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Study of Thiram toxicity on body organ weight in laboratory-induced protein deficient male Wistar (albino) rats

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ABSTRACT

Thiocarbamates are a highly significant group of pesticides that play a critical role in the agricultural industry.The development of pesticides with dithiocarbonate properties started during World War II. In the 1930s, some compounds, such as thiram and Ziram, were introduced. These compounds are used as fungicides and are effective against fungi and plant diseases caused by fungi. Thiram has a significant effect on the weight of testes and seminal vesicles. This study aims to investigate the effect of thiram, a representative of carbamate pesticides, on male rats with laboratory-induced protein deficiency and its impact on the weights of different body organs.

Keywords: Thiram, protein deficiency, body organs weight, spleen, testes, liver, kidney, male Wistar (Albino) rats

INTRODUCTION

According to Worthing & Walker in 1983, thiram, a pesticide, has been found to cause skin and eye irritation. A study conducted on male Wistar rats administered thiram in various doses of 225, 300, 450, 600, 900, and 1200 mg/kg diet for 29 days. The study revealed that thiram significantly affected various parameters, including decreased body weight at 300 mg/kg and a significant effect on testes and seminal vesicle weight at 450 mg/kg diet.It is widely known that pesticides can be toxic to certain forms of life, including humans and animals. There have been several reports on the toxicity of various pesticides, and they are known to cause changes in behavior, biochemistry, and cell structure. These changes can cause alterations in cellular components such as carbohydrates, proteins, lipids, and amino acids (Mahmood et al., 1979; Kaushal and Gupta, 1977; Ishikawa et al., 1978; Tarik et al., 1977), as well as changes in organ weights, white blood cell count, red blood cell count, and hemoglobin concentration (Hornshaw et al., 1987).Van Leeuwen (1986) conducted a study that found thiram to be a harmful chemical. In rats, a dose of 2500 mg thiram per kg body weight increased their mortality rate. Thiram is metabolized in the liver to produce CS2, which contributes to its toxicity. Thiram treatment has also resulted in changes to hematological parameters in male albino rats with diabetes (Yadav and Awasthi, 2014). Reproductive toxicity has also been observed in diabetic male Wistar (albino) rats induced by thiram (Yadav, 2019).

MATERIALS AND METHODOLOGY

In the present study the following investigations are undertaken:
Impact of thiram on different body organs like liver, kidney, testes, and spleen.

- *Induction of protein deficiency in rats:*Rats weighing between 60 to 100 grams were put on a low-protein diet (12%) for two months to induce the condition of protein deficiency. This was confirmed by observing changes in body weight, blood protein concentration, blood glucose concentration, and blood urea. The protein-deficient diet was prepared by HAFED cattle feed plants located in Rohtak.
- *Diet composition:*The composition of the diet is given in **Table 1**.

Table 1. Diet composition

Protein level %		
Ingredients	**12%(low protein diet)**	**30% (normal diet)**

Soybean meal, 48%	92 g/kg	418 g/kg
Protein level %	780 g/kg	478 g/kg
Ground corn	25 g/kg	08 g/kg
Glucose mono carbohydrates	50 g/kg	17 g/kg
Alfalfa meal	33 g/kg	33 g/kg
Dicalcium phosphate	09 g/kg	09 g/kg
Limestone	05 g/kg	05 g/kg
Vitamin Mix	01 g/kg	01 g/kg
Mineral mix	01 g/kg	01 g/kg
Selenium mix	04 g/kg	04 g/kg
Iodized salt		27 g/kg
Soyabean		

- *Treatment of rats with thiram*-The present study employed two different methods to administer thiram to rats. One group was administered thiram via intraperitoneal injection, whereas the other group was fed thiram-laced food in various quantities for 30 days. The injection dosage was calculated at 60mg per kilogram of each rat's body weight, and the thiram was mixed with groundnut oil before administration.

RESULTS

In the present study, the organ's weights are taken as the % of total body at x 10
Impact of thiram treatment on liver weight.

In normal rats fed ad libitum, the value was found to be 51.678 percent of total body weight *10. In protein-deficient rats, the corresponding value was 39.353 percent. The exposure to a single intraperitoneal dose of thiram led to a reduction in liver weight. After 5 hours, the reduction was found to be 5.70 percent, which increased to 10.3 percent after 24 hours and 18.4 percent after 7 days in normal rats. In protein-deficient rats, the reduction values were 7.9 percent, 11.8 percent, and 15.3 percent after 5 hours, 24 hours, and 7 days respectively. Repeated exposure to thiram for 7 days resulted in 15.4 percent and 19.0 percent reduction in normal and protein-deficient rats, respectively. The observed values are mentioned in **Table 2.**

