IJPSR (2019), Volume 10, Issue 12 **(Research Article)**

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 14 March 2019; received in revised form, 17 June 2019; accepted, 17 July 2019; published 01 December 2019

ALTERATIONS IN LIPID PROFILE PARAMETERS OF ALBINO RAT AFTER INTOXICATION OF MERCURY SELENIDE NANOPARTICLES

Kulbhushan Kumar * and Prabhu Narayan Saxena

Department of Zoology, Toxicology Lab, School of Life Sciences, Khandari Campus, Dr. B. R. Ambedkar University, Agra - 282005, Uttar Pradesh, India.

Keywords:

Acute, Sub-acute, Cardiac risk, Oxidative stress

Correspondence to Author:
Kulbhushan Kumar

Department of Zoology, Toxicology Lab, School of Life Sciences, Khandari Campus, Dr. B. R. Ambedkar University, Agra - 282005, Uttar Pradesh, India.

E-mail: Kulbhushankumar01041990@gmail.com

ABSTRACT: Nanoparticles are of great scientific interest, in fact, a bridge between bulk materials and atomic or molecular structures. The main characteristic of nanoparticles is their extreme smaller size, which falls in the transitional zone between molecules and the corresponding bulk materials. Lipids and fatty acids are a family of molecules classified within the lipid macronutrient class. The present study is based on the changes in lipid profile parameters due to Hg-Se NPs. Both mercury and selenium have a binding affinity for each other. Mercury is comparatively toxic than selenium; hence in combination, selenium works antagonistically to mercury. Acute and sub-acute treatments of mercury selenide nanoparticles (Hg-Se NPs) reflect changes in lipid profile in female Albino rats, which may be considered in cardiac risk assessment and its follow up program. The level of cholesterol, triglycerides (TG) and lipoprotein were found to be reduced after acute (1 day) and sub-acute (7, 14, and 21 days) treatments. The reduction in cholesterol and triglycerides revealed quick penetrating power of Hg-Se NPs whereas decrement in high-density lipoproteins has been assessed as an outcome of oxidative stress in the form of hydrogen peroxide, oxide anion, and nitrogen ions.

INTRODUCTION: Nanoparticles are those material particles whose size ranges from 1-100nm. The environment is consistently receiving nanoparticles either by natural or anthropogenic activities [1, 2]. Today, nanoparticles due to their new properties, such as large surface area and high reactivity, have largely been considered [3]. Nanoparticles present possible dangers, both medically and environmentally [4, 5]. NPs have a high penetration power and can pass through cell membranes of cells. NPs are too tiny but cannot be ignored.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.10(12).5404-09

The article can be accessed online on www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.10(12).5404-09

Recent advances in nanotechnology have drawn our attention towards their impact on environment [6, 7]. The study aims to discuss the environmental and societal impacts of these nanomaterials. The biological impacts of nanoparticles and their biokinetics are dependent on size, chemical composition, surface structure, solubility, and shape of aggregation [8].

These parameters can modify cellular uptake, protein binding, translocation from the portal of entry to the target site, and the possibility of causing tissue injury. Nanoparticles are of great scientific interest as they are in fact, a bridge between bulky materials and atomic or molecular structures [9]. A decrease in particle size can lead to an increase in the number of structural defects, as well as disruption of the well-structured electronic configuration of a material, which could establish

specific surface groups that function as reactive sites [10, 11]. Thus, the toxicity of NPs is at least partly related to the surface reactivity of the particle, which may also be relevant to health effects [12]. Also, many of the NPs that are synthesized today are metallic such as nanosilver or nano copper which under certain conditions release metal ions [13]. Both mercury and selenium have a binding affinity for each other. Mercury is comparatively toxic than selenium, hence in combination, selenium works antagonistically to mercury.

The present study is carried out on female Wister rat. Lipid profile is used as part of a cardiac risk assessment [14]. The aim of studying lipid profile is considered along with other known risk factors of heart disease to develop a plan of treatment and follow up. A lipid profile may also be ordered at regular intervals to evaluate the success of lipid-lowering lifestyle changes to determine the effectiveness of drug therapy [15]. Acute and sub-acute treatment schedules have thus been planned to explore the effects of Hg-Se nanoparticles on different components of lipid profile in the present investigation.

