J. Plant Prot. and Path., Mansoura Univ., Vol. 3 (9): 905 - 919, 2012

EVALUATION OF ACUTE TOXICITY AND TERATOGENIC EFFECTS OF SOME PLANT GROWTH REGULATORS ON ