Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, 11(2), 837-847, 2003

# EFFECT OF INSECT GROWTH REGULATORS ON THYROID FUNCTION AND ORGANS WEIGHT IN MALE ALBINO RATS

[60]

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## ABSTRACT

Eight groups of male mature albino rats (25 each) were administered 1000, 2000 and 4000 ppm of buprofezin or 150, 300 and 600 ppm of diafenthiuron through drinking water for 90 days followed by 30 days recovery period. The effect of tested materials on thyroid function was assessed (thyroxin and tri-iodothyronine hormone). The administration with buprofezin caused decline in thyroxine level (T4) and tri-iodothyronine, while diafenthiuron treatment resulted in an increase in the thyroid hormones (T4 and T3). The treatment buprofezin led to increase the weights of liver, kidney and lungs, while, no differences were noted in the weights of brain, spleen and heart. Diafenthiuron resulted in an increase in lungs weight, while, the other organs were not affected.

**Key words:** Rats, Thyroid, Organs, Insect Growth Regulators (IGR)

## INTRODUCTION

The extensive application of pesticides is usually accompanied with serious problems of pollution and health hazards. It is now well established that many pesticides in common use can produce some toxic and adverse effects on thyroid and internal organs. The main problems are clinical and subclinical effects leading to losses in animal performance or in residue contamination of animal products which may later be consumed by humans.

Several studies on different animal species indicated obvious changes in the body as a result of exposure to pesticides. These changes were dependent on animal species and age, also on the type of pesticides used, dose and route of administration (**Garthoff *et al* 1981**).

The changes in the weight of internal organs are accompanied with parallel changes in their function which is reflected at the level of blood constituents (**Gupta *et al* 1983**). The present work was carried out to study the effect of cer-

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**(Received July 19, 2000)**
**(Accepted May 17, 2003)**

tain insect growth regulators on Thyroid function and organs weight in albino rats.

## MATERIAL AND METHODS

### 1- Insect growth regulators used

a) Buprofezin (Applaud): is a new insect growth regulator (IGR) discovered and developed by Nihon Nohyaku Co., Ltd., Tokyo, Japan. The formulation used was suspension concentrate (25% SC) containing 25% buprofezin. (2-tert-butylin-3-isopropyl-5-plenylperhydro-1,3,5-thiadiazine-4-one).

b) Diafenthiuron: The diafenthiuron [Polo 500 SC of CIBA-GEIGY Limited, Co., Swithzerland] is a new thiourea acaricide/insecticide containing 50% diafenthiuron. (IUPAC: 3-(2,6-disopropyl-4-phenoxyphenyl)-1-tert-butyl-thiourea) or N-[2,6-bis(1-methylethyl)-4-phenoxy-phenyl]-N-(1,1-dimethyl-ethyl-thiourea).

### 2- Animals and procedures

Two hundreds mature albino rats (average weight 200 ± 10 gm) were separated into eight experimental groups of 25 rats each and treated as follow:

* Groups A and B: rats were kept as normal control (untreated) for comparison.
* Groups C, D and E : rats were treated with buprofezin through drinking water at concentrations of 1000, 2000 and 4000 ppm, respectively.
* Groups F, G and H : rats were administered diafenthiuron through drinking water at concentration of 150, 300 and 600 ppm, respectively.

Daily administration was continued for 90 days and five animals from each group were left for 30 days after the experimental period to study the possible reversible effect on thyroid function and organs weight. On days 15, 30, 65, 90 and 120, five rats from each group were decapitated. The organs were removed, weighted and the plasma were taken for hormone assay. Thyroxin (T4) and tri-iodothyronine (T3) were measured in plassma (**Britton *et al* 1975**). The coat-A-count kits purchased from Diagnostic Products Corporation, (DPC), Los Angles, U.S.A. were used throughout the present investigation.

## RESULTS

The administration of different concentrations of buprofezin to rats led to a decrease in the thyroxine (T4) and tri-iodothyonine (T3) levels. All the concentrations induced reduction in thyroid function after 15 days of administration and this continued for 120 days (Table, 1).

The treatment of male albino rats with different concentrations of diafenthiuron resulted in an increase in the levels of thyroid function. Maximal increase as recorded after 65 and 90 days. Treated animals didn't return to normal levels during the recovery period (Table, 2).

The buprofezin treatment caused increase in the weights of liver, kidney and lungs, while, no differences were noted in the weights of brain, spleen and heart (Tables 3 & 4). Similar results were noticed with diafenthiuron. (Tables 5 & 6).