MATERIALS AND METHODS:

Synthesis of Hg-Se Nanoparticles: Synthesis of HgSe NPs was done by a sonochemical method involving ultrasonic radiations. The chemical reaction that gets created instantaneously at very high temperature and pressure developed in and around the collapsing bubble. The conditions formed in the hotspots have been experimentally determined, with a transient temperature of ~5000K, the pressure of 1800 atmosphere and cooling rates over 1010K/S after Suslick *et al.*, 1999. Hg-Se NPs are characterized by high electron mobility, large electron concentration and variation band gap posses a unique combination of properties. The study of morphology and size distribution of Hg-Se nanoparticles was carried out by Transmission Electron Microscope, **Fig. 1**.

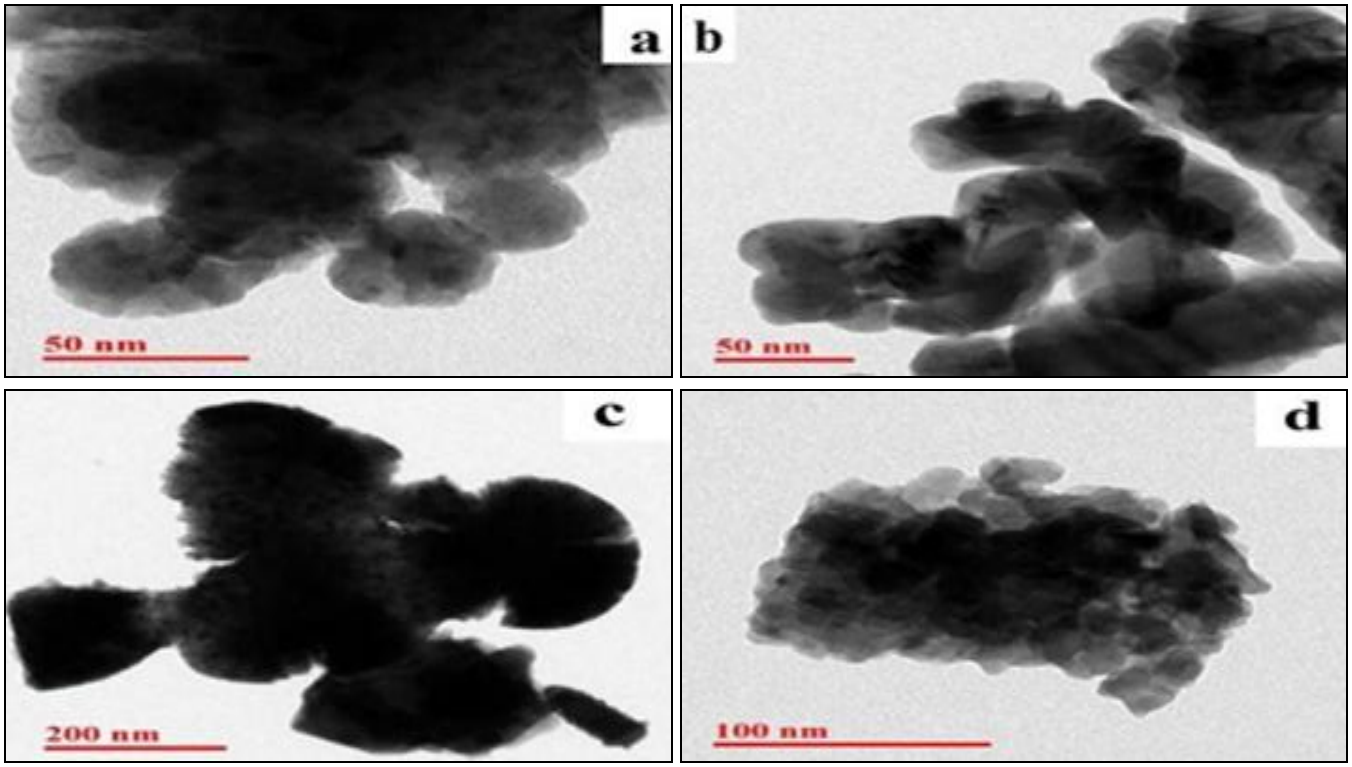

FIG. 1: TEM IMAGES OF Hg-Se NPs (a-d)

Selection of Dose: Randomly selected female Wister albino rat from the inbred colony of almost equal size and weight were kept at a temperature of 25 ± 5 ºC and relative humidity 80 ± 5%. The dose of Hg-Se nanoparticles was prepared by dissolving 10 mg of Hg-Se nanoparticles in 10 ml of de-ionized for an acute group. For sub-acute group, 1 ml from the above prepared solution was divided into 7 (1/7 = 0.14mg), 14(1/14 = 0.07 mg) and 21(1/21= 0.04 mg) days accordingly. 0.14 mg, 0.07 mg and 0.04 mg of Hg-Se nanoparticles solution was then dissolved in 9.86 ml, 9.93 ml and 9.96 ml

of de-ionized water. The dose was given to each animal by 1 mg/kg body weight vide infra.

