

# Impact of Sodium Selenite on Antioxidative Metabolism in Kidney Tissue of Albino Rat Under Ammonia Stress



## Zoology

**KEYWORDS :** Selenium, Ammonia toxicity, Albino Rat, Kidney

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### ABSTRACT

The present study aims to examine whether selenium alleviates ammonia stress conditions. The LD<sub>50</sub> of Ammonium Sulphate and Sodium Selenite was determined, after toxicity testing evaluation. It is 62.5 mg/kg body weight for ammonium sulphate and 1.5mg/kg body weight for sodium selenite. The selected sub lethal concentrations of ammonium sulphate and sodium selenite are 12.5 mg/kg body weight and 0.3 mg/kg body weight respectively. These are administered through intraperitoneal method to rats for one week. After one week treatment, antioxidative enzymes like Superoxide dismutase (SOD), Catalase (CAT), Glutathione peroxidase (GPx), Glutathione reductase (GR) activities were estimated in Kidney tissue of albino rats by using standard methods. The impact of sodium selenite in rat under ammonia stress is discussed.

### Introduction:

Ammonia normally produced from catabolism of amino acids is potentially a lethal neurotoxin. The conversion of ammonium to urea, which involves urea cycle, occurs in the mitochondrial and cytosolic compartment of hepatocytes. Urea which contains two nitrogen atoms is synthesized from aspartate and ammonium mobilized from various sources (Sujatha et al., 2011). Hyperammonemia (HA) is a major and commonly observed feature of hepatic encephalopathy (HE). Although ammonia certainly plays a decisive role in the pathogenesis of HE, the relation between plasma ammonia and the severity of cerebral dysfunction is controversial. Common causes of hyperammonemia include genetic defects in the urea cycle organic acidemias as well as genetic or acquired disorders resulting in significant hepatic dysfunction (Uchaman and Georgieff, 1992). Hyperammonemia occurs commonly due to defective detoxification in the liver due to various inborn errors of metabolism.

Selenium is an essential trace element for humans and animals, involving diverse physiological actions. Selenium is an integral part of the catalytic site of several enzymes, including glutathione peroxidase (GP<sub>x</sub>) and thioredoxin reductase (TRR); the former catalyzes the reduction of hydro peroxides and hydrogen peroxide by reduced glutathione, the latter catalyses the NADPH dependent reduction of the redox protein thioredoxin, and both function to protect cells from oxidative damage (Yan et al., 2011). Nevertheless, the narrow range between its therapeutic dosage and tolerable upper intake level severely compromises wide applications. It is well known that the supplemental selenium may be acquired through the diet, but selenium bio-availability depends on the source (Finley, 2006).

Superoxide dismutase, Catalase, Glutathione peroxidase, Glutathione reductase antioxidative enzymes have an important role in metabolic oxidation and these enzyme levels have been estimated in the present study to understand the effect of ammonia stress and protective role of selenium an oxidative metabolism of the animal.

### Material and methods:

Healthy male Wistar strain albino rat (200 ± 10 g) obtained from Indian institute of science, Bangalore were maintained in polypropylene cages under laboratory condition (temperature 34 ± 20° C light: dark=12:12h humidity 75%) and fed with standard laboratory chow (Hindustan lever limited, Bombay) and water was provided *ad libitum*. The rats were acclimatized to the laboratory conditions for 7 days. To ascertain LD<sub>50</sub>, four groups of albino rats, each group comprising of 10 animals were injected intraperitoneally with varying doses of ammonium sulphate and sodium selenite. After toxicity testing evaluation, the LD<sub>50</sub> is determined and is found to be 62.5 mg/kg body weight for ammonium sulphate and 1.5mg/kg body weight for Sodium selenite.

After determination of LD<sub>50</sub> dose, 1/5 of the LD<sub>50</sub> (12.5 mg of ammonium sulphate/Kg body weight) was selected, as sub lethal concentrations of Ammonium sulphate. This concentration was selected, so as to keep the animals in ammonia stress but will not result in mortality. Similar studies using sodium selenite was performed to understand the effect of Selenium and 0.3mg of sodium selenite /Kg body weight is selected as the test dose.

Healthy adult animals were divided into four groups containing six animals each. The first group of animals was considered as control, the second group of animals treated with ammonium sulphate, third group animals treated with sodium selenite and fourth group treated with ammonium sulphate treated rats with sodium selenite. The control and experimental animals were sacrificed by cervical dislocation at the end of the treatment i.e., 7 days and Kidney tissue was collected and stored in deep freezer at - 20°C and used for biochemical analysis.