## DISCUSSION

T4 is the major hormone secreted by the thyroid gland. It influences the rate of many metabolic reactions of the body and is required for normal mental development and growth. Increased circulation of

Table 1. Effect of treatment with different concentrations of buprofezin on Thyroxine (T4) and tri-iodothyronine (T3) in male albino rats

| Treatment | Period conc. Parameter | | | | | |
|---|---|---|---|---|---|---|
| | Thyroxine | (T4) | (μg/dL) | Tri-iod-othyronine | (T3) | (ng/dL) |
| Before (Basal) control | 4.48 | ±0.52 | | 105.41 | ±8.59 | |
| After 15 days | | | | | | |
| 1000 ppm | 1.88 | ±0.24 | ** | 58.9 | ±4.59 | ** |
| 2000 ppm | 2.13 | ±0.15 | ** | 50.01 | ±3.69 | ** |
| 4000 ppm | 1.47 | ±0.03 | ** | 44.91 | ±2.73 | ** |
| After 30 days | | | | | | |
| 1000 ppm | 1.61 | ±0.28 | ** | 41.6 | ±3.2 | ** |
| 2000 ppm | 1.75 | ±0.28 | ** | 50.84 | ±3.1 | ** |
| 4000 ppm | 1.79 | ±0.07 | ** | 61.5 | ±4.54 | ** |
| After 65 days | | | | | | |
| 1000 ppm | 2.35 | ±0.21 | * | 58.58 | ±4.54 | ** |
| 2000 ppm | 2.19 | ±0.18 | ** | 79.03 | ±3.16 | * |
| 4000 ppm | 1.48 | ±0.28 | ** | 59.8 | ±3.9 | ** |
| After 90 days | | | | | | |
| 1000 ppm | 1.75 | ±0.18 | ** | 88.95 | ±4.48 | |
| 2000 ppm | 1.79 | ±0.15 | ** | 84.54 | ±3.02 | |
| 4000 ppm | 1.88 | ±0.16 | ** | 73.17 | ±7.27 | * |
| Recovery for (30 days) | | | | | | |
| 1000 ppm | 3.24 | ±0.14 | | 77.28 | ±2.39 | * |
| 2000 ppm | 3.93 | ±0.11 | | 94.22 | ±5.00 | |
| 4000 ppm | 4.12 | ±0.22 | | 62.87 | ±5.85 | ** |

* Significant at $P < 0.05$.
** Significant at $P < 0.01$.

Table 2. Effect of treatment with different concentration of diafenthiurons on Thyroxine (T4) and tri-iodothyronine (T3) in male albino rats

| Treatment | Period conc. Parameter | | | | | |
|---|---|---|---|---|---|---|
| | Thyroxine | (T4) | (µg/dL) | Tri-iod-othyronine | (T3) | (ng/dL) |
| Before (Basal) control | 5.18 | ±0.39 | | 112.61 | ±5.24 | |
| After 15 days | | | | | | |
| 150 ppm | 6.4 | ±0.54 | | 174.32 | ±10.06 | ** |
| 300 ppm | 7.29 | ±0.33 | ** | 166.00 | ±10.33 | ** |
| 600 ppm | 6.13 | ±0.42 | | 171.2 | ±10.8 | ** |
| After 30 days | | | | | | |
| 150 ppm | 7.07 | ±0.37 | * | 164.8 | ±10.44 | ** |
| 300 ppm | 9.12 | ±0.68 | ** | 177.2 | ±6.46 | *** |
| 600 ppm | 8.28 | ±0.27 | ** | 162.0 | ±11.79 | * |
| After 65 days | | | | | | |
| 150 ppm | 8.27 | ±0.4 | ** | 223.4 | ±10.76 | *** |
| 300 ppm | 10.03 | ±0.44 | *** | 293.8 | ±16.63 | *** |
| 600 ppm | 9.6 | ±0.25 | *** | 180.0 | ±0.04 | ** |
| After 90 days | | | | | | |
| 150 ppm | 9.29 | ±0.45 | *** | 208.8 | ±11.92 | *** |
| 300 ppm | 9.20 | ±0.22 | *** | 185.0 | ±6.51 | *** |
| 600 ppm | 6.62 | ±0.80 | | 172.8 | ±9.31 | ** |
| Recovery for (30 days) | | | | | | |
| 150 ppm | 6.85 | ±0.37 | * | 157.2 | ±9.37 | ** |
| 300 ppm | 7.02 | ±0.26 | * | 138.4 | ±8.39 | * |
| 600 ppm | 6.91 | ±0.59 | | 161.4 | ±8.15 | ** |

* Significant at $P < 0.05$.
** Significant at $P < 0.01$.
*** Significant at $P < 0.001$.