TABLE 1: SELECTION OF DOSE

Treatment Type	Treatment Days	Dose mg/kg b.w.	Dose in ppm
Acute	1	1	1000
Sub-acute	7	0.14	140
	14	0.07	70
	21	0.04	40

Experimental Design: Lipid profile was estimated under the stress of Hg-Se NPs. The animals were divided into four experimental groups, one acute (1 day) and three sub-acute (7, 14, and 21 days).

Acute Treatment (1 Day): Three rats were placed in the acute group and were provided 1 mg/kg body weight Hg-Se nanoparticles by gauge tube.

Sub-Acute Treatment (7 Days, 14 Days, and 21 Days): The sub-acute treatment was divided into three groups 7, 14, and 21 days.

Control: The controls were run with acute and sub-acute sets with 3 rats in each and were provided de-ionized distilled water *ad libitum* as per the body weight.

Collection of Blood Samples: The rats were etherized, and an autopsy was done at the appropriate time intervals of experimental rats. The blood was collected individually in test tubes by cardiac puncture through hypodermic needles and was centrifuged. Serum samples were then collected into the plain vial to be used for serum lipid analyzing using the automatic analyzer. The data were analyzed statistically after Fischer and Yates (1950).

RESULTS:

Effect of Hg-Se NPs on Cholesterol After:

Acute: Cholesterol level ranges from 40-60 mg/dL and 89-119 mg/dL with an average of 51 ± 5.86 and 100.66 ± 9.28 in treated and control sets, respectively. A significant ($P<0.05$) decrease in cholesterol level has been observed.

Sub-Acute After:

7 Days: Cholesterol level ranges from 47-51mg/dL and 89-119 mg/dL with an average of 48.66 ± 1.20 and 100.66 ± 9.28 in treated and control sets, respectively. A non-significant ($P<0.001$) decrease in cholesterol level has been observed.

14 Days: Cholesterol level ranges from 50-66 mg/dL and 89-119 mg/dL with an average of 57.66 ± 4.63 and 100.66 ± 9.28 in treated and control sets, respectively. A significant ($P<0.02$) decrease in cholesterol has been observed.

21 Days: Cholesterol level ranges from 51-58 mg/dL and 89-119 mg/dL with an average of 55.33 ± 2.18 and 100.66 ± 9.28 in treated and control sets, respectively. Highly significant ($P<0.001$) decrease has been observed in cholesterol.

Effect of Hg-Se NPs on Triglycerides After:

Acute: Triglycerides level ranges from 41-62 mg/dL and 105-157 mg/dL with an average of 54.66 ± 6.84 and 132 ± 15.05 in treated and control sets, respectively. Highly significant ($P<0.01$) decrease has been observed in triglycerides.

Sub-Acute After:

7 Days: Triglycerides level ranges from 56-101 mg/dL and 105-157 mg/dL with an average of 80 ± 130.8 and 132 ± 15.05 in treated and control sets, respectively. A non-significant ($P>0.05$) decrease in the level of triglycerides has been observed.

14 Days: Triglycerides level rages from 46-56 mg/dL and 105-157 mg/dL with an average of 52.3 ± 3.17 and 132 ± 15.05 in treated and control sets, respectively. Highly significant ($P<0.001$) decrease has been observed.

21 Days: Triglycerides level ranges from 66-84 mg/dL and 105-157 mg/dL with an average of 74.66 ± 5.20 and 132 ± 15.05 in treated and control sets, respectively. A significant ($P<0.05$) decrease in triglycerides has been observed.

Effect of Hg-Se NPs on HDL After:

Acute: HDL level ranges from 276-39.4 mg/dL and 40.6-55 mg/dL with an average of 34.86 ± 3.67 and 46.16 ± 4.46 in treated and control sets, respectively. A non- significant ($P>0.05$) decrease in HDL has been observed.

