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Short Communication

Effect of Two Different Rodenticides on Serum Biochemistry of House Rats (*Rattus rattus*)

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ABSTRACT

This study was conducted to compared the serum biochemical parameters of the *Rattus rattus* as influenced by feeding two different rodenticides i.e., brodifacoum and food energy inhibitor (cellulose). The experiment was conducted on total 42 rats which were divided equally into 3 groups. One group was fed brodifacoum while the other was fed cellulose. The third group served as a control. Both the groups were fed with the calculated amount of brodifacoum and cellulose for 14 days. At the end of experiment, rats of all the three groups were killed and blood was collected to obtain serum. Significantly low feed intake was recorded in food energy inhibitor fed group. Serum was analyzed for glucose, alanine aminotransferase (ALT), aspartate aminotransferase (AST), Triiodothyronine (T_3) and Thyroxine (T_4). It was observed that serum glucose and T_3 were significantly low ($p<0.05$) in brodifacom fed group while ALT and T_4 were significantly high ($p<0.05$) in brodifacom fed rats. The biochemical comparison of these rodenticides provides useful information regarding the controlling strategy of *Rattus rattus*.

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INTRODUCTION

Rattus rattus, an important cosmopolitan commensal rodent pest, damaging crops both in the field and in storage throughout the temperate and tropical regions of the world (Prakash, 1988). Rodents, belonging mainly to the family Muridae (rats and mice) are known as pests in both commercial and agricultural situations. These animals are considered to be one of the most damaging pests to crops. Almost all food produced for consumption by both humans and domestic animals are liable to be damaged by rodents during processing and storage, leading to significant financial losses. Furthermore, they constitute a high health risk to both livestock and humans, since rodents may transmit diseases to humans and domesticated animals either directly through bites or through exposure to infected feces and urine, or by indirect means via a vector such as a fly or mosquito (Gage and Kosoy, 2005). Their potential to cause significant economic loss and pose a health risk have lead to numerous rodent control techniques including both chemical and non-chemical methods.

First and second generation anticoagulants are widely used to control rodents. However, a problem remains with primary and secondary toxicity to non-target species. For example, secondary toxicity of anticoagulants in barn owls causes sub-lethal haemorrhages for several days (Godfrey, 1985). Brodifacom, the most toxic, has been proposed for use against a rodent population once a week for 3-treatments and it was found that brodifacom was as effective as zinc phosphide when offered for one feeding (Dubock and Kaukeinen, 1978). On the other hand, the available information suggests that cellulose from powdered corn cobs is not expected to exhibit chronic, developmental and reproductive or nervous system toxicity. Cellulose from powdered corn cob posses a negligible risk to the environment. Cellulose is a rodenticide for control of rats and mice indoors (e.g. buildings, barns, empty feed storage areas, warehouses) where no other food sources are available. Therefore, this study was designed to evaluate the effect of BRD (brodifacom) and FEI (Food energy inhibitor) toxicity on different parameters of house rats.

MATERIALS AND METHODS

The present study on house rats (*Rattus rattus*) was carried out in Faisalabad District from June, 2007 to

November, 2008. In each district 18 randomly selected villages under the defined area were sampled. Indoor populations of *Rattus rattus* was assessed in the selected locations through the activity signs like damaged to the commodities, runway tracks, existence of burrows and rodent droppings and cereal grains and other scatters on the sites. The rats were kept individually in metallic cages in the department of Physiology and Pharmacology, University of Agriculture, Faisalabad. Total of 42 rats were divided randomly into 3 groups. Group A contained food energy inhibitor fed rats. Group B was marked as brodifacoum fed rats while group C served as control. Feed and water were available *ad libitum* to all rats. Feed was offered in the form of baits and water was given in bottle, having the same number as that of relevant cage, equipped with stainless steel sipper tubes. The experiment lasted for 14 days.

Treated rats of group A were given the cellulose pellets according to the body weight (an average of 20 gm of pellets). Treated rats of group B were given standard doses of brodifacoum (in the form of blocks) containing 0.05% active ingredient. Whereas, the control rats were given the measured normal feed. Blood from each remaining rats of groups A and B (both treated) and C (control) was collected in clean glass test tubes, allocated the same number as that of alive rats in the trial. Rats were decapitated for collection of blood. The test tubes containing blood were placed in the laboratory for 10 minutes and then centrifuged at 167xg for 20 minutes to let the serum separate. The serum was aspirated carefully with a pipette, placed in serum cups (Eppendorf), labeled and stored in freezer (-20°C) till analysis.

