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# Effect of saline water on general performance of rat

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**Abstract**
The present investigation was carried out on 48 male adult Wistar rats divided into four equal groups. Group I served as control whereas group II, III, and IV rats were given adlib drinking saline water (TDS-5600 ppm), 50% diluted saline water and 25% diluted saline water of 5600 TDS, respectively for 90 days with adlib commercial feed. Group II and III showed clinical symptoms of varying degrees of pasty feces, rough fur coat, itching, depression and poor general conditions. There was a significant increase in moisture percent of litter material in different groups suggesting increased urination in group III rats due to increased water consumption. Water consumption in different groups differs significantly and indicated increase consumption directly proportional to TDS for the sake of excretion of excess salts from the body. Average weekly body weight gain showed numerical decrease in group II followed by group III and group IV suggesting dose dependant decrease in weight gain. It is thus concluded that water salinity causes a dose dependant adverse effect on digestive system leads to lower body weight gain. However, 25 % dilution of saline water having TDS 5600 ppm showed minimal adverse effect on general performance.

**Keywords:** General performance, saline water, rat

## 1. Introduction
Water is an essential nutrient for all living beings. Water consumption is more important than feed for living beings as limitations in water intake adversely affect performance and more drastically than any other nutrient deficiency. Tolerance of minerals in water depends on many factors i.e. physiological state of the animal, season, climate, species, feed and kind of salt present in water [1]. Some salts and other elements when present at higher level may reduce animal growth and production or may cause illness and death. However due to their physiological adaptability many animals are able to adopt wide variety of different types of water and still can survive. The measures used to evaluate water quality include salinity, hardness, pH, sulfate, nitrate and analysis for other specific elements known to be toxic. One of the principle factors affecting water quality is salinity, i.e. amount of total dissolved salts (TDS) in the water. Presence of high concentration of some inorganic ions such as Calcium, Magnesium, Sodium, Chloride, Sulphates and Bicarbonates may cause harmful effects resulting in poor performance, illness or even death [2].
For fresh water salinity and TDS are equivalent. A high level of suspended solids and an objectionable taste, odor or color in water can cause animals to drink less water than they should. Excessive salinity in livestock drinking water can upset the animal's water balance. An abrupt change from water of low salinity to high salinity may be more harmful while a gradual change may not have the same effect. Abrupt supply of high TDS water may either be refused by animals or can cause decrease consumption affecting livestock productivity instantly. However exposure to low saline water may not show detectable production losses and water as a cause remain undetected during most of the conditions. The different salts have varying clinical effects which have little or no practical significance. Usually chlorides are less harmful than sulfates, magnesium chloride appears to be more injurious than calcium or sodium salts [3]. Hence, the present study was undertaken to investigate the effect of water salinity of high TDS and its dilution with normal water on clinical observations and general performance of rats given for 90 days daily.

## 2. Materials and Methods
The necessary prior approval was granted from the Institutional Animal Ethics Committee for conduct of the experiment. Forty eight male adult Wistar rats weighing around 150 to 200 gm

were procured from National Centre for Laboratory Animal Sciences, National Institute of Nutrition, Hyderabad. All the experimental animals were acclimatized for a period of one week to the new environment under identical hygienic and managemental conditions before beginning of the study and had free access to food and water. All animals were house caged in a temperature controlled room.

**2.1 Experimental Design**

After acclimatization period, the rats were randomly divided in four equal groups of 12 rats in each. Group I was served as a control group, whereas group II was given saline water having TDS 5600 ppm, group III was given 50 % diluted saline water (TDS 5600 ppm) + 50 % normal water and group IV was given 25 % saline water (TDS5600 ppm) + 75 % Normal water. All the groups were treated with their respective treatment water for 90 days. The saline water having TDS 5600 ppm was procured from bore well of the village Chohotta bazaar, District- Akola whereas the normal water used was the municipal water of Akola city. Before start of experiment, initial body weights of individual rat from all groups were recorded. The clinical observations, general performance in the form of weekly water consumption, weekly feed consumption and weekly body weight gain was recorded for 90 days. All the experimental procedures were carried out as per the guidelines of the Institutional Animal Ethics Committee (IAEC) and Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) and were treated humanely with all efforts were made to minimize suffering.

