11 | 0.13 | 85 | 0.21± 08 | 0.15 | 93 |
| | 1/8 | 141.19±23 | 3.10±05 | 2.2 | 91 | 0.29±04 | 0.20 | 88 | 0.13±05 | 0.13 | 85 | 0.22±07 | 0.15 | 93 |

| Tratments | Doses LD 50 | Treatment Period 45 days | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Body weight (g) | Liver | | | Kidney | | | Heart | | | Spleen | | |
| | | | Weight (g) | % ratio | % | Weight (g) | % ratio | % | Weight (g) | % ratio | % | Weight (g) | % ratio | % |
| | | 140.15±19 | 3.84± 0.3 | 2.8 | 100 | 0.52±04 | 0.38 | 100 | 0.26 ±11 | 0.19 | 100 | 0.29 ±08 | 0.21 | 100 |
| Silmatrix 25% | 2/5 | 135.26±73 | 3.06 ± 12 | 2.2 | 78 | 0.43 ±09 | 0.31 | 81 | 0.17 ±10 | 0.12 | 63 | 0.19 ±09 | 0.14 | 67 |
| | ¼ | 128.03±53 | 3.50 ±19 | 2.5 | 89 | 0.46 ± 05 | 0.33 | 86 | 0.18 ±11 | 0.13 | 68 | 0.24 ±08 | 0.17 | 89 |
| | 1/8 | 138.35±56 | 3.55±15 | 2.7 | 96 | .047±0.3 | 0.34 | 89 | 0.18±10 | 0.13 | 68 | 0.26±11 | 0.18 | 85 |
| $SIO_2$-NPs | 2/5 | 141.21±12 | 5.29±06 | 2.3 | 82 | 0.45±09 | 0.31 | 81 | 0.21±12 | 0.14 | 73 | 0.21±10 | 0.14 | 66 |
| | 1/4 | 136.11±18 | 3.61±11 | 2.6 | 92 | 0.47±11 | 0.34 | 89 | 0.23±0.8 | 0.17 | 89 | 0.22±05 | 0.16 | 76 |
| | 1/8 | 139.68±26 | 3.59±08 | 2.6 | 92 | 0.47±10 | 0.34 | 89 | 0.24±0.2 | 0.17 | 89 | 0.25±02 | 0.17 | 80 |

(%) Relative to control. Each value represented the mean of 6 rats (mean ± SD). Means in the same column followed by the same letter are not significantly different at P > 0.05.

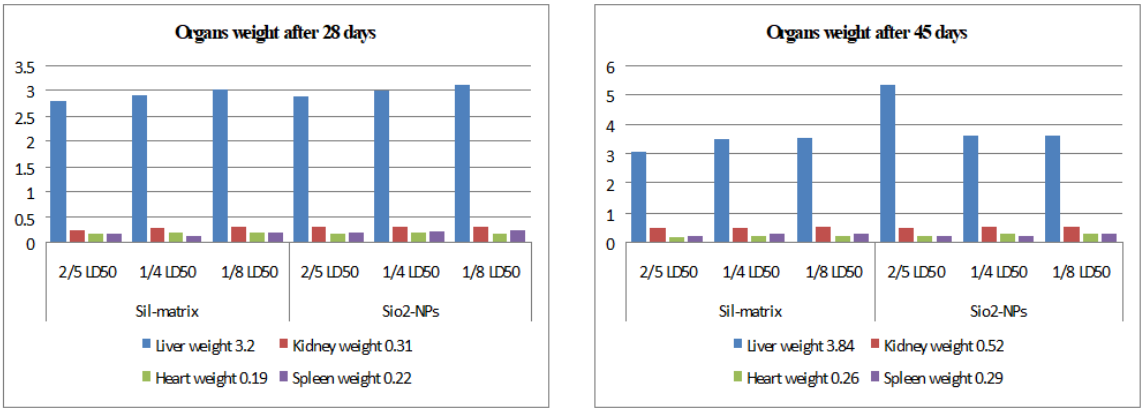


**Fig. 2:** Effect of sil-matrix and silica nano-particles on organs weight of male albino rats.

### 1.1.3. Food Intake:

The values of the food intake of rats treated with the nano-silica are shown in Table (1) and Figure (1). Food intake significantly unchanged by the ingestion with all tested

three doses and experiment period relative or compared to control. Results reported that oral ingestion of tested material at dose 1/8 revealed lower feed efficiency decrease than 2/5 $LD_{50}$ with all period time.