Table 3. Effect of treatment with different concentrations of buprofezin on internal organ weight of male albino rats

| Treatment | Treatment period (days) | | | | | |
|---|---|---|---|---|---|---|
| | 15 | 30 | 65 | 90 | Recovery for 30 days | Over all mean of treatment |
| | Liver weight (gm/100 gm b.w.) | | | | | |
| Control (0.0 ppm) | 11.562 | 10.962 | 11.186 | 11.002 | 10.438 | 11.030 |
| 1000 ppm | 13.198 | 11.776 | 12.228 | 12.858 | 10.060 | 12.024* |
| 2000 ppm | 12.916 | 12.384 | 13.450 | 13.102 | 9.808 | 12.332* |
| 4000 ppm | 13.470 | 12.206 | 12.648 | 12.546 | 11.240 | 12.422* |
| L.S.D. of treatment means = 0.5125<br>Non significant of interaction between period of treatment x treatment concentration. | | | | | | |
| | Brain weight (gm/100 gm b.w.) | | | | | |
| Control (0.0 ppm) | 5.846 | 6.180 | 6.114 | 5.724 | 5.506 | 5.874 |
| 1000 ppm | 6.442 | 5.822 | 5.372* | 6.266 | 5.818 | 5.944 |
| 2000 ppm | 6.386 | 6.634 | 5.956 | 5.940* | 5.174 | 6.018 |
| 4000 ppm | 6.112 | 6.002 | 5.978 | 6.060 | 5.964 | 6.023 |
| Non Significant differences exist between different treatments.<br>L.S.D. of interaction between period of treatment x treatment concentration = 0.619. | | | | | | |
| | Kidney weight (gm/100 gm b.w.) | | | | | |
| Control (0.0 ppm) | 5.298 | 5.240 | 5.326 | 5.066 | 5.168 | 5.220 |
| 1000 ppm | 5.444 | 5.354 | 5.626 | 5.396 | 5.356 | 5.435* |
| 2000 ppm | 5.142 | 5.352 | 5.760 | 5.160 | 4.750 | 5.233 |
| 4000 ppm | 5.326 | 4.978 | 5.312 | 4.964 | 4.950 | 5.106 |
| L.S.D. of treatment means = 0.1880.<br>Non significant of interaction between period of treatment x treatment concentration. | | | | | | |

Table 4. Effect of treatment with different concentrations of buprofezin on internal organ weight of male albino rats

| Treatment | Treatment period (days) | | | | | |
|---|---|---|---|---|---|---|
| | 15 | 30 | 65 | 90 | Recovery for 30 days | Over all mean of treatment |
| | | | Spleen weight (gm/100 gm b.w.) | | | |
| Control (0.0 ppm) | 2.886 | 3.160 | 2.890 | 2.922 | 2.584 | 2.888 |
| 1000 ppm | 3.316 | 3.952 | 2.872 | 2.614 | 2.724 | 2.916 |
| 2000 ppm | 3.132 | 2.910 | 3.116 | 2.766 | 2.634 | 2.912 |
| 4000 ppm | 3.182 | 3.076 | 2.836 | 2.666 | 2.616 | 2.875 |
| Non significant differences exist between different treatments. Non significant of interaction between period of treatment x treatment concentration. | | | | | | |
| | | | Heart weight (gm/100 gm b.w.) | | | |
| Control (0.0 ppm) | 3.594 | 3.670 | 3.526 | 3.498 | 3.556 | 3.569 |
| 1000 ppm | 3.770 | 3.632 | 3.628 | 3.552 | 3.878 | 3.692 |
| 2000 ppm | 3.324 | 3.616 | 3.666 | 3.656 | 3.854 | 3.623 |
| 4000 ppm | 3.482 | 3.652 | 3.572 | 3.660 | 3.686 | 3.612 |
| Non significant differences exist between different treatments. Non significant of interaction between period of treatment x treatment concentration. | | | | | | |
| | | | Lung weight (gm/100 gm b.w.) | | | |
| Control (0.0 ppm) | 4.792 | 5.022 | 5.018 | 4.490 | 4.670 | 4.798 |
| 1000 ppm | 5.704 | 5.734 | 5.478 | 6.790 | 5.714 | 5.884* |
| 2000 ppm | 5.548 | 6.164 | 5.382 | 5.214 | 4.804 | 5.422* |
| 4000 ppm | 5.362 | 5.278 | 5.632 | 5.222 | 5.344 | 5.368* |
| L.S.D. of treatment means = 0.4075. Non significant of interaction between period of treatment x treatment concentration. | | | | | | |

