Sci. J. Fac. Sci. Menoufia Univ., 2014, Vol. XXVI, 21-40

HISTOCHEMICAL EFFECTS OF SOME INSECT GROWTH REGULATORS ON THE HOUSE FLY, *MUSCA DOMESTICA* (DIPTERA: MUSCIDAE).

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ABSTRACT

The current work was carried out to evaluate the histochemical impacts of five insect growth regulators; applaud (buprofezin), consult (hexaflumuron) and match (lufenuron) as chitin synthesis inhibitors (CSIs), mimic (tebufenozide) as ecdysone agonist (EA) and admiral (pyriproxyfen) as juvenile hormone analogue (JHA) on the polysaccarides, chitin, proteins and the nucleic acids of house fly larvae, *Musca domestica*. The IGRs were applied by feeding the 1st instar larvae on diets mixed with the selected IGRs at100 ppm. Following 72 hours of treatment, a noticeable variation in polysaccharide material was observed. Applaud, match, mimic and admiral decreased the polysaccharide content (chitin) in the integument (body wall) and in the fat body cells. In addition, a noticeable variation in neutral polysaccharide material was observed. Applaud and match decreased the chitin content, while consult increased the chitin content in the integument. Moreover, a noticeable variation in protein content was observed. Applaud, mimic and admiral induced a slight increase in the protein content in the integument and in the fat bodies. On the other hand, the two CSIs, consult and match induced a reduction in the protein content in the integument and in the fat bodies. Also, the obtained results indicated that treatment of 1st instar larvae of *M. domestica* with consult, match and mimic induced slight decrease of RNA content, while applaud elicited high decrease of RNA. Admiral led to disappearance of RNA completely from the cells of epidermis (body wall) and in the fat bodies. With respect to the effect of the tested IGRs on DNA, the effects were slight in the epidermal and the fat body cells.

INTRODUCTION

The biological, biochemical and morphological effects of applaud, match, consult, mimic and admiral at 10,100, 1000 and 2000 ppm of *Musca domestica* larvae were studied by (**Abo-El-Mahasen *et al*., 2010; Assar *et al*., 2010 and Kahlil *et al*., 2010)**, respectively. Histochemical studies on insects are considered one of the most specific and interesting types of investigations. The histochemistry of insect midgut, the fat bodies and the integument have received little attention. However, few investigations of histochemical effects of insecticides on *M. domestica* have been carried out.

Scheller and Bodenstein (1981) studied the possible effects of ecdysterone and methoprene on RNA and DNA synthesis in brains of *Calliphora vicina.* They reported that the DNA and RNA contents of the brain cells increased during the last instar larvae. **Saha *et al*. (1986)** studied the effect of JHA and ecdystrone on the fat body in females of *Chrysocoris stollii* and observed that DNA and RNA decreased significantly in comparison with those of untreated insects. **Gan *et al*. (1991)** stated that the desoxyribonucleic acid (DNA) content of *Culex pipiens* larvae was significantly reduced in treated 4th instar larvae with diflubenzuron. **Assar and Emara (1997)** tested the histochemical effects of dimilin (diflubenzuron) on the midgut and the integument of the 4th instar larvae of *Spodoperta exigua*. The polysaccarides decreased in the midgut cells. There was no effect on the polysaccarides in the integument and a slight decrease of RNA and a high decrease of DNA. While diflubenzuron, induced a remarkable reduction in the total protien content on larvae of *S. exigua*. **Mittal and Navpreet (1998)** reported that treatment of 4th instar larvae of *C. pipiens* with JHA 1,3 carbpropoxy phenoxy 3,7 dimethyl 6-octene (0.05 - 0.l ppm) led to decrease in biosynthesis and storage of glycogen and proteins in fat body cells due to interference of JHA with digestion and absorption of food in the midgut epithelium. **Mittal and Ruchita (1998)** found that treatment of 4th instar larvae of *C. pipiens* with 0.5 ppm. of JHA (ethylS-geranyloxy 3-methyl pent-2-enoate for 24 hours caused decrease in glycogen, proteins and RNA which was more marked than the decrease in DNA.