The average feed efficiency ratio of [2/5, 1/4 and 1/8 $LD_{50}$] nano-silica for 28 days influence wee ranged between 13-19 %, 11-18 %, and 9-17 % respectively, on the other hand, the average feed efficiency ratio of 1/20 1/40 and 1/60 $LD_{50}$ nano-silica for 28 days influence wee ranged between 15-21, 12.20 % and 11-18 % respectively.

The low feed efficiency ratio may be due to the toxic effects of tested material and their adjuvant which in turn alter the rate of whole-body metabolism.

The present data are in disagreement with those of Abdel-Rahim G A. (2007), who reported that gain in body weight and feed efficiency, were reduced by pesticide exposure; on the other hand, 60 days treatment had more effect than 28 days treatment. In connection, feed efficiency was changed paralleled with changed values of gain in body weight. The more toxic 2/5 $LD_{50}$ than 1/8 $LD_{50}$ may be due to the adjuvant of 2/5 $LD_{50}$ was more toxic than those of 1/4 and 1/8 $LD_{50}$. So the toxicity effect on body weight gain was dose-dependent on the tested materials doses.

These are in agreement with the results of Kobeasy M I, *et al.,* (2009) found that the toxic influences of pesticides were elevated with increasing doses. The final body weight of treated rats with nano-slica was significantly lower than those of the control.

The severe effect was found in the rats ingested with 2/5 $LD_{50}$ ($SiO_2$-NPs) relative to control. The amount of food intake of the treatment period 28 days were about unchanged significantly. This means that the values of food intake were paralleled to the rate of growth and feed efficiency. Also, feed efficiency was decreased insignificantly under the effect of ($SiO_2$-NPs) with doses dependent.

This means that gain in body weight and feed efficiency were relative to control under treatment by ingestion of [2/5, 1/4 and 1/8 $LD_{50}$] of $SiO_2$-NPs relative to the healthy normal control. The obtained results in body weight gain may be the toxic ions could be associated with several factors that produced imbalance metabolism and by impairing zinc status in zinc-dependent enzymes which are necessary for many metabolic processes Zhang, FQ, *et al.,* (2017).

**2. Biochemical Aspects (changes of total protein content levels):**

Total protein content was observed in the plasma, liver, kidney, heart and spleen in the cases of administration tested materials as shown in Table (3) and Figure (3).

**2.1. Total Protein in Plasma:**

The effects of ($SiO_2$-NPs) on plasma total protein after 28, and 45 days at the three tested concentrations compared to the control were no statistically significant. Results confirmed insignificant differences in the plasma total protein of the three other concentrations at either 28 or 45 days. Total protein values in plasma at the concentration of 2/5 $LD_{50}$ were 93 and 144 % after 28 and 45 days compared to control, respectively. The corresponding values were 134 and 137 % at the same concentration and period treatment respectively. There were no significant differences in rat plasma total protein for the rest of the considered treatments at the different tested concentrations and time periods.

**2.2. Total Protein in The Liver:**

Results indicated significant differences between at both 2/5 and 1/8 $LD_{50}$ concentrations after 45 days. On the other hand, there were no significant differences between 2/5 and 1/8 $LD_{50}$ on rat liver for 28 days. Total protein values in the liver at the concentration of 1/20 $LD_{50}$ were 68 and 76 % after 28 and 45 days respectively compared to control. Tested materials produced significant effects on total protein in the liver after45 days of treatment at the different tested concentrations compared to the control.

### 2.3. Total Protein in The Kidney:

($SiO_2$-NPs) caused significant effects on kidneys after 45 days of treatments at all different tested concentrations compared to the control. Statistically significant differences in the effects on the kidney albino rat at both 2/5, 1/8 $LD_{50}$ after 45 days. On the other hand, no significant effects were observed between the effects of ($SiO_2$-NPs) on male rat kidney protein with 1/8 $LD_{50}$ dose for all time periods. As the general observation, there were no significant decreases in the total protein content in the kidneys for all concentration treatments compared to control treatments.

### 2.4. Total protein in heart:

(SiO2-NPs) showed no significant effects on the heart after 28 and 45 days of treatments considered at all different concentrations compared to the control. However, there were certain slight differences between the doses at 2/5 and 1/4 $LD_{50}$ after 45 days respectively. Meanwhile, there were no statistically significant effects between 1/40 and1/60 doses on heart total protein after 45 days of treatment. Total protein values in the heart at the concentration of 2/5 $LD_{50}$ were 120 and 93 % after 28 and 45 days, respectively compared to control. The corresponding values were 150 and 119 % at the same concentration after 28 and 45 days, respectively compared to control. As the general observation, there were no significant decreases in the total protein content in the heart for all concentration treatments compared to control treatments.