Table 5. Effect of treatment with different concentrations of diafenthiuron on internal organ weight of male albino rats

| Treatment | Treatment period (days) | | | | | |
|---|---|---|---|---|---|---|
| | 15 | 30 | 65 | 90 | Recovery for 30 days | Over all mean of treatment |
| | | | Liver weight (gm/100 gm b.w.) | | | |
| Control (0.0 ppm) | 9.504 | 11.386 | 10.934 | 10.600 | 10.436 | 10.572 |
| 150 ppm | 10.302* | 10.526* | 10.304 | 10.284 | 9.874 | 10.258 |
| 300 ppm | 10.266 | 12.328* | 10.594 | 10.556 | 10.142 | 10.777 |
| 600 ppm | 10.434* | 11.092 | 10.296 | 10.412 | 10.416 | 10.530 |
| L.S.D. of treatment means = 0.342<br>L.S.D. of interaction between period of treatment x treatment concentration = 0.765. | | | | | | |
| | | | Brain weight (gm/100 gm b.w.) | | | |
| Control (0.0 ppm) | 4.534 | 4.460 | 4.342 | 4.650 | 4.274 | 4.452 |
| 150 ppm | 4.922 | 4.578 | 4.544 | 4.362 | 4.086 | 4.498 |
| 300 ppm | 4.418 | 4.762 | 4.178 | 4.080* | 4.928 * | 4.273 |
| 600 ppm | 4.568 | 4.318 | 4.164 | 4.724 | 3.970 * | 4.349 |
| Non Significant differences exist between different treatments.<br>L.S.D. of interaction between period of treatment x treatment concentration = 0.424. | | | | | | |
| | | | Kidney weight (gm/100 gm b.w.) | | | |
| Control (0.0 ppm) | 4.412 | 5.122 | 5.094 | 4.502 | 4.798 | 4.786 |
| 150 ppm | 4.982* | 5.096 | 4.876 | 4.776 | 4.650 | 4.876 |
| 300 ppm | 4.878 * | 5.032 | 4.616 * | 4.850 * | 4.636 | 4.802 |
| 600 ppm | 4.822 * | 4.924 | 4.692 * | 4.652 * | 4.716 | 4.801 |
| Non significant exist between different treatments.<br>L.S.D. of interaction between period of treatment x treatment concentration = 0.298. | | | | | | |

Table 6. Effect of treatment with different concentrations of diafenthiuron on internal organ weight of male albino rats

| Treatment | Treatment period (days) | | | | | |
|---|---|---|---|---|---|---|
| | 15 | 30 | 65 | 90 | Recovery for 30 days | Over all mean of treatment |
| | Spleen weight (gm/100 gm b.w.) | | | | | |
| Control (0.0 ppm) | 2.768 | 3.000 | 2.576 | 2.696 | 2.584 | 2.725 |
| 150 ppm | 3.136 | 2.708 | 2.358 | 2.230 | 2.578 | 2.602 |
| 300 ppm | 2.522 | 2.680 | 2.586 | 2.808 | 2.516 | 2.622 |
| 600 ppm | 2.992 | 2.750 | 2.648 | 2.400 | 2.748 | 2.694 |
| Non significant differences exist between different treatments. L.S.D. of interaction between period of treatment x treatment concentration 0.354. | | | | | | |
| | Heart weight (gm/100 gm b.w.) | | | | | |
| Control (0.0 ppm) | 2.996 | 3.652 | 3.338 | 3.046 | 3.348 | 3.276 |
| 150 ppm | 3.528 * | 3.772 | 3.296 | 3.112 | 3.260 | 3.396 |
| 300 ppm | 3.240 | 3.646 | 3.360 | 3.468 * | 3.428 | 3.428 |
| 600 ppm | 3.310 * | 3.464 | 3.376 | 3.224 | 3.474 | 3.370 |
| Non significant differences exist between different treatments. L.S.D. of interaction between period of treatment x treatment concentration = 0.269. | | | | | | |
| | Lung weight (gm/100 gm b.w.) | | | | | |
| Control (0.0 ppm) | 4.828 | 4.834 | 4.518 | 4.286 | 4.148 | 4.523 |
| 150 ppm | 4.796 | 4.508 | 4.250 | 4.160 | 4.452 | 4.434 |
| 300 ppm | 4.940 | 4.604 | 3.988 * | 4.446 | 4.496 | 4.495 |
| 600 ppm | 4.926 | 4.646 | 4.804 | 5.352 * | 4.394 * | 4.824 * |
| L.S.D. of treatment means = 0.2334. L.S.D. of interaction between period of treatment x treatment concentration = 0.522. | | | | | | |

thyroxine causes hyperthyrodism while, secretion decrease results in hypothyrodism. T3 is found in the serum as a result of secretion by the thyroid gland (where it is synthesized) and as a result of the degradation of circulating thyroxine.

