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Ameliorative effect of *Mucuna pruriens* on cypermethrin induced toxicity on body weights and organ weights in Wistar rats

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Abstract
The ameliorative potential of *Mucuna pruriens* was studied against Cypermethrin induced toxicity. Total 48 adult male *Wistar* albino rats were divided into 4 groups (n=12). Group I (control) and group II, III, IV rats treated with cypermethrin, *Mucuna pruriens*, cypermethrin and *Mucuna pruriens* at the rate of 25, 300, 25 and 300 mg/kg b.wt. respectively orally for 28 days. Six (06) rats from each group were sacrificed on 14th and 28th day of the experiment.
In the present study, weekly body weights were significantly (P<0.05) reduced in group II rats. The absolute and relative weights of testes in group II rats were significantly (P<0.05) decreased on 28th day of study than group I rats. On 14th and 28th day of experiment, a significant (P<0.05) increase in absolute and relative liver weights and a significant (P<0.05) decrease in absolute and no significant change in relative kidney weights were observed in group II rats than group I rats. However, administration of *Mucuna pruriens* caused a mild ameliorative effect on the parameters investigated.

Keywords: *Cypermethrin, Mucuna pruriens,* body weights, organ weights, wistar rats

1. Introduction
Cypermethrin (CYP) is a synthetic pyrethroid belonging to α-cyano group, commonly used in various agricultural, livestock and household practices to control pests [1]. Although considered non-toxic to mammals, several reports indicated the adverse effects of CYP on various systems [2, 3, 4, 5, 6]. CYP accumulates in biological membranes and generates reactive oxygen species (ROS) causing oxidative damage in mammals [7]. CYP is recognized as an endocrine disrupting chemical with anti-androgenic activity, producing adverse effects on male reproductive system [8, 9].
Mucuna pruriens (MP) belongs to Fabaceae family, commonly known as cowitch plant. MP have been outlined to have anti-oxidant, aphrodisiac, pro-male fertility, anti-stress, anti-inflammatory and anti-microbial properties. It is rich in alkaloids, flavanoids, phenols and steroids. MP seeds have L- dihydroxyphenyl -alanine (L-DOPA), a major constituent, uncommon non-protein amimo acid and immediate precursor of neurochemical dopamine indulged in mood and sexuality [10]. From the literature reviewed no substantial work has been reported on protective effect of MP on CYP induced toxicity. Therefore, the present experiment was designed to study the ameliorative effect of MP against CYP toxicity in *Wistar* rats.

2. Materials and Methods
2.1 Experimental animals
Forty eight (48) adult male albino *Wistar* rats weighing between 180-220 g were procured from Jeeva Life Sciences (ISO 9001:2015 certified company), Hyderabad for this research. The experiment was carried out according to the guidelines and prior approval of Institutional Animal Ethics Committee (IAEC-No. 7/24/C.V.Sc., Hyd.IAEC-rats/12.06.2021)

2.2 Chemical source
Cypermethrin was obtained from Syngenta India Limited, Hyderabad under the trade name Cymbush (10% Emulsifiable Concentrate; EC) and *Mucuna pruriens* seed powder was obtained from Organic Herbs, Delhi, India.

2.3 Experimental design
A total of 48 male albino *Wistar* rats were randomly divided into four (4) groups consisting of twelve (12) animals in each.
Group I - Control
Group II - CYP (@ 25 mg/kg b.wt)
Group III - MP (@ 300 mg/kg b.wt)
Group IV - CYP +MP (@25 mg/kg b.wt + 300 mg/kg b.wt)
The dose regimens were administered orally daily for 28 days. The rats were monitored for clinical signs and death.

2.4 Body weights (g)
Individual body weights of all the rats were recorded by using electronic balance on day of arrival (0 day) and subsequently on 7th, 14th, 21st and 28th day of experiment.