Shaurub *et al.* (1998) stated that pyriproxyfen reduced the synthesis of RNA and DNA in the ovaries and testes of *Spodoptera littoralis* treated as 4th instar larvae. **Mittal and Navpreet (2000)** found that newly synthesized JHA 1 - (3 - methyl- 6 - isopropylcyclohexyloxy- 3, 7-dimethyl- 2 (E), 6 - octadiene) at 3 ppm induced decrease of glycogen, proteins, DNA and RNA in *C.pipiens* larvae. **Assar (2004)** studied the histochemical effect of LC_{25} pyriproxyfen, hexaflumuron and methoxyfenozide against one day old larvae of the flesh fly, *Parasarcophaga aegyptiaca* by dipping treatment. All the three tested insect growth regulators decreased the polysaccharide content. Hexaflumuron and methoxyfenozide gave a moderate reduction in polysaccharide content, while pyriproxyfen gave the lowest effect. LC_{25} of the tested insect growth regulators decreased the protein content in the midgut and the fat bodies. Methoxyfenozide and hexaflumuron were more effective than pyriproxyfen. Most cells appeared greatly influenced containing only traces of proteins in their cytoplasm. Midgut and fat cells of larvae treated with pyriproxyfen showed a slight decrease of RNA only, while hexaflumuron and methoxyfenozide induced a marked reduction of RNA content. DNA did not affect with the treatment by all these insect growth regulators.

Assar and Abo-Shaeshae (2004) investigated the histochemical effects of LC_{50} of methoxyfenozide and pyriproxyfen by mixing technique on the midgut, fat bodies and integument of *M. domestica*. A marked reduction in the total protein was noticed in the fat cells of *M. domestica* larvae treated with methoxyfenozide and pyriproxyfen. The proteins decreased in the integument (cuticle) of larvae treated with methoxyfenozide. Pyriproxyfen gave a moderate reaction with mercury bromphenol blue in the integument. Moreover, midgut cells of larvae treated with methoxyfenozide and pyriproxyfen showed a slight decrease of RNA only. Fat bodies in the larvae treated with methoxyfenozide showed a high decrease of RNA, while pyriproxyfen elicited slight reduction in both RNA and DNA in the fat cells. The effect of methoxyfenozide on the integument is not clear, because the tested compound caused degeneration in the hypodermal cells, while pyriproxyfen elicited a high decrease of RNA only in the hypodermal cells of the integument. **Shams El-Dein (2006)** stated

that the carbohydrate, protein and RNA content in the midgut and fat body of *C.pipiens* was reduced due to treatment of larvae with LC_{50} of hexaflumuron, methoxyfenozide and pyriproxyfen while DNA content was not affected.

MATERIALS AND METHODS

1-Maintenance of culture

The strain of *Musca domestica* was obtained from the Research Institute of Medical Entomology, Dokki, Giza. The colony was maintained under laboratory conditions of 27 ± 2 °C and 70 ± 5% relative humidity **(Hashem and Youssef 1991)**.

2-The tested insect growth regulators:-

A-Chitin synthesis inhibitors:-

1- Buprofezin

Trade name: Applaud, purchased from Dow Agroscience, Egypt.

Common name: Buprofezin (25% WP)

Chemical name: 2-[(1,1-dimethylethyl)imino] tetrahydro-3-

(1 -methylethyl)-5-phenyl-4H-1, 3, 5-thiadiazin-4-one

Code name: NNI-750 (Nihon Nohyaku); PP618 (Zeneca)

2-Hexaflumuron

Trade name: Consult, purchased from Dow Agroscience, Egypt.

Common name: Hexaflumuron (10% EC).

Chemical name: 1-[3, 5-dichloro-4-(1, 1, 2, 2-tetrafluoroethoxy) phenyl]-3-(2, 6-difluorobenzoyl) urea

Code name: 86479-06-3

3- Lufenuron

Trade name: Match, purchased from Dow Agroscience, Egypt.

Common name: Lufenuron (10% EC).

Chemical name: N-[[[2, 5-dichloro-4-(1, 1, 2, 3, 3, 3- hexafluoropropoxy) -= phenyl] amino] carbonyl]-2, 6-difluorobenzamide

Code name: CGA 184699

B-Ecdysone agonist:-

Tebufenozide

Trade name: Mimic, purchased from Dow Agroscience, Egypt.

Common name: Tebufenozide (24 % EC)

Chemical name: 3, 5-dimethylbenzoic acid 1-(1, 1-dimethylethyl)-= 2-(4-ethylbenzoyl) hydrazide

Code name: RH-5992

C- Juvenile hormone analogue: -

Pyriproxyfen

Trade name: Admiral (Sumilarv), purchased from Sumitomo Co. Egypt.