Superoxide dismutase (SOD) was estimated by Misra and Fridovich (1972) method, Catalase (CAT) was estimated by Aebi (1984) method, Glutathione peroxidase (GPx) was estimated by Flohe and Gunzler (1984) method, Glutathione reductase (GR) was estimated by Carlberg and Mannervik (1985) Total proteins was assayed by the method of Lowry et.al (1951). The results were subjected to statistical analysis. The experimental protocol was approved by institutional animal ethics committee (IAEC). (Resolution Number: 01/2006-2007/ (I)/ (a) CPCSEA/ IAEC/SVU/PN-MSS/ dt. 14.09.2007).

### Results:

In the present study the tissue of Kidney of male albino rats was selected and all the enzymes were estimated in control, ammonium sulphate, sodium selenite and ammonium sulphate treated rats with sodium selenite. (Table: 1).

The activities of SOD, CAT, GPx and GR in the kidney of ammonium sulphate administered rats show significant decrease compared to control rats. Treatment with sodiumselenite in ammonium sulphate administered rat significantly elevated SOD, CAT, GPx and GR activities, as compared to those animals on ammonium sulphate treatment alone.

Parameter	Control	Ammonium sulphate	Sodium selenite	Ammonium sulphate + Sodium selenite
<b>SOD</b>				
Mean	7.3350	4.2067	7.6265	6.6514
SD	±0.4115	±0.1758	±0.3738	±0.1988
% Change over control		(-42.7)	(3.97)	(-9.32)

<b>CAT</b> Mean SD % Change over control	0.6545 ±0.0273	0.4336 ±0.0572 (-33.7)	0.6816 ±0.0687 (4.12)	0.6050 ±0.0111 (-7.3)
<b>GPx</b> Mean SD % Change over control	0.9546 ±0.0740	0.4945 ±0.0262 (-42.3)	0.9909 ±0.04681 (3.8)	0.8985 ±0.02951 (-5.8)
<b>GR</b> Mean SD % Change over control	1.005 ±0.0164	0.540 ±0.0379 (-46.2)	1.0635 ±0.1366 (5.8)	0.8966 ±0.0457 (-10.2)

Treatment with sodium selenite rats significantly showed no variations when compared to control rats.

Table 1: The changes in the levels of SOD, CAT, GPx and GR activities in kidney tissue of albino rats treated for 7 days with ammonium sulphate & Sodium selenite treated albino rats and effect of Sodium selenite along with Ammonium sulphate treated albino rats.

All values are significant at  $P < 0.05$

**Units:** SOD-units of Superoxide anion reduced/ /mg protein/ min

CAT- $\mu$  moles of  $H_2O_2$  degraded/mg protein/min

GPx- $\mu$  moles of NADPH Oxidized /mg protein/min

GR- $\mu$  moles of NADPH Oxidized /mg protein/mi

### Discussion:

Superoxide dismutase (SOD), Catalase (CAT), Glutathione peroxidase (GPx), Glutathione reductase (GR) are the antioxidant enzymes that provide cellular protection against the damage caused by free radicals and ROS (Ashraf, 2007; Patra, 2011). Present study reveals that treatment of ammonium sulphate causes significant decrease in these four (SOD, CAT, GPx, GR) enzyme activities in kidney tissue of rat. There by production of more free radicals and ROS in the ammonium sulphate treated rats tissue which is not possible removed by the reduced antioxidant enzymes. Then this might have probably produced oxidative stress in rat. The decreased antioxidative enzymes activity levels was supported by several authors namely Albino rats treated with Ammonium chloride (Subash, 2008), with Cadmium chloride treated in rats (Amita kumara et al., 2012), the Profenophos treated in fish (Kavitha, 2009).

In the present investigation no variations between sodium selenite treated rats with control rats was observed. Increased levels of SOD, CAT, GPx and GR in ammonium sulphate along with sodium selenite treated rats when compared to ammonium sulphate were observed. The protective role of Sodium selenite can be envisaged from decreased levels of SOD, CAT, GPx and GR activities in the experimental tissue of kidney. The presence of selenium helps to induce and maintain the glutathione antioxidant system. Selenium is incorporated into proteins to make selenoproteins, which are important to antioxidant enzymes. The antioxidant properties of selenoproteins helps to prevent the cellular damage from free radicals (Combs and Gray, 1998 and Hafez et al., 2012). Thus a similar situation might have resulted in observed changes in the present investigation..

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