Effect of the Glycoside Convicine on Female and Male Albino Rats: Pregnancy and Sperm Quality

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Abstract: Convicine (CV) is a glycoside isolated from Faba beans (Vicia faba L.). It is causing hemolytic crisis called favism especially with young males suffers from a deficiency in glucose-6-phosphate dehydrogenase. In the present study these experiments were conducted to investigate the side effect of CV on the pregnant albino rats and on the sperm quality of male albino rats. The first experiment included four groups of pregnant females were injected with CV in three dose levels (80, 100, 150 mg/100g b.wt, ip) at 12th, 13th and 14th days of gestation. The weight of the alive feti decreased significantly while resorbed feti and abortion percent increased significantly in a dose dependent. The second experiment, offspring’s of control and treated pregnant rats (100 mg/100g b.wt, ip) on the day 12th, 13th and 14th days of gestation were weighed weekly. The offsprings weights decreased significantly \((p<0.01)\) than control group starting from 1st up to 56th date of birth. The third experiment, the male rats were injected for 60 days with CV (100 mg/100g b.wt, ip) and the results revealed a significant decrease in spermatozoa number. Moreover, there were an increase in the abnormality and mortality percent of spermatozoa, while the weight of male genital organs decreased significantly than control group.

Key words: Convicine · Albino rats · Pregnancy · Sperm quality

INTRODUCTION

Convicine is a glycoside that is found primarily in Faba beans (Vicia faba L.) which is one of the most important plant. Pulse crops in the world, being consumed in large quantities in the Middle East, Far East and North Africa particularly in Egypt.

Convicine is a compound which is hydrolysed by the intestinal micro flora [1] to highly reactive free radical generating compound isouramil [2] which have been strongly implicated as the causative agent in favism [3] a hemolytic disease in human’s particularly young males that have a deficiency of erythrocytic glucose-6-phosphate dehydrogenase (G-6-PD) activity [4].

The free radical generators may also cause often adverse effects including lipid peroxidation [4] and mitochondrial metabolism [4] and possibly diabetes [5].

This study was conducted to investigate the effect of convicine on the pregnant rats and sperm quality of male rats.

MATERIALS AND METHODS

Material: Convicine was prepared according to the procedure of Arbid and Marquardt [6]. The solution was freshly prepared by dissolving convicine in distilled water and adding 2 drops of tween80.

Animals: Pregnant female rats weighing (180-200g) at 12th, 13th and 14th days of gestation and male mature rats weighing (150-180g) were obtained from the animal house colony, National Research Centre, Dokki, Giza. The animals were maintained on commercial balanced diet and tap water. The experiments were performed after approval from the ethics committee of National Research Centre and in accordance with recommendations for proper care and use of laboratory animals (NIH No. 85:23 revised 1985).

Methods Experimental Design: These experiments were conducted, the first one was performed on 32 pregnant females (the 12th day of concept was determined by

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vaginal smear) and they were divided into 4 groups (8 rats each): the rat was kept as control and injected with saline (0.5 ml/100 g b.wt., ip).

The 2nd, 3rd and 4th groups were injected with convicine levels 80, 100 and 150 mg/100 g b.wt., ip respectively, each dose was injected for 3 times on the day 12th, 13th and 14th of gestation. The weight of alive fetai and percent of resorption and abortion were recorded and statistically analyzed.

The 2nd experiment offsprings of control and CV treated pregnant rats (100 mg/100 g b.wt., ip) on the days 12th, 13th and 14th of gestation was weighed weekly. Starting from the 1st to 56th date of birth. In table 2, the percent of decrease in the body weight was ranging from 10.34% to 18.76% (at 1st to 24th date of birth). This decrease was cleared by time as the percent of decrease reached to 33.67% at the 56th date of birth (Table 2, Figure 1).

Concerning the effect of CV on the sperm quality in male (experiment 3), it was observed that spermatozoa number and mortality percent were significantly decreased ($P < 0.01$) (Table 3) as well as the percent of abnormal spermatocytes was increased significantly when compared to control group. The weights of male genitals organs were decreased significantly ($P < 0.01$) when compared with control group (Table 4). The percent of decrease was in testes 41.78%, epididymis 52%, prostate 42.85%, seminal vesicle 60.97% and vasa deferentia 51.25% (Figure 2).