Common name: Pyriproxyfen (10 % EC)

Chemical name: 2-[1-methyl-2-(4-phenoxyphenoxy)ethoxy]pyridine

Code name: S-9318; S-31183

First instar larvae of *M. domestica* were reared for three days on diets treated with 100 ppm of the tested IGRs. The treated larvae were cut into three parts. The middle part was taken, fixed in different specific fixatives for each stain, blocked, sectioned and stained for histochemical study.

A-Demonstration of polysaccharides

1- periodic Acid-Schiff technique (PAS)(Hotchkiss, 1948)

Mucopolysaccharides are deep purplish-red.

2-Alcian blue-PAS method (Mowry, 1956)

It is a good method for differentiating between acid and neutral mucopolysaccharides. Acid mucopolysaccharides stained blue.

Neutral mucopolysaccharides stained red. Mixtures mucopolysaccharides stained purpule

B- Demonstration of proteins:

Mercury-Bromphenol Blue (Bonhag, 1955)

Proteins are stained deep clear blue colour.

C- Demonstration of nucleic acids

Schiff -Methylene blue (Garvin *et al*., 1976)

DNA is stained red to purple and RNA is stained blue.

RESULTS AND DISCUSSION

1-polysaccharides:-

A large amount of polysaccharide material was observed in the integument and the cells of fat bodies of untreated (control) larvae of *M. domestica* as indicated by strong PAS- positive reaction given by these cells as red violet colour [plate (1) Fig. (1, 7), respectively]. Following 72 hours, of treatment with 100 ppm of the tested IGRs, a noticeable variation in polysaccharide material was observed. Applaud, match, mimic and admiral decreased the polysaccharide content in the integument (body wall) [plate (1) Fig. (2, 4, 5 and 6)], respectively and in the fat body cells [plate (1) Fig. (8, 10, 11 and 12)], respectively. Consult gave slight increase in the polysaccharide content in the integument [plate (1) Fig. (3)] and in the fat body cells [plate (1) Fig. (4)].

A large amount of neutral polysaccharide material (chitin) was observed in the integument of untreated larvae of *M. domestica* as indicated

by the strong Alcian blue PAS reaction (red colour) [plate (2) Fig. (1)]. Following 72 hours of treatment with 100 ppm of the three tested CSIs (applaud, consult and match), a noticeable variation in neuteral polysaccharide material was observed. Applaud and match decreased the chitin content (neuteral polysaccharide) in the integument of *M. domestica* larvae [plate (2) Fig. (2 and 4)], respectively, while consult increased the chitin content in the integument [plate (2) Fig. (3)].

Gangishetti *et al.* (2009) assured that the amount of epidermal and tracheal chitin was reduced in *Drosophila melanogaster* larvae as a result of lufenuron and diflubenzuron treatment. The reduction in neutral polysaccarides (chitin) content induced by applaud and match in the present study is similar to the results reported by **Ishaya and Casida (1974)** using diflubenzuron, **El-Kordy (1985)** using triflumuron and diflubenzuron and **Assar et al. (2010)** using applaud and match on the glucose content of *M. domestica*.

The increase of neutral polysaccharide (chitin) induced by consult in the present study was noticed by **El-Sherif (1995)** and **El-Sokkary (2003)** using pyriproxyfen against *Schistocerca gregaria* and **Assar et al. (2010)** using consult on the glucose content of *M. domestica*.

Applaud, match, mimic and admiral decreased the polysaccharide content in the integument and in the fat body cells of *M. domestica* larvae. These results agree with those obtained by **Assar and Emara (1997)** using dimilin against *S.exigua*; **Mittal and Navpreet (1998), Mittal and Ruchita (1998), Mittal and Navpreet (2000)** against *C.pipiens* with JHAs**; Assar (2004)** using hexaflumuron, pyriproxyfen and methoxyfenozide against *P. aegyptiaca* and **Shams El-Dein (2006)** using hexaflumuron, pyriproxyfen and methoxyfenozide against *C. pipiens*.