For the quantitative measurement of glucose in the rats serum, commercially available kit BIORAY CAT # 1426-6 was used. For the quantitative determination of AST and ALT in the serum commercially available kit by RANDOX were used. Similarly, T_3 and T_4 concentration was also determined by commercially available kits (Randox®). Inter-assay and intra-assay coefficient of variation are less than 12% throughout the assay range, for both assays.

Statistical analysis

The data obtained was subjected to statistical analysis as described by Steel *et al*. (1997). In case of significance difference between different groups Duncan Multiple Range Test was applied (Duncan, 1955).

RESULTS

It is clear from the results that mean feed intake was significantly low ($P<0.05$) in cellulose fed rats. However, there was non significant difference in feed intake between control and brodifacoum fed groups. The mean concentration of serum glucose concentration was significantly low ($P<0.05$) in group B (Table 1). The mean serum ALT concentration was significantly high ($P<0.05$) in group B. However, mean serum AST concentration did not significantly differ among the studied groups. Mean serum T_3 and T_4 concentration was significantly low and high ($P<0.05$) in group B, respectively (Table 1).

DISCUSSION

Studies on effect of FEI and brodifacoum (BRD) on biochemical profile are extremely sparse. The purpose of this study was to compare the effect of BRD and cellulose on feed intake and serum glucose, AST, ALT, T_3 and T_4 in house rats. In this experiment it was found that feed intake was significantly low in cellulose fed rats. The reason for low feed intake by the rats is the result of the mechanism of action of cellulose which interferes with digestive system causing blockage in the intestines and cecum, resulting in low feed intake. It was observed that glucose was significantly low in BRD fed rats as compared to control rats. The reason for this decline may partially be less feed consumption by the rats of this group. Therefore, the levels of glucose in serum of both groups significantly decreased. Further decrease in glucose concentration in serum of BRD group is unclear, however, it is postulated that BRD interferes with glucose concentration in the blood and may result in death of rats.

In the present study, the level of ALT was significantly high in BRD group. The increase in ALT levels in the serum of rats can be attributed to liver damage at cellular level and also due to increase in plasma membrane permeability as a result this enzyme is liberated in the serum (Drotman and Lohorn, 1978). In a study feeding apple pomace (cellulose) to rats in different combination depressed the growth parameter including AST and ALT levels. In such rats liver damage was observed in post-mortem report. This also indicates that rats might have low level of enzymes required for utilization of feed high in fibers compared to other animals. It is also a well known fact that AST level is higher in conditions of liver damage and development of fibrosis.

Table 1: Average feed consumption, serum glucose, alanine aminotransferase, aspartate aminotransferase, triiodothyronine and thyroxine of control, FEI and BRD treated rats (*Rattus rattus*).

Parameters	Groups		
	FEI (A)	BRD (B)	Control (C)
Feed consumption (g)	10.2 ± 1.7^{b}	13.88 ± 1.5^{a}	12.79 ± 2.3^{a}
Serum glucose (mg/dL)	117.23 ± 4.99^{b}	66.33 ± 5.78^{c}	155.6 ± 5.44^{a}
Alanine aminotransferase (U/L)	31.13 ± 3.71^{b}	44.33 ± 6.55^{c}	10.45 ± 1.44^{a}
Aspartate aminotransferase (U/L)	26.68 ± 3.12^{a}	30.1 ± 5.78^{a}	25.11 ± 2.44^{a}
Triiodothyronine (ng/mL)	4.9 ± 0.41^{a}	3.23 ± 0.56^{b}	4.4 ± 0.39^{a}
Thyroxine (µg/dL)	3.3 ± 2.74^{b}	4.1 ± 2.56^{a}	2.1 ± 1.8^{c}

Values (Mean ± SE) with different superscripts in a row differ significantly ($P<0.05$). Brodifacoum (BRD); Food energy inhibitor (FEI).

Normal thyroid hormone levels are essential for growth, development and maintenance of tissue function. Countless number of environmental chemicals has been found to affect production, transport or metabolism of thyroid hormones through variety of mechanisms (Brown, 2003). Zaidi *et al.* (2000) reported that TSH level was elevated, T3 suppressed and T4 slightly decreased in chemical insults. BRD seems to affect directly on thyroid glands, reducing and release of T_3 concentration or converts T_3 into T_4 and increases its level (Tseng and Chen, 1992).

Therefore, it is concluded that glucose level was significantly low in BRD fed group, ALT was significantly high in BRD group. Whereas, T_3 was significantly low and T_4 was significantly high in BRD fed rats. This data provides useful information regarding the serum biochemistry as affected by feeding two different rodenticides in *Rattus rattus* which will help in better understanding the control strategy of rats.

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