### Statistical Analysis
The differences between groups were tested for significance using t test determined by SPSS software program, version 21. Values are expressed as mean ± S.E. The level of statistical significance was taken at $P < 0.05$.

#### Table 1: Effect Of Different Doses Of Convicine On Albino Rats

<table>
<thead>
<tr>
<th>Groups</th>
<th>Resorption (%)</th>
<th>Abortion (%)</th>
<th>Alive fetai weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>4.52±0.032</td>
</tr>
<tr>
<td>1 (80 mg CV/100 g b.wt., ip)</td>
<td>0</td>
<td>0</td>
<td>3.92±0.6</td>
</tr>
<tr>
<td>2 (100 mg CV/100 g b.wt., ip)</td>
<td>29.8±2.5*</td>
<td>18.5±1.4*</td>
<td>2.62±0.26*</td>
</tr>
<tr>
<td>3 (150 mg CV/100 g b.wt., ip)</td>
<td>35.6±1.6*</td>
<td>20±1.3*</td>
<td>2.12±0.024*</td>
</tr>
</tbody>
</table>

Values are means ± S.E of 8 animals. As compared with normal control (*) group (t test) at $P < 0.01$.

#### Table 2: Effect Of Convicine (150 Mg/100g B.Wt. Ip On 12th, 13th And 14th Days Of Gestation) In Pregnant Rats On Body Weight Of Offspring

<table>
<thead>
<tr>
<th>Days of birth</th>
<th>Offsprings from control mothers (g)</th>
<th>Offsprings from treated mothers (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.8±0.24</td>
<td>5.2±0.02*</td>
</tr>
<tr>
<td>8</td>
<td>12.2±0.25</td>
<td>11.22±0.24**</td>
</tr>
<tr>
<td>16</td>
<td>17.2±0.28</td>
<td>16.23±0.18**</td>
</tr>
<tr>
<td>24</td>
<td>23.24±0.32</td>
<td>18.88±0.26**</td>
</tr>
<tr>
<td>32</td>
<td>32.24±0.33</td>
<td>23.64±0.36**</td>
</tr>
<tr>
<td>40</td>
<td>41.23±1.63</td>
<td>26.42±0.34**</td>
</tr>
<tr>
<td>48</td>
<td>47.6±1.22</td>
<td>32.1±2.26**</td>
</tr>
<tr>
<td>56</td>
<td>58.2±2.8</td>
<td>38.6±3.34**</td>
</tr>
</tbody>
</table>

Values are means ± S.E of 8 animals. As compared with normal control group (*) (t test) at $P < 0.05$, (**) (t test) at $P < 0.01$. 

### RESULTS

Experiment 1, resorption and abortion percent were increased significantly ($P < 0.01$), while the weight of alive fetai was decreased significantly in pregnant injected females with the higher doses of CV (100 and 150 mg/100 g b.wt., ip). No detectable resorption or abortion was seen in the lowest dose of CV injected pregnant rats (Table 1).

Offsprings weight in the experiment 2, decreased significantly ($P < 0.01$) than control group starting from the 1st to 56th date of birth. In table 2, the percent of decrease in the body weight was ranging from 10.34% to 18.76% (at 1st to 24th date of birth). This decrease was cleared by time as the percent of decrease reached to 33.67% at the 56th date of birth (Table 2, Figure 1).
Table 3: Effect Of Convicine (150 Mg/100g B.Wt. Ip) On Epididymal Spermatozoa Characters Of Male Albino Rats After 60 Days Of Daily Administration

<table>
<thead>
<tr>
<th>Groups</th>
<th>Spermatozoa concentration (Million/ml)</th>
<th>Mortality (%)</th>
<th>Abnormality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>690±2.8</td>
<td>86±2.6</td>
<td>5.3±0.44</td>
</tr>
<tr>
<td>Convicine</td>
<td>355±2.24</td>
<td>13.2±1.38</td>
<td>25.6±1.8**</td>
</tr>
</tbody>
</table>

Values are means ± S.E of 8 animals. As compared with normal control (**) group (t test) at *P*<0.01.