On the other hand, consult increased the polysaccharide and the chitin content. The increase in carbohydrate content was recorded by **El-Sherif (1995)** using pyriproxyfen**; Badawy and El- Gammal (2000)** using benzoyl-phenyl urea, S- 71624**, El- Gammal and Badawy (2000)** using

JHM (S-71639) and **El-Sokkary (2003)** using pyriproxyfen and chlorfluazuron against *S. gregaria***.**

One of the well-known and widely distributed example of neutral mucopolysaccharides is chitin which is the simplest neutral mucopolysaccharide. It exisists mainly in the exoskeleton of insects and other arthropods. The units of chitin are glucosamine. In other words, chitin consists of N-acetyl-D-glucosamine units joined together in pairs by (1-4) glucoside linkages **(Mousa *et al.*, 1984)**.

2-Proteins

The total protein in the integument and fat body cells of *M. domestica* were reflected by the appearance of a bluish coloration. This was illustrated in the normal (untreated) sections of the integument [plate (3) Fig. (1)] and the fat bodies [plate (3) Fig. (7)]. Total protein in these sections pronounced large amount of dense blue particles. After 72 hr. of treating the larvae with the tested IGRs, a noticeable variation in protein content was observed. Applaud,mimic and admiral induced a slight increase in the protein content in the integument [plate (3) Fig. (2,5 and 6)] and in the fat bodies [plate (3) Fig. (8, 11, 12). On the other hand, the two CSIs, consult and match induced a reduction in the protein content in the integument and in the fat bodies. Consult induced a slight reduction in the protein content in the integument [plate (3) Fig. (3)] and in the fat bodies [plate (3) Fig. (9)]. While match induced a marked reduction in the protein content in the integument [plate (3) Fig. (4)] and in the fat bodies [plate (3) Fig. (10)].

Protein substances are essential constituents of the general animal cells and also in the maintenance of different activities. Consult and match decreased the total protein content in the integument and in the fat bodies. This confirms the findings of **Assar and Emara (1997)** who reported that dimilin (diflubenzuron) elicited reduction in the protein content of *S. exigua* as well as *C.pipiens* by JHA [**Mittal and Navpreet (1998), Mittal and Ruchita (1998)** and **Mittal and Navpreet (2000)**] **.Assar and Abo- Shaeshae (2004)** found that methoxyfenozide and

pyrioproxyfen (admiral) reduced the protein content in the larvae of *M. domestica*. Also, **Assar (2004)** stated that pyriproxyfen and hexaflumuron (consult) induced reduction in the protein content of *P. aegyptiaca*. **Shams El-Dein (2006)** mentioned that hexaflumuron, pyriproxyfen and methoxyfenozide elicited reduction in the protein content of *C. pipiens* larvae. On the other hand, applaud, mimic and admiral increased the total protein content in the integaument and the fat bodies of *M. domestica* larvae.

Biochemically, **Ghoneim (1994)** stated that chlorfluazuron induced a significant increase of fat body protein content in newly formed pupae of *S. littoralis*. **El-Sherif (1995)** reported that pyriproxyfen increased the level of haemolymph proteins of *S. gregaria* nymphs while a decrease in their fat bodies occurred.

Applaud, mimic and admiral increased the total protein content in the integument and fat bodies of *M. domestica* larvae. These results agree with **Assar *et al* . (2010)** who reported that the same IGRs increased the total content in the homogenate of 3rd larvae of *M. domestica*. Also, similar increase in the protein content of the same insect with dimilin, BAY SIR and altosid was reported by **Bakr (1986),** with pyriproxyfen on *S. gregaria* **(El-Sokkary, 2003)** and on *S. littoralis* **(Farag ,2001)**.The increase in total protein content may be due to the natural increase of protective hydrolytic and detoxyifying enzymes that usually take place shortly after treatment.

On the contrary, match and consult decreased the total protein content. Match was more effective than consult. These results are in harmony with **Assar *et al*. (2010)** by these IGRs on the same insect, and the findings in other insect species by different IGRs such as pyriproxyfen **(El-Sherif ,1995)** and lufenuron **(Bakr *et al*. 2007)** against *S. gregaria***,** pyriproxyfen **(Shaurub *et al*., 1998),** and tebufenozide **(Abd El-Mageed, 2008)** against *S. littoralis***,** pyriproxyfen against *A. ipsilon* **(El- Sheikh ,2002);** and by pyriproxyfen and hexaflumuron against *P. aegyptiaca* **(Assar ,2004)**. The decline in protein content obtained by match and consult can be explained according to **Mitilin *et al.* (1977)** by the inhibition of protein synthesis as a result of inhibition of DNA and RNA synthesis as the