Sub-Acute After:

7 Days: HDL level ranges from 21.5-35.4 mg/dL and 40.6-55 mg/dL with an average of 27.63 ± 4.09 and 46.16 ± 4.46 in treated and control sets, respectively. A significant ($P<0.05$) decrease in HDL has been observed.

14 Days: HDL level ranges from 28.9-38.3 mg/dL and 40.6-55 mg/dL with an average of 33.53 ± 2.71 and 46.16 ± 4.46 in treated and control sets, respectively. A significant (P<0.05) decrease in HDL has been observed.

21 Days: HDL level ranges from 30.4-34.9 gm/dL and 40.6-55 mg/dL with an average of 32.06 ± 1.42 and 46.16 ± 4.46 respectively. A significant (P<0.05) decrease in HDL has been observed.

TABLE 2: CHOLESTEROL LEVEL IN ALBINO RAT AFTER Hg-Se TREATMENT FOR ACUTE (1 DAY) AND SUB-ACUTE (7, 14 AND 21 DAYS) DURATION

Experimental Sets	Treatment Duration (Days)	No. of Rats	Control		Hg-Se Treated		Significance Level
			Range	Mean ± SEM	Range	Mean ± SEM	
Acute	1	3	89-119	100.66±9.28	40-60	51±5.86	P < 0.05
Sub –acute	7	3	89-119	100.66±9.28	47-51	48.66±1.20	P < 0.05
	14	3	89-119	100.66±9.28	50-66	57.66±4.63	P < 0.05
	21	3	89-119	100.66±9.28	51-58	55.33±2.18	P > 0.05

TABLE 3: TRIGLYCERIDE LEVEL IN ALBINO RAT AFTER Hg-Se TREATMENT FOR ACUTE (1 DAY) AND SUB-ACUTE (7, 14 AND 21 DAYS) DURATION

Experimental Sets	Treatment Duration (Days)	No. of Rats	Control		Hg-Se Treated		Significance Level
			Range	Mean ± SEM	Range	Mean ± SEM	
Acute	1	3	105-157	132±15.05	41-62	5.66±6.84	P < 0.05
Sub –acute	7	3	105-157	132±15.05	56-101	80±13.08	P > 0.05
	14	3	105-157	132±15.05	46-56	52.33±3.17	P > 0.05
	21	3	105-157	132±15.05	66-84	74.66±5.20	P < 0.05

TABLE 4: HDL LEVEL IN ALBINO RAT AFTER HG-SE TREATMENT FOR ACUTE (1 DAY) AND SUB-ACUTE (7, 14 AND 21 DAYS) DURATION

Experimental Sets	Treatment Duration (Days)	No. of Rats	Control		Hg-Se Treated		Significance Level
			Range	Mean ± SEM	Range	Mean ± SEM	
Acute	1	3	40.6-55	46.16±4.49	27.6-39.4	34.86±3.67	P > 0.05
Sub –acute	7	3	40.6-55	46.16±4.49	21.5-35.4	27.63±4.09	P < 0.05
	14	3	40.6-55	46.16±4.49	28.9-38.3	33.53±2.71	P > 0.05
	21	3	40.6-55	46.16±4.49	30.4-34.9	32.06±1.42	P < 0.05

DISCUSSION: Mercury selenide precipitates have extremely low solubility, thus are thought to be metabolically inert. Mercury and selenium affect the bioavailability of each other [16, 17]. Exposure to mercury has already shown a reduction in the activity of the selenoproteins, glutathione peroxidase in the fetal/neonatal brain [18]. Mercury being a toxic heavy metal, paralyzes normal functioning of the central nervous system, kidneys, liver and lungs and exists in three forms elemental or metallic mercury, inorganic mercury and organic mercury [19, 20].

Selenium, an essential trace element in animals, has been recognized as an antioxidant and protects the brain against stress-induced oxidative damages [21, 22]. The present study involves the alterations in three parameters of lipid profile in female Wistar rat under the stress of Hg-Se nanoparticles, which include changes in cholesterol, triglycerides and HDL [23, 24]. The level of cholesterol and triglycerides (TG) were found reduced after acute (1d) and sub-acute (7, 14, and 21 days) oral intoxication of Hg-Se nanoparticles **Table 2-3**. The decline in levels of cholesterol and triglycerides in female albino rats following Hg-Se NPs intoxication reveals their greater penetrating power of nanoparticles [25, 26]. The level of total serum cholesterol is a strong predictor of the likelihood that an individual rat will develop almost no heart-related disorders and will have a much lesser degree of chances of stroke [27, 28]. The significant and non-significant decrease is observed in lipoproteins level *viz.* high-density lipoprotein (HDL) after acute and sub-acute intoxication of Hg-Se nanoparticles **Table 4**. The decrement in HDL lipoprotein level is an outcome of oxidative stress in the form of hydrogen peroxide, oxide anions and nitrogen ion [29, 30].