**2.2 Statistical analysis**

The data generated during the experiment for hematology and biochemical parameters were analyzed by using Completely Randomized Design using WASP ICAR Goa, Version 2. (http://www.ccari.res.in/waspnew.htm).

**3. Results**

**3.1 Clinical observations**

Control group rats did not revealed any clinical symptoms till the experimental period of 90 days, thus confirming the safety of normal water used during experimental studies. However, treatment group II, III and IV showed clinical symptoms of pasty feces, rough fur coat, itching, depression, poor general condition with dull and depress appearance. The clinical symptoms of pasty feces (diarrhea) were more prominent in II and III group rats with varying intensity. The onset of pasty diarrhea was evident from the second day in group II rats in 50 per cent animals. However the onset of diarrhea was slow and was observed after the seventh day of experiment in group III rat given 50% saline water. After second week of experiment group II and III rats showed intermittent diarrhea up to the end of the experiment with semisolid to a pasty consistency. Surprisingly diarrhea was more evident in group III rats given 50% saline water as compared to group II and group IV.

**3.2 Moisture percent in litter**

The moisture percent of litter in different groups showed significant ($p$<0.01) differences (Table 1). The significant increase moisture percent was observed in group III (34.08±1.27%) litter material followed by group II (29.56±1.34%), group I (23.29±1.15%) and group IV (15.35±1.01%) indicating the increased volume of urine secretion in group III rats given 50% saline water. Due to increased urination the litter material appeared to be moist in III and II group compared to control and group IV rats.

**3.3 Weekly water consumption**

Water consumption in different groups was found to be statistically significant (Table 2). Significantly increased water consumption was observed in group III (239.76±13.30 ml) rats followed by group II (219.24±9.19 ml) rats. Significantly lower water consumption was observed in group IV (190.12±5.25 ml) rats however; it was comparable with control group rats (207.12±5.51 ml).

**3.4 Weekly feed consumption**

Average weekly feed consumption (g) per rat was found to be statistically non-significant between control and treatment group rats (Table 3). The average weekly feed consumption in group I (control), II, III and IV rats was observed to be 80.01±3.12 g, 77.90±2.97 g, 78.62±2.87 g and 76.20±3.41 g, respectively. Numerically lower feed consumption was observed in group II rats. This indicates that feed consumption decreases with increase in salinity of water.

**3.5 Weekly body weight gain**

The week wise weight gain analysis revealed statistically significant difference at $5^{th}$, $6^{th}$, $8^{th}$, $9^{th}$ and $11^{th}$ weeks among group II and control group rats suggesting impact of saline water on rat health after $5^{th}$ week (Table 4).

The treatment mean of average weekly body weight gain of rat at the end of the $13^{th}$ week of the experiment was statistically non-significant, however numerically lower weight gain was observed in group II (6.68±1.12 g) given 100% saline water followed by group III (7.80±1.15 g), group IV (8.87±1.11 g) and control group (9.11±0.91 g) suggesting a dose dependant decrease in weight gain in treatment group rats.

**4. Discussion**

Drinking saline water is of no benefit to man or other mammals, which have no extra renal mechanism for excretion of salts, however, an accidental consumption of large amounts of sea water can cause transient renal failure [4]. Highly saline water by itself is not likely to be a problem for animals; however certain ions in saline water can be extremely detrimental to livestock performance and can be sometimes fatal. Water that contains dissolved salt more than 1000 ppm is considered to be saline/ brackish or mineralized and is unsuitable for drinking for both humans as well as animals. It has been further mentioned that feed consumption is reduced and effect on health or on ruminal microflora may lead to retardation of food digestion with a decrease in the rate of passage through alimentary tract [3].

The clinical signs observed in the present experiment might be possibly due to adverse effect of saline water. While diarrhea might have occurred due to irritation and pathophysiological changes in gastrointestinal tract because of high sodium and chloride (or TDS) content of saline water [5]. The findings of diarrhea earlier reported [6] in animals drinking 50 percent sea water corroborates with present findings.