first sign of cell death. **El-Bermawy, (1994)** verified that treatment of *M. domestica* larvae with variable levels of IKI, BAY SIR and sumilarv (admiral) resulted in a reduction in the total protein content of 3rd instar larvae of *M. domestica*, while an increase in total protein content of 1st and 2nd larvae was recorded. The author attributed this reduction to the inhibitory role of the tested IGRs on tissue protein synthesis, whereas, the high levels of total protein in tissues of 1st and 2nd larval instars may be referred either to a special stimulatory effect of the tested IGRs or unaffected protein synthesis. **Bakr *et al.*, (2007)** reported that the reduction of protein level might be due to the destructive effect of match on some of the cerebral neurosecrotory cells of the brain responsible for secretion of the proteins of the treated nymphs of *S. gregaria*.

3-Nucleic acids

The integument [plate (4) Fig. (1)] and the fat bodies [plate (4) Fig. (7)] sections of the control larvae stained with Schiff Feulgen methylene blue method showed the normal pattern of the nucleic nuclei. The nuclei exhibited a red color indicating their DNA contents. The RNA particles appeared as blue granules in the cytoplasm and in the nuclei.

Treatment of 1st instar larvae of *M. domestica* with 100 ppm of consult, match and mimic (plate 4: Fig. 3,4 and 5, respectively) induced slight decrease of RNA (plate 4 Fig. 2). Admiral led to disappearance of RNA completely from the epidermis (body wall) (plate 4 Fig.6). The effects of the tested IGRs on RNA content in the feat body cells (plate 4 Fig.7-12) are similar with its effects inside the hypodermal cells. The tested IGRs induced slight decrease in DNA content in the hypodermal cells (plate 4 Fig.1-6) and the fatbody cells (plate 4 Fig.7-12).

Assar and Emara (1997) stated that dimilin induced a high decrease of DNA in the midgut nuclei of *S. exigua*. There was a slight decrease of RNA particles in the cytoplasm of hypodermal cells of treated

larvae as compared to untreated group. **Assar (2004)** stated that pyriproxyfen, hexaflumuron and methoxyfenozide decrease RNA in the

midgut and the fat bodies of *P. aeygptiaca* while DNA was not affected. **Assar and Abo-Shaeshae (2004)** reported that methoyfenozide and pyriproxyfen reduced the synthesis of RNA in the midgut, fat bodies and the infegument of *M. domestica*, however no appreciable difference could

be observed for the synthesis of DNA. Also, **Shams El-Dein (2006)** stated that pyriproxyfen, hexaflumuron and methoxyfenozide reduced RNA in the midgut and the fat bodies of *C. pipiens* while DNA was not affected.

According to the biological, biochemical and morphological studies investigated by (**Abo-El-Mahasen *et al*., 2010; Assar *et al*., 2010 and Kahlil *et al*., 2010)**, respectively concerning the effects of applaud, consult, match, mimic and admiral on the house fly larvae as well as the present histochemical studies, it can be concluded that the tested IGRs, especially applaud, match, mimic and admiral may be used successfully for controlling house fly.

Abbreviations

Ch: chitin	Fc: fat cell
En: endocuticle	Nu: Nucleus
Ep: epicuticle	DNA : deoxyribonucleic acid
Ex: exocuticle	RNA: ribonucleic acid
Hy: hypodermis	Tr: trachea