2.5 Absolute and relative organ weights
Experimental rats were sacrificed by cervical disarticulation on 14th and 28th day of experiment and a detailed necropsy examination was carried out as per standard procedure. The absolute weights (g) of testes, liver and kidneys of all the animals were recorded using an electronic balance. The relative weights (%) were calculated as follows:

$$\text{Relative wt.} = \frac{\text{Organ wt.}}{\text{Body wt}} \times 100$$

2.6 Statistical analysis
Data obtained were subjected to statistical analysis by applying one way Analysis of variance (ANOVA) using statistical package for social sciences (SPSS) version 20.0. Differences between the means were tested by using Duncan's multiple comparison tests and significance level was set at $P<0.05$ [11].

3. Results and Discussion
3.1 Effect of CYP on weekly body weights
An insignificant ($P<0.05$) reduction in the body weights of group II and IV rats were noticed on 7th day when compared to group I rats. However, group II and IV rats on comparison with group I and III rats exhibited significant ($P<0.05$) decline on 14th, 21st and 28th day of experiment. This weight loss could be due to toxic action of CYP on intestinal epithelium which might have influenced intestinal absorption leading to decrease in appetite and thereby growth rate.

Table 1: Weekly body weights (g) in different groups

Group	Day 7	Day 14	Day 21	Day 28
Group I	220.75 ± 2.17^{b}	233.5 ± 1.84^{a}	245.65 ± 2.49^{a}	254.22 ± 1.93^{b}
Group II	216.75 ± 1.97^{b}	217.25 ± 1.11^{b}	219.10 ± 1.88^{c}	221.12 ± 2.99^{d}
Group III	228.25 ± 1.49^{a}	239.50 ± 2.21^{a}	250.75 ± 2.43^{a}	265.22 ± 2.17^{a}
Group IV	219.25 ± 2.25^{b}	223.25 ± 2.93^{b}	229.10 ± 2.26^{b}	236.17 ± 1.40^{c}

Values are Mean ± SE (n=12) on day 7th and 14th; One-way ANOVA
Values are Mean ± SE (n=6) on day 21st and 28th; One-way ANOVA
Means with different superscripts in a column differ significantly at $P<0.05$.

Also it may be due to the collective action of CYP such as parasympathomimetic activity (decreased feed intake and diarrhea), production of ROS, liver injury and enhanced catabolism of lipids and proteins. These findings were similar to the observations of [12, 13]. Group IV rats showed insignificant ($P<0.05$) increase on 7th and 14th day whereas significant ($P<0.05$) elevation on 21st and 28th day of study in the mean values of body weight. This could be due to the anabolic and protective (anti-oxidant and anti-inflammatory) effects of MP on CYP induced toxicity (Table 1).

3.2 Effect of CYP on absolute and relative weights of testes
The absolute and relative weights of testes of group II rats did not exhibit any significant variation on 14th day of experiment. But, weights of testes were significantly ($P<0.05$) reduced on 28th day of study when compared with group I rats. CYP induced accelerated oxidative stress and low levels of serum testosterone could have suppressed spermatogenesis resulting in reduction of tubule size, formation of more abnormal sperms, decrease in number of germ cells and elongated spermatids, thereby decreasing testicular weights. Similar results were noticed in previous studies of [14, 15, 16].
On 28th day of experiment, group IV rats demonstrated significant ($P<0.05$) increase in mean values of both absolute and relative testicular weights on comparison with group II rats. Hypothetically, the improvement could be due to the androgenic property of MP which might have improved spermatogenic and steroidogenic activities by enhancing testicular cells and their secretions. This hypothesis is being supported by [17, 18, 19]. (Table 2)

3.3 Effect of CYP on absolute and relative weights of liver
Significantly ($P<0.05$) higher mean values of absolute and relative liver weights were recorded in group II rats than group I rats on 14th and 28th day of experiment. This increase could be due to the intense detoxification carried out by liver and/or probably due to the functional hypertrophy of the SER and increased drug metabolizing multienzyme complex. These observations are coinciding with the earlier studies of [20, 21, 22].
Mean values of absolute and relative liver weights were significantly ($P<0.05$) lower in group IV rats when compared with group II rats on 14th and 28th day. Aforementioned change could be due to restoration of cellular architect-ture of hepatocytes near to normal as a result of anti-oxidative [23, 24] and anti-inflammatory [25] action of MP seed powder (Table 3).