Table 2: ***Impact of thiram treatment on liver weight***

Organ: Liver **Parameter: Weight**

Time	**Normal rats (% of total body weight x 10)**	**Protein deficient rats (% of total body weight x 10)**
Ad Libitum (control)	51.68%	39.35%
After 5 hrs	48.73%	36.24%
After 24 hrs	46.36%	34.71%
After 7 days	42.17%	33.33%
After every 7 days repeated dose	43.72%	31.88%

Impact of thiram treatment on kidney weight.
The value in normal rats fed ad libitum was 3.97% and in protein-deficient rats, the respective value was 2.841% of total body weight *10

The exposure to a single intraperitoneal dose of thiram caused an increase in kidney weight.After 5 hours the percent increase was 3.4 which became 5.2% increase after 24 hours, 12.2% elevation after 7 daysin normal rats.The corresponding values in protein-deficient rats were 3.9,16.7,and 27.3 percent increased after 5 hours,24 hours, and 7 days respectively.The repeated exposure to thiram for 7 days resulted in an increase of 10.3 and 29.7 percent in normal andprotein deficientrates.The impact of thiram treatment on kidney weightis mentioned in **Table 3.**

Table 3: ***Impact of thiram treatment on kidney weight***

Organ: Kidney	**Parameter: Weight**	
Time	**Normal rats (% of total body weight x 10)**	**Protein deficient rats (% of total body weight x 10)**
Ad Libitum (control)	3.97%	2.84%
After 5 hrs	4.11%	2.95%
After 24 hrs	4.18%	3.32%
After 7 days	4.45%	3.62%
After every 7 days repeated dose	4.38%	3.69%

Impact of thiram treatment on testes weight.
In normal rats fed ad libitum, the value was 6.636 percent of total body weight *10, while in protein-deficient rats, the value was 6.253.

When the rats were exposed to a single intraperitoneal (IP) dose of thiram, there was a reduction in the testes' weight. After 5 hours, the testes' weight reduced by 5.3%, which decreased to 3.9% after 24 hours and 9.5% after 7 days in normal rats. In protein-deficient rats, the corresponding values were a reduction of 3.8%, 10.2%, and 16.5% after 5 hours, 24 hours, and 7 days, respectively. With repeated exposure to thiram for 7 days, there was a reduction of 15.3% and 18.7% in normal and protein-deficient rats, respectively. The impact of thiram treatment on testes weight is mentioned in **Table 4.**

Table 4: ***Impact of thiram treatment on testes weight***

Organ: Testis	**Parameter: Weight**	
Time	**Normal rats (% of total body weight x 10)**	**Protein deficient rats (% of total body weight x 10)**
Ad Libitum (control)	6.64%	6.25%
After 5 hrs	6.28%	6.02%
After 24 hrs	6.38%	5.62%
After 7 days	6.01%	5.22%
After every 7 days repeated dose	5.62%	5.08%

Impact of thiram treatment on spleen weight.
The following data was collected in a study on the effects of thiram exposure on rats. The study found that the value of total body weight in normal rats fed ad libitum was 3.29 percent, while in protein-deficient rats it was 2.013 percent.
The study also found that exposure to a single IP dose of thiram caused an increase in spleen weight. In normal rats, the percent elevation was 2.6% after 5 hours, 4.3% after 24 hours, and 17.0% after 7 days. In protein-deficient rats, the corresponding values were 11.6%, 36.9%, and 61.4% after 5 hours, 24 hours, and 7 days respectively.When the exposure to thiram was repeated for 7 days, the spleen weight in normal and protein-deficient rats increased by 16.0% and 62.4%, respectively. The impact of thiram treatment on spleen weight is mentioned in **Table 5.**

Table 5: ***Impact of thiram treatment on spleen weight***

Organ: Spleen	**Parameter: Weight**	
	Normal rats (% of total body weight x 10)	**Protein deficient rats (% of total body weight x 10)**
Ad Libitum (control)	3.29%	2.01%
After 5 hrs	3.38%	2.25%

After 24 hrs	3.43%	2.76%
After 7 days	3.85%	3.25%
After every 7 days repeated dose	3.82%	3.27%

DISCUSSION

Both normal and protein-deficient rats experienced a decrease in body weight after being treated with thiram, which is caused by decreased dietary intake. This effect is more severe in protein-deficient pathological conditions. In diabetic conditions, the level of liver glycogen has been found to decrease, and liver weight decreases due to hypophagia. Starvation results in the loss of liver weight; however, the spleen, kidney, and heart typically maintain their weight. Thiram changes lysosomal enzymes which are essential for testicular growth and development of spermatozoa, and it decreases the level of ATPase enzyme in the testes. ATPase enzyme provides energy for sperm motility. Treon et al. (1965) observed an enlargement of kidney weight and necrosis of convoluted tubules in kidneys. An increase in spleen weight suggests the occurrence of splenomegaly.

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