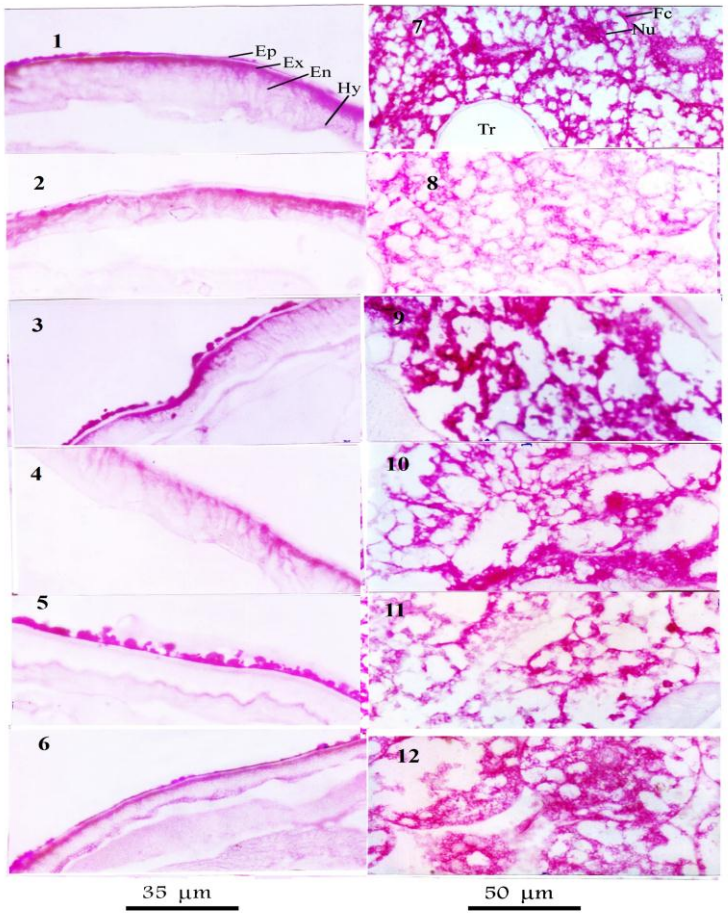

Plate (1): Sections in the integument and fat body of 3rd instar larvae of *M. domestica* untreated and treated as 1st larval instar with 100 ppm of the tested IGRs and stained by PAS showing polysaccharide particles (red violet)

Fig (1) : Integument (control)
Fig (2) : Treated with applaud
Fig (3) : Treated with consult
Fig (4) : Treated with match
Fig (5) : Treated with mimic
Fig (6) : Treated with admiral
Fig (7) : Fat body (control)
Fig (8) : Treated with applaud
Fig (9) : Treated with consult
Fig (10) : Treated with match
Fig (11) : Treated with mimic
Fig (12) : Treated with admiral

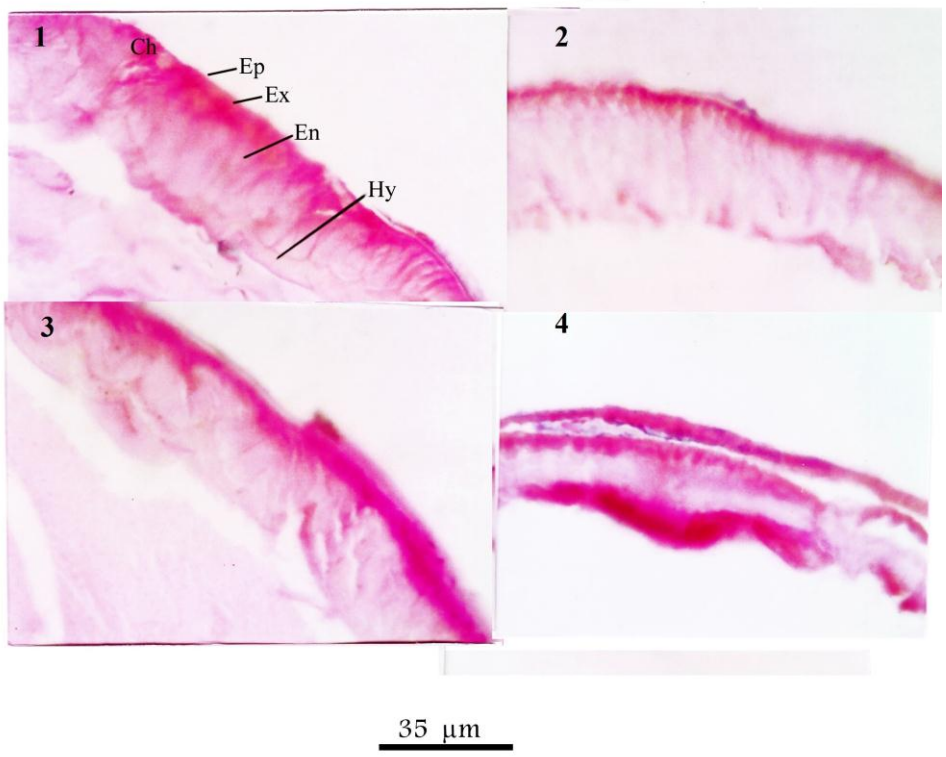

Plate (2): Sections in the integument of 3rd instar larvae of *M. domestica* untreated and treated treated as 1st larval instar with 100 ppm of the tested IGRs and stained by alcian blue PAS showing neutral polysaccarides (chitin) (red colour)