CONCLUSION: In the present investigation, oral administration of mercury selenide nanoparticles the level of cholesterol, TG, and lipoprotein HDL level has shown a considerable decrease.

The present findings can be extrapolated to other mammalian species which may pave the way for minimizing lipid profile by the interplay of nanoparticles generated by other heavy metals. However, it needs more experimentation to validate the findings made in the present investigation. As such complications arising in the vascular system following lipid accumulation may be minimized.

ACKNOWLEDGEMENT: The author is highly indebted to the Department of Zoology, School of Life Sciences, Dr. B.R.A University Khandari Agra for providing all the facilities and support during research work.

The author is also thankful to the Head of Department for providing ethical approval (Reg.-1608/CPCSEA) from the Institution Animal Ethical Committee (IAEC) for conducting experiments.

CONFLICTS OF INTEREST: The author declares no conflicts of interest.

REFERENCES:

1. Vishwakarma V, Samal SS and Manoharan NS: Risk associated with nanoparticles. Journal of Minerals and Materials Characterization and Engineering 2010; 9(5): 455-59.
2. Coman C, Tabaran F, Ilie I, Matea C, Iancu C, Mocan L and Mocan T: Assessment of silver nanoparticles toxicity in human red blood cells using ELISA and immuno-fluorescence microscopy techniques. Biotechnology, Molecular Biology and Nonamedicine 2003; 1(1): 2330-26.
3. Ding J, Zhang JR, Hong JM, Zhu JJ and Chen HY: Sonochemical synthesis of taper shaped HgSe nanorods in polyol solvent. Journal of Crystal Growth 2003; 260: 527-31.
4. Edikpo N, Okonkwo PO and Adikwu E: Effect of artemether treatment on plasma lipid profile in malaria. Pharmacology and Pharmacy 2014; 5: 646-56.
5. Mantur VS, Somannvar MS, Yendigeri S, Das KK and Goudar SS: Ameliorating effect of black tea extract on cadmium chloride induced alteration of serum lipid profile and liver histopathology in rats. Indian J Physiol Pharmacol 2014; 58(2): 128-32.
6. Kalaiselvi A, Reddy GA and Ramalingam V: Ameliorating effect of ginger extract (*Zingiber officinale*) on liver marker enzymes, lipid profile in aluminium chloride induced male rats. International Journal of Pharmaceutical Sciences and Drug Research 2015; 7(1): 52-58.
7. Sulaiman FA, Akanji MA, Oloyede HOB, Sulaiman AA, Olatunde A, Joel EB, Adewale TH, Adeboye HA, Idris SO, Quadri AL, Oyegoke RA and Adeyemi OS: Oral exposure to Silver/Gold Nanoparticles: Status of rat lipid profile, serum metabolites and tissue morphology. Journal of Medical Sciences 2015; 15(2): 71-79.
8. Adeyemi OT, Osilesi O, Adebawo OO, Onajobi FO and Oyedemi SO: Selected lipid profile in the serum and tissues of weaned male albino rats fed on processed Atlantic Horse Mackerel (*Trachurus trachurus*). Advances in Biosciences and Biotechnology 2015: 6: 286-01.
9. Jang E: Natural organics control aggregation of mercury sulfide nanoparticles in freshwater systems. Journal of the U.S. SJWP 2009; 4(01): 1-14.
10. Zare ME, Niasari MS and Sobhani A: Simple sonochemical synthesis and characterization of HgSe nanoparticles. Ultrasonic Sonochem 2012; 19: 1079-86.
11. Saxena PN and Rawat G: Mercury selenium nanoparticles induced immunological alteration in male Wistar rat. Proceedings of the World Congress on New Technologies. 2015; 415: 1-9.
12. Wang H, Xu S, Zhao XN, Zhu JJ and Xin XQ: Sonochemical synthesis of size-controlled mercury selenide nanoparticles. Materials Science and Engineering 2002; 96: 60-64.
13. Gedanken A: Using Sonochemistry for the fabrication of nanomaterials. Ultrasonics Sonochem 2004; 11: 47-55.