**Table 3:** Effect of sil-matrix and nano-silica particles on total protein content level of male albino rats.

| Treatments | Doses $LD_{50}$ | Time period | Plasma | | Liver | | Kidney | | Heart | | Spleen | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Plasma g/dl | alternation | liver g/g | alternation | kidney g/g | alternation | heart g/g | alternation | spleen g/g | alternation |
| Con | | 28 D | 8.92±0.02 | 100 | 0.86±0.01 | 100 | 0.89±0.05 | 100 | 0.88±0.07 | 100 | 0.84±0.02 | 100 |
| | | 45 D | 8.84±0.08 | 99 | 0.89±0.02 | 103 | 0.85±0.02 | 95 | 0.86±0.06 | 97 | 0.87±0.01 | 103 |
| Silmatrix 25% | 2/5 | 28 D | 8.14±0.01 | 91 | 0.83±0.06 | 96 | 0.81±0.04 | 91 | 0.81±0.08 | 92 | 0.76±0.05 | 90 |
| | | 45 D | 8.02±0.05 | 90 | 0.81±0.08 | 94 | 0.73±0.05 | 82 | 0.72±0.01 | 81 | 0.72±0.03 | 85 |
| | ¼ | 28 D | 8.51±0.02 | 95 | 0.84±0.03 | 97 | 0.82±0.01 | 92 | 0.83±0.02 | 94 | 0.79±0.02 | 94 |
| | | 45 D | 8.23±0.09 | 92 | 0.82±0.07 | 95 | 0.74±0.02 | 83 | 0.80±0.07 | 90 | 0.75±0.04 | 89 |
| | 1/8 | 28 D | 8.61±0.03 | 96 | 0.85±0.01 | 98 | 0.83±0.06 | 93 | 0.84±0.02 | 95 | 0.77±0.08 | 91 |
| | | 45 D | 8.36±0.04 | 94 | 0.82±0.09 | 95 | 0.78±0.07 | 87 | 0.81±0.03 | 92 | 0.79±0.02 | 94 |
| $SIO_2$-NPs | 2/5 | 28 D | 8.19±0.07 | 91 | 0.78±0.02 | 90 | 0.71±0.03 | 79 | 0.72±0.05 | 81 | 0.67±0.04 | 79 |
| | | 45 D | 7.84±0.01 | 87 | 0.74±0.04 | 86 | 0.68±0.03 | 76 | 0.67±0.02 | 76 | 0.62±0.01 | 73 |
| | ¼ | 28 D | 8.15±0.08 | 91 | 0.83±0.08 | 96 | 0.75±0.04 | 84 | 0.76±0.01 | 86 | 0.75±0.02 | 89 |
| | | 45 D | 7.94±0.05 | 89 | 0.76±0.01 | 88 | 0.70±0.05 | 78 | 0.79±0.03 | 89 | 0.77±0.09 | 91 |
| | 1/8 | 28 D | 8.37±0.03 | 93 | 0.82±0.03 | 95 | 0.82±0.08 | 92 | 0.82±0.04 | 93 | 0.79±0.02 | 94 |
| | | 45 D | 8.06±0.06 | 90 | 0.79±0.02 | 91 | 0.76±0.09 | 85 | 0.80±0.05 | 90 | 0.82±0.03 | 97 |

Values are means ± standard error for five replicates.