Fig (1) : Integument (control)
Fig (2) : Treated with applaud
Fig (3) : Treated with consult
Fig (4) : Treated with match

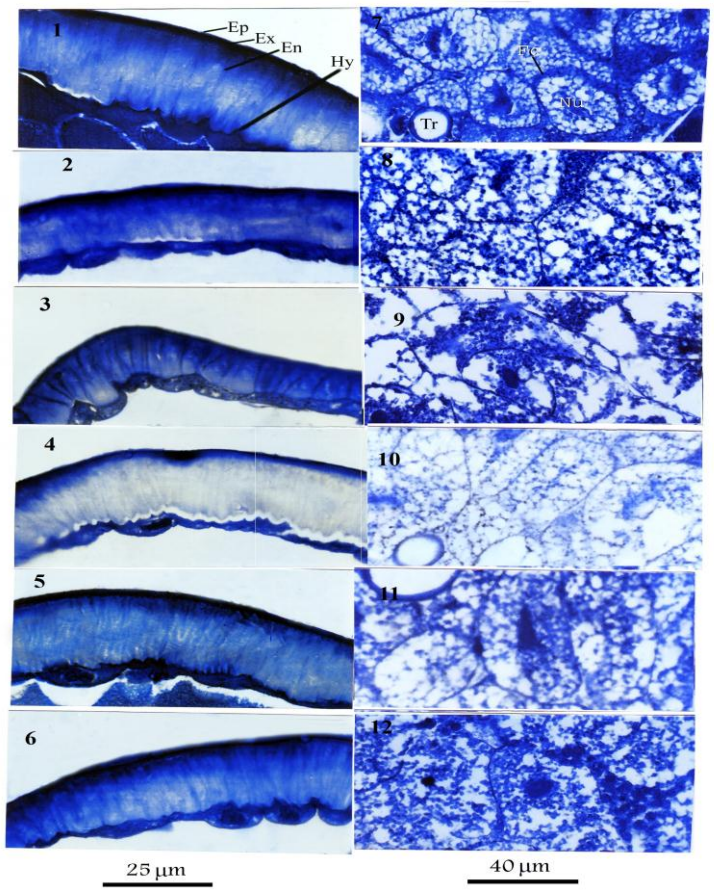

Plate (3): Sections in the integument and fat body of 3rd instar larvae of *M. domestica* untreated and treated treated as 1st larval instar with 100 ppm of the tested IGRs and stained with mercury bromphenol blue showing normal pattern and localization of total protein particles; (blue colour).

Fig (1) : Integument (control)
Fig (2) : Treated with applaud
Fig (3) : Treated with consult
Fig (4) : Treated with match
Fig (5) : Treated with mimic
Fig (6) : Treated with admiral
Fig (7) : Fat body (control)
Fig (8) : Treated with applaud
Fig (9) : Treated with consult
Fig (10) : Treated with match
Fig (11) : Treated with mimic
Fig (12) : Treated with admiral