The significant increase in moisture percent of litter in group III rats might be due to increase in urination due to increased water consumption which is required to remove the excess of sodium and chloride present in saline water through urine [3] Present findings corroborates with previous worker [7] who also recorded that higher level of salt intake in rats consumed

large amount of water and maintained polyurea. An attempt of estimating the moisture content of litter was proved to be very much useful to evaluate water consumption in various groups and subsequent excretion through urinary system which was recorded and interpreted during the different studies conducted on water salinity. Water consumption in different groups differs significantly and indicated increase consumption of water during increase salinity for the sake of excretion of excess salts from the body. However salinity of water reduces water consumption possibly due to decrease palatability when compared with normal water. Total body water and water turnover rate, increases with increased consumption of saline water and increase in turnover rate is indicative of the changes in fluid transport required for the elimination of excess sodium chloride or high TDS. This increase in turnover rate is attributed to increase in water consumption required to keep the excreted urine sufficiently diluted to remove the excess high levels of sodium chloride [3].

Feed consumption during present study indicated numerical decrease in feed consumption in treatment group rats given saline water when compared with control group rats given normal water possibly due to digestive disturbances causing general adverse effect in treatment group rats. Present findings are in agreement with previous reports who stated that water with alkaline pH causes digestive upset which results in rejection of water and depressed appetite [6, 8-10]. Drinking of saline water results in reduced digestion of organic matter and proteins in the stomach along with decreased efficiency of utilization of feed energy [3] which might be the reason for lower weight gain in group II, III and IV rats compared to rat drinking normal tap water. Observations of weekly body weight gain indicated adverse effect of water salinity during experimental studies after 5$^{th}$ week of experiment. However no specific trend was observed in body weight gain during treatment of water salinity in rats. However adverse effect showed decreased weight gain with an increase in total dissolved solids or salinity given for 90 days. As very little information is available on effect of saline water or high TDS water on general performance of animals and hence detailed study is required to assess the impact of water salinity on general performance in animals.

**Table 1:** Average weekly moisture percent of litter material in control and treatment groups.

| Week | Groups | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| 01 | 20.01 | 28.56 | 35.21 | 16.69 |
| 02 | 26.41 | 32.54 | 36.54 | 12.32 |
| 03 | 19.37 | 25.54 | 37.58 | 11.49 |
| 04 | 28.45 | 21.73 | 34.14 | 17.23 |
| 05 | 31.02 | 34.14 | 32.81 | 19.54 |
| 06 | 15.84 | 21.45 | 23.03 | 8.29 |
| 07 | 21.25 | 27.15 | 30.62 | 13.43 |
| 08 | 27.32 | 25.73 | 39.07 | 13.18 |
| 09 | 20.75 | 33.45 | 28.03 | 14.46 |
| 10 | 23.1 | 31.34 | 37.08 | 20.18 |
| 11 | 23.18 | 33.11 | 35.12 | 19.81 |
| 12 | 24.63 | 36.21 | 34.62 | 14.52 |
| 13 | 21.52 | 33.36 | 39.21 | 18.53 |
| Treatment Mean | 23.29$^{c}$±1.15 | 29.56$^{b}$±1.34 | 34.08$^{a}$±1.27 | 15.35$^{d}$±1.01 |

Treatment found significant at 1% and 5% level of significant
CD (0.05) = 3.429
Means bearing same superscript do not differ significantly

**Table 2:** Average weekly water consumption (ml) per rat per week in control and treatment groups.

| Week | Groups | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| 1 | 169.67 | 169.83 | 172.58 | 178.75 |
| 2 | 181.83 | 175.33 | 174.50 | 179.17 |
| 3 | 193.58 | 198.17 | 187.83 | 178.83 |
| 4 | 208.33 | 211.33 | 201.33 | 170.33 |
| 5 | 216.00 | 219.50 | 234.83 | 192.83 |
| 6 | 188.25 | 198.67 | 205.83 | 168.83 |
| 7 | 201.33 | 207.67 | 247.00 | 189.67 |
| 8 | 220.67 | 242.00 | 278.17 | 200.67 |
| 9 | 242.00 | 295.83 | 314.33 | 240.17 |
| 10 | 213.00 | 219.00 | 254.00 | 176.00 |
| 11 | 228.50 | 239.50 | 284.00 | 194.00 |
| 12 | 210.00 | 223.17 | 261.33 | 197.67 |
| 13 | 219.40 | 250.20 | 301.20 | 204.40 |
| Treatment mean | 207.12$^{bc}$ ±5.51 | 219.24$^{ab}$ ±9.19 | 239.76$^{a}$ ±13.30 | 190.12$^{c}$ ±5.25 |