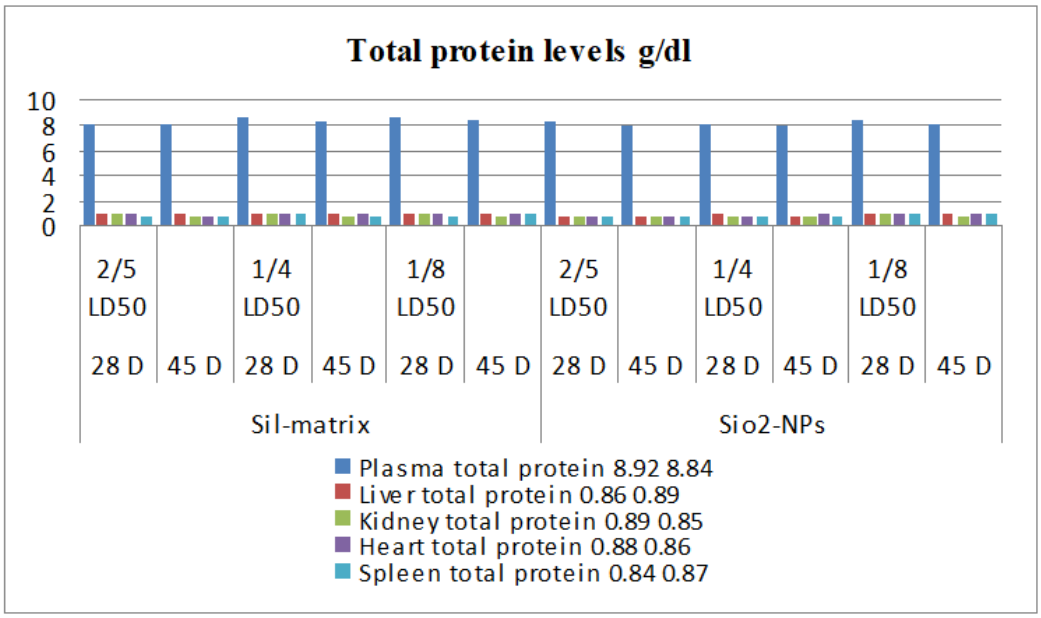


**Fig. 3:** Effect of sil-matrix and nano-silica particles on total protein content level of male albino rats.

## CONCLUSION

Previous results emphasize that ($SiO_2$-NPs) caused a pronounced decreased in the protein content compared to control. Results suggest that such differences between the two tested periods might be attributed to the differences in time. The decrease in the total soluble protein values in the plasma of the traded animals may be due to the inhibition of the protein biosynthesis through specific enzymes in cell processes and significant low excretion was decreased in the rat exposed to ($SiO_2$-NPs).

Generally speaking, there were significant differences in total proteins between all treatment concentration doses and time period. This increase in total protein caused by ($SiO_2$-NPs) may be due to the damage in cells followed by ($SiO_2$-NPs) treatment. This finding is in accordance with Vohra P, and Khera K S. (2015) they reported that the remarkable increase of proteins in the kidney might be due to the destruction of tissues, which causes a subsequent release of protein.

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## ARABIC SUMMARY

### الجوانب السمية للتغيرات الفسيولوجية والكيميائية الحيوية لسيليكات البوتاسيوم وجزيئات السيليكا النانوية على الفئران البيضاء

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تعتبر السيليكا الموجودة بشكل طبيعي لها خاصية كبيرة كمبيد حشري نشط. كما أن السيليكا النانوية الحجم [$SiO_2$-$NP_s$] لها أيضا خاصية المبيدات الحشرية وستكون مطلوبة بكميات أقل مقارنة بالمبيدات الحشرية التقليدية بسبب حجم السطح الضخم للجسيمات النانوية. تم أستخدام جزيئات النانو على نطاق واسع في التطبيقات الإستهلاكية والصناعية، مثل الأدوية ومستحضرات التجميل والأطعمة، لأنها تتميز بخصائص فيزيائية كيميائية فريدة ووظائف مبتكرة.

صممت الدراسة الحالية لفحص التأثير السام لمبيدات الآفات التي يتم تناولها عن طريق الفم Sil-matrix 29٪ (سيليكات البوتاسيوم) وجزيئات السيليكا النانوية ($SiO_2$-$NP_s$) وذلك على ذكور الفئران البيضاء بجرعات شبه مميتة [$LD_{50}$ 8/1 - 4/1 - 5/2] ، وتم دراسة التأثير على (وزن الجسم - وزن الأعضاء مثل الكبد والكلى والقلب والطحال - والتأثير السام للخلايا ومنها مستويات محتوى البروتين الكلي) لمدة 28 و 45 يومًا فترة التعرض. وأظهرت النتائج أن تناول مادة Sil-matrix 29٪ وجسيمات السيليكا النانوية ($SiO_2$-$NP_s$) عن طريق الفم [$LD_{50}$ 8/1 - 4/1 - 5/2] أدت الى تغيرات مهمة في متوسط زيادة وزن الجسم ووزن الأعضاء. من ناحية أخرى تم زيادة قيمة محتوى البروتين الكلي بعد تناول Sil-matrix و ($SiO_2$-$NP_s$) لجميع الجرعات وفترة العلاج.