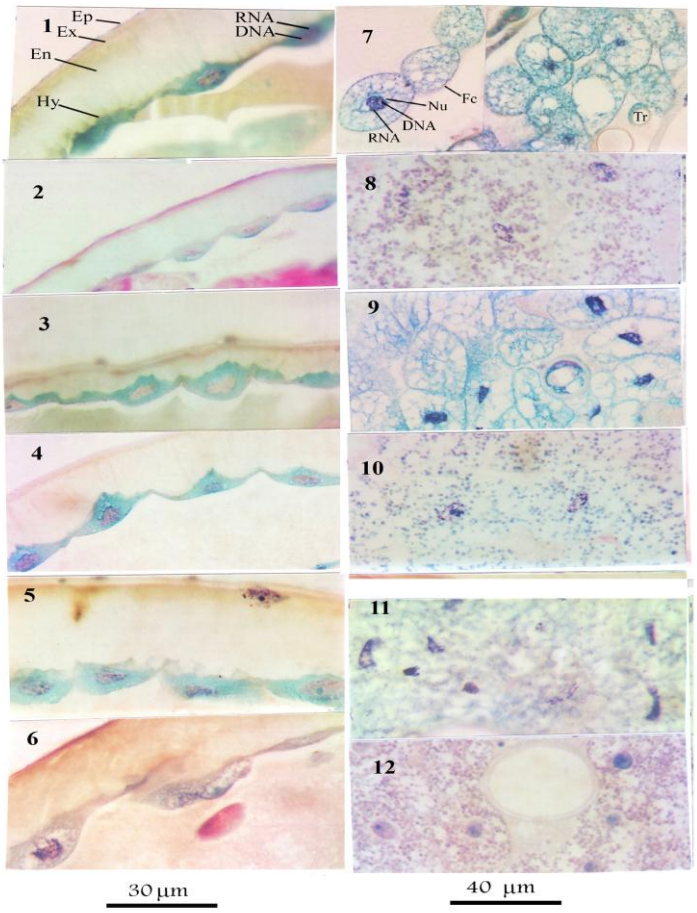

Plate (4): Sections in the integument and fat body of 3rd instar larvae of *M. domestica* untreated and treated treated as 1st larval instar with 100 ppm of the tested IGRs and stained with Schiff Feulgen methylene blue, showing normal pattern and localization of nucleic cuds (RNA, blue) (DNA: red)

Fig (1) : Integument (control)
Fig (2) : Treated with applaud
Fig (3) : Treated with consult
Fig (4) : Treated with match
Fig (5) : Treated with mimic
Fig (6) : Treated with admiral
Fig (7) : Fat body (control)
Fig (8) : Treated with applaud
Fig (9) : Treated with consult
Fig (10) : Treated with match
Fig (11) : Treated with mimic
Fig (12) : Treated with admiral

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التاثيرات الهستوكيميائية لبعض منظمات النمو الحشرية على Musca domestica (Diptera: Muscidae)

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استهدفت هذه الدراسة تحديدالتاثيرات الهستوكيمائية لخمسة من منظمات النمو الحشرية وهى البيبروفيزين(أبلويد) والهيكسافلوميرون (كونسلت) و الليوفينورون (ماتش) كمثبطات تكوين الكيتين، والتيبوفينوزيد(ميمك)كمشابه لهرمون الانسلاخ و البيربروكسيفين (أدميرال) كمشابه لهرمون الشباب علي المواد عديدة التسكر والكيتين والبروتينات والأحماض النووية في جدار الجسم والأجسام الدهنية ليرقات العمر الأول للذبابة المنزلية والتى تم تغذيتها على غذاء معامل بتركيز ١٠٠ جزء فى المليون من المبيدات المختبرة لمدة ٧٢ ساعة).

وقد أوضحت النتائج أن المعاملة باكونسلت أدت الى زيادة طفيفة في محتوى المواد عديدة التسكر في جدار الجسم والأجسام الدهنية. بينما أدى استخدام كل من الأبلويد والماتش والميمك والأدميرال الي نقص في المواد عديدة التسكر.

في حين أن مثبطات الكيتين المختبرة (الأبلويد والماتش) أدت الي نقص ملحوظ في محتوى المواد عديدة التسكر المتعادلة (الكيتين) بينما أدى الكونسلت الي زيادة في الكيتين في جدار الجسم. وأظهرت النتائج اختلاف في المحتوى البروتينى حيث ادت المعاملة بالأبلويد والميمك والأدميرال الي حدوث زيادة طفيفة في المحتوى البروتينى في جدار الجسم والأجسام الدهنية وعلى النقيض من ذلك احدث كل من الماتش والكونسلت انخفاضا في المحتوى البروتينى في جدار الجسم والأجسام الدهنية لليرقات المعاملة.

كما أوضحت النتائج أن المعاملة بالكونسلت والماتش والميمك أدى الي نقص طفيف في محتوى الحمض النووى RNA بينما أحدث الأبلويد نقصا شديدا في محتوى الحمض النووى RNA في حين أدت المعاملة بالأدميرال الي اختفاء هذا الحمض من الخلايا سواء في جدار الجسم أو الأجسام الدهنية. وبالنسبة لتاثيرات المبيدات المختبرة علي محتوى الحمض النووى DNA فكان التاثير بسيطا في كل من جدار الجسم والأجسام الدهنية بالمقارنة بالكنترول.