Treatments means found Significant at 1% and 5% level of significance
CD (0.05) = 25.424
Means bearing same superscript do not differ significantly

**Table 3:** Average weekly feed consumption (g) per rat per week in control and treatment groups.

| Week | Groups | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| 1 | 94.20 | 89.85 | 93.09 | 93.64 |
| 2 | 92.64 | 88.89 | 86.41 | 85.57 |
| 3 | 94.14 | 88.69 | 89.77 | 89.13 |
| 4 | 90.83 | 87.31 | 87.44 | 87.07 |
| 5 | 85.26 | 82.52 | 80.48 | 83.20 |
| 6 | 84.46 | 83.67 | 84.37 | 84.70 |
| 7 | 77.50 | 81.07 | 79.26 | 74.76 |
| 8 | 70.76 | 69.81 | 73.96 | 67.70 |
| 9 | 63.90 | 60.73 | 63.47 | 59.56 |
| 10 | 71.13 | 71.74 | 72.66 | 70.14 |
| 11 | 71.14 | 72.57 | 72.42 | 69.03 |
| 12 | 81.22 | 78.40 | 81.35 | 73.92 |
| 13 | 62.98 | 57.47 | 57.49 | 52.29 |
| Treatment mean | 80.01±3.12 | 77.90±2.97 | 78.62±2.87 | 76.20±3.41 |

Treatments found to be Non Significant

**Table 4:** Average weekly body weight gain (g) per rat per week in control and treatment groups.

| Week | Groups | | | | CD |
|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | (0.05) |
| 1 | 14.58±1.32 | 12.5±1.29 | 16.50±1.65 | 16.91±2.02 | NS |
| 2 | 15.75±1.47 | 14.00±1.63 | 15.08±1.05 | 16.75±1.26 | NS |
| 3 | 12.50±1.17 | 13.33±1.14 | 12.75±0.98 | 12.33±1.02 | NS |
| 4 | 10.66±0.95 | 8.08±1.34 | 7.33±0.72 | 8.91±1.00 | NS |
| 5 | 9.33$^{a}$±1.06 | 5.33$^{b}$±0.72 | 8.16$^{a}$±1.03 | 8.83$^{a}$±1.02 | 2.769 |
| 6 | 8.75$^{a}$±0.85 | 5.91$^{b}$±0.65 | 6.83$^{ab}$±0.66 | 8.66$^{a}$±0.58 | 1.982 |
| 7 | 7.16±1.01 | 6.00±1.12 | 6.33±3.19 | 7.00±1.48 | NS |
| 8 | 7.16$^{a}$±0.74 | 3.16$^{b}$±0.83 | 4.00$^{b}$±0.85 | 7.16$^{a}$±1.51 | 3.053 |
| 9 | 6.00$^{a}$±0.36 | 2.33$^{b}$±0.71 | 4.50$^{ab}$±1.02 | 5.50$^{a}$±0.71 | 2.193 |
| 10 | 6.83±0.70 | 4.33±0.91 | 5.83±1.86 | 5.83±0.90 | NS |
| 11 | 6.66$^{a}$±0.49 | 2.83$^{b}$±0.40 | 5.00$^{a}$±0.68 | 6.33$^{a}$±0.95 | 1.970 |
| 12 | 6.50±0.92 | 5.00±0.51 | 4.66±0.88 | 5.66±0.61 | NS |
| 13 | 6.66±0.84 | 4.16±0.40 | 5.00±0.44 | 5.50±1.20 | NS |
| Treatment mean | 9.11±0.91 | 6.68±1.12 | 7.80±1.15 | 8.87±1.11 | NS |

NS-Non significant
Treatment effect found Significant at 5% level of Significance
Means bearing same superscript in a column do not differ significantly

## 5. Conclusion

From the observations, it was concluded that saline water of TDS 5600 ppm and its 50% dilution causes adverse on general performance and digestive system of rats which leads to decrease in body weight gain. However, 25 % dilution of saline water having TDS 5600 ppm showed minimal adverse effect on general performance.

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