These results indicate that, buprofezin treatment reduced thyriod function where T4 and T3 concentrations decreased. These results are similar to those obtained by **Arnold *et al* (1983)**, who mentioned that, T4 decreased in rats treated with ethylenthiourea (ETU). Similar findings are also in agreement with the data of **Goldman *et al* (1990)**, who mentioned that, chlordimeform caused decrease in thyroid hormone levels.

Diafenthinore led to increase in thyroid (T4 and T3). Similar findings were reported by **Porter *et al* (1993)**, who observed that treatment of rats with aldicarb, methomyl and triazine led to increase in thyroxine level. Influence of pesticides on thyroid function results through the effect on biosynthesis of thyroid hormones **(Rusmy *et al* 1983)**.

**Raizada *et al* (1979)** reported that, pesticides appears to block the conversion of iodide to iodine and this has results in hypertrophy and marked hyperplasia of thyroid and a decrease in the synthesis of thyroxine. Table (3) shows that treatment of buprofezin resulted in an increase in some internal organs weight (liver, Kidney and Lungs) while, no differences were noted in other organs (brain, spleen and heart). On the other hand, diafenthurion treatment caused no significant effect on organs weight except the lungs, (Table 4). These results are in agreement with those obtained by **Cannon and Kimbrough (1979)**, who reported that, treatment of rats with kepone showed no differences in organs weight, except the liver and kidneys. Contrary to this are the findings of **Renner *et al* (1981)**, they reported that no changes were noted in the internal organs rats with PCNO. Our results are in agreement with those of **Shaker *et al* (1988)**, who found that both liver and spleen weights were increased in rats treated with dimethoate and deltamethrin. Increase in liver weight may be attributed primarily to hepatocytoma, increase in endoplasmic and excess lipid accumulation **(Shaker *et al* 1988)**.

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مجلة اتحاد الجامعات العربية للدراسات والبحوث الزراعية ، جامعة عين شمس ، القاهرة ، ١١(٢) ، ٨٣٧ - ٨٤٧ ، ٢٠٠٣

# دراسة تأثير بعض منظمات النمو علي وظائف الغدة الدرقية وأوزان الاعضاء الداخلية لذكور الفئران البيضاء البالغة

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في هذا البحث تمت دراسة تأثير السمية التحت مزمنة لكل من مركب الببروفيزين والديفنثيورون علي وظائف الغدة الدرقية وأوزان الاعضاء الداخلية - حيث قسمت ذكور الفئران البالغة الي ثمانية مجموعات متساوية (٢٥ حيوان) - حيث اخذت المجموعة الاولي والثانية كمجموعتين ضابطتين - أما المجموعة الثالثة والرابعة والخامسة فقد عوملت بمركب الببروفيزين وذلك باضافتة في مياه الشرب بالتركيزات ١٠٠٠ ، ٢٠٠٠ ، ٤٠٠٠ جزء في المليون وذلك لمدة ٩٠ يوما ، ثم بعد ذلك توقفت المعاملة لمدة ثلاثون يوما لمعرفة احتمال الشفاء.

أما المجموعة السادسة والسابعة والثامنة فقد عوملت بمركب الدايفنثيورون بالتركيزات ١٥٠ ، ٣٠٠ ، ٦٠٠ جزء في المليون بنفس الطريقة السابقة ، وقد تم اخذ عينات الدم من الحيوانات المعاملة بعد ذبحها وذلك بعد فترات ١٥ ، ٣٠ ، ٦٥ ، ٩٠ ، ١٢٠ يوما من بداية المعاملة ، وقد تم دراسة التغيرات التي طرأت علي النظم الهرمونية (الثيروكسين والتراي أيودوثيرونين) في هذه العينات ، كما تم وزن الاعضاء الداخلية [كبد، كلي ، مخ ، طحال ، رئتين ، القلب].

ونجد أنه قد أدت معاملة الحيوانات لمدة ٩٠ يوما بمركب الببروفيزين الي نقص مستوي هرمون الثروكسين والتراي ايودوثيرونين علي العكس من ذلك فان مركب الدايفنثيورون قد تسبب في زيادة ملحوظه في مستوي الهرمونين ، ايضا قد أدت المعاملة بمركب الببروفيزين الي زيادة ملحوظة في وزن كل من الكبد والكلي والرئتين ، أما المعاملة بمركب الدايفينثيورون فقد نتج زيادة في وزن الرئتين فقط .

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