14. Cheraghi J, Hosseini E, Hoshmandfor R and Sahraei R: Haematologic parameters study of male and female rats administered with different concentrations of silver nanoparticles. International Journal of Agriculture and Crop Sciences 2013; 5(7): 789-96.
15. Vandebriel RJ, Tonk ECM, Gremmer ER, Verharen HW, Vander Van LT, Lovern HV and Jong WH: Immunotoxicity of silver nanoparticles in an intraverious 28 days repeated -dose toxicity study in rats. Particle and Fibre Technology 2014; 11(1): 11-21.
16. Edikpo N, Okonkwo PO and Adikwu E: Lipid profile and oxidative stress workers in wistar rats following oral and repeated exposure to file herbal mixture. Journal of Toxicology 2014; 10: 1-7.
17. Garcia RL and Rondero AG: Solid lipid nanoparticles (SLN) and nanostructured lipid carried (NLC): occlusive effect and perpetration enhancement ability. Journal Sciences and Applications 2015; 5: 62-72.
18. Demerdash FME: Effects of selenium and mercury on the enzymatic activities and lipid peroxidation in brain, liver and bloods of rats. J Env Sci Heath B 2001; 36(4): 489-99.
19. Raymend LJ, Ralston NVC and Forks G: Mercury: Selenium interactions and health implications. Seychelles Medical and Dental Journal 2004; 7(1): 72-77.
20. Doudi M and Setorki M: Effect of nanoparticles Fe_2NiO_4 on leukocytes-hematocrit and liver enzymes *in-vivo* condition. IJBPAS 2014; 3(7): 1054-66.
21. Latheef SAA, Radhika K and Subramanyam G: Histopathological changes due to the effect of selenium in experimental cockerels. Indian J Med Res 2012; 139: 927-32.
22. Pragya R, Nandini P and Bhavesh P: Nanomaterials: A future concern. Int J Res Chem Environ 2012; 2(2): 1-7.
23. Siddiqui M, Hamid K, Rashik MHA, Akther MS and Choudhari MSK: Changes in lipid profile of rat plasma after chronic administration of Laghobanondo Resh (LNR). Biology and Medicine 2010; 2(3): 58-63.
24. Mocan T: Hemolysis as an expression of nanoparticles induced cytotoxicity in red blood cells. Biotechnology, Molecular Biology and Nanomedicine 2013; 1(1): 2330-18.
25. Roesslein M, Hirsch C, Kaiser JP, Krug HF and Wick P: Comparability of in vitro for bioactive nanoparticles: A common assay to detect reactive oxygen spices (ROS) as an example. Int J Mol Sci 2013; 14: 24320-37.
26. Bhattacharya S and Pal S: Additive protective effects of selenium and vitamin E against arsenic-induced lipidemic and cardio toxic effects in mice. International Journal of Pharmacy and Pharmaceutical Sci 2014; 6(5): 406-13.

27. Ozougwa VEO and Chukwuka ME: Studies on the effect of crude oil fractions on the lipid profile of A*chatina achatina*. International Journal of Current Microbiology and Applied Sciences 2014; 3(2): 662-69.
28. Nweze CC, Abdullahi MH, Rasaq NO and Uzoukwu AE: Effects of antioxidant supplementation on lipid profile and some hematological parameters in Malaria induced albino rats. International Journal of Innovative Science, Engineering and Technology 2015; 2(2): 141-47.
29. Begum G, Hamid K and Choudhuri MSK: Changes in lipid profile of rat plasma after chronic administration of Mallasindura (MSL) an Ayurvedic metallic preparation. Journal of Pharmaceutical Sciences and Research 2015; 7(3): 123-26.
30. Uma T, Sangeetha B and Haritha B: The study of lipid profile levels, oxidative stress and thyroid status in thyroid disorders. Journal of Applied Research 2015; 1(2): 55-61.

How to cite this article:
Kumar K and Saxena PN: Alterations in lipid profile parameters of Albino rat after intoxication of mercury selenide nanoparticles. Int J Pharm Sci & Res 2019; 10(12): 5404-09. doi: 10.13040/IJPSR.0975-8232.10(12).5404-09.