Table 4: Effect Of Convicine (150 Mg/100g B.Wt. Ip) On Weight Of Male Albino Rats Genital Organs After 60 Days Of Daily Administration

<table>
<thead>
<tr>
<th>Groups</th>
<th>Testes</th>
<th>Epidydmis</th>
<th>Seminal Vesicle</th>
<th>Prostate</th>
<th>Vasa deferentia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.13±0.141</td>
<td>1.25±0.05</td>
<td>0.41±0.022</td>
<td>0.35±0.012</td>
<td>0.8±0.005</td>
</tr>
<tr>
<td>Convicine</td>
<td>1.24±0.13**</td>
<td>0.6±0.045**</td>
<td>0.16±0.012**</td>
<td>0.2±0.016**</td>
<td>0.39±0.003**</td>
</tr>
</tbody>
</table>

Values are means ± S.E of 8 animals. As compared with normal control (**) group (t test) at *P*<0.01.

**DISCUSSION**

Favism is a genetic disease characterized by hemolytic anemia which occurs in sensitive people shortly after consumption of broad beans (faba beans, *Vicia faba* L.), this beans contain relatively high levels of vicin and convicine [8].

It has been proposed that the main immediate causative agents associated with favism are divicine and isouramil [2], which are cleaved from their respective glycosides vicine and convicine by intestinal microbial â-glycosidase [9]. The favic crisis usually begins several hours after ingestion of raw or cooked beans and can persist for several days [10]. The clinical condition is characterized by a variety of symptoms including fever, weakness, free hemoglobin in blood and urine, ictrus, enlarged spleen, elevated reticulocyte counts and renal failure [11]. The other side effects of convicine on the pregnant rats and on the sperm quality of male rats investigated in our study.

The results of experiment 1 revealed that CV treated pregnant rats has increased percent of resorbed and dead feti and abortion also occurred. These results may be due to the effect of CV on haemoglubin, in which hemoglobin produced ferryl species can react with its aglycon isouramil that accelerating its oxidation and methemoglobin is performed [12], also reduced the partial pressure of oxygen in the blood and the percent of oxygen saturation [13].

In addition, the RBCs have a markedly reduced oxygen carrying capacity which presumably greatly limits aerobic metabolism, of severe enough, will lead to death due to asphyxiation [13].
CV reduced the body weight gain of offsprings from injected pregnant rats in experiment 2. This findings due to the effect of isouramil which (the aglycon of convicine) possesses a thermo stable ant nutritional factor found in faba beans or due to the other depressing factors on the animals during the feeding with the faba beans [14].

The obtained results were in agreement with Robblee et al. [15] who demonstrated that when the faba beans content of the poultry diet exceeded 30% there was an increase in mortality rate, decreased egg production and feed convicine efficiency.

The resultant effect of CV on sperm quality in the experiment 3, revealed a significant reduction in the sperm number and motility percent. This findings runs parallel with that obtained by Arbid and Marquardt [13] who reported that vicine (the other glycoside in fava beans) caused arrest of spermatogermes at spermatid level, decreased the number and motility of sperms in male rats.

However, the genital organs weights were also decreased in CV injected male rats. Thus CV depressed the fertility, hatchability of eggs, damaged or denaturated protiens and, or altered the structure of the lipid components in the yolk membrane [16].

Due to the formation of free radicals from CV in vivo [13] and subsequently reduced blood glutathione (Scott, 1978) and the cell membrane became fragile [17] as well as any cells in the body including the ova in females and sperms in male were affected.

CONCLUSION

It can be concluded that Convicine when hydrolyzed to its aglycan isouranil, in addition to its effect on RBCs membrane and metabolism and on the immunological system, it has adverse effect on pregnant rats as well as on spermatogenesis in male rats.

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REFERENCES