3.4 Effect of CYP on absolute and relative kidney weights
Significant ($P<0.05$) decrease in mean values of absolute kidney weights and non-significant change in mean values of relative kidney weights were observed in group II rats than group I rats on 14th and 28th day of experiment. These findings are in accordance with those of [20, 15, 22]. The decline in kidney weights in the present study might be due to sloughing off of renal tubular epithelium, shrinkage of glomeruli and necrosis of renal tubules.

Table 2: Absolute and relative weights of testes

	Absolute wt. (g)		Relative wt. (%)	
Group	**Day 14**	**Day 28**	**Day 14**	**Day 28**
Group I	4.33 ± 0.28	4.67 ± 0.15^{a}	1.86 ± 0.01	1.83 ± 0.02^{a}
Group II	4.02 ± 0.21	3.80 ± 0.14^{b}	1.84 ± 0.01	1.72 ± 0.03^{b}
Group III	4.41 ± 0.15	4.76 ± 0.13^{a}	1.85 ± 0.02	1.79 ± 0.02^{a}
Group IV	4.17 ± 0.28	4.32 ± 0.19^{a}	1.87 ± 0.02	1.83 ± 0.01^{a}

Table 3: Absolute and relative weights of liver

	Absolute wt. (g)		Relative wt. (%)	
Group	**Day 14**	**Day 28**	**Day 14**	**Day 28**
Group I	7.17 ± 0.62^{b}	8.27 ± 0.46^{b}	3.07 ± 0.07^{c}	3.26 ± 0.03^{c}
Group II	8.75 ± 0.16^{a}	9.84 ± 0.34^{a}	4.03 ± 0.09^{a}	4.44 ± 0.06^{a}
Group III	7.58 ± 0.38^{ab}	8.45 ± 0.20^{b}	3.17 ± 0.05^{c}	3.19 ± 0.03^{c}
Group IV	8.01 ± 0.34^{ab}	8.91 ± 0.37^{b}	3.59 ± 0.03^{b}	3.78 ± 0.02^{b}

Table 4: Absolute and relative kidney weights

	Absolute wt. (g)		Relative wt. (%)	
Group	**Day 14**	**Day 28**	**Day 14**	**Day 28**
Group I	1.86 ± 0.10^{a}	1.92 ± 0.08^{a}	0.79 ± 0.03	0.75 ± 0.02
Group II	1.60 ±0.05^{b}	1.56 ± 0.04^{b}	0.73 ± 0.01	0.70 ± 0.01
Group III	1.83 ± 0.08^{a}	1.90 ± 0.08^{a}	0.77 ± 0.02	0.72 ± 0.01
Group IV	1.73 ± 0.04^{ab}	1.75 ± 0.03^{a}	0.76 ± 0.01	0.74 ± 0.02

Values are Mean ± SE (n=6) on day 14th and 28th; One-way ANOVA
Means with different superscripts in a column differ significantly at $P<0.05$

Significantly ($P<0.05$) higher mean values of absolute kidney weights but insignificant change in relative kidney weights were noticed in group IV rats on comparison with group II rats on day 14 and 28 of the experiment. The positive results might be due to the protective action of MP seed powder (Table 4).

4. Conclusion

In conclusion, CYP induced significant reduction in body weights and toxic changes in testes, liver and kidneys. It showed marked alteration in organ weights. Administration of MP showed mild amelioration against toxic changes induced by CYP which can be attributed to antioxidant, anti-inflammatory, androgenic and spermatogenic properties of MP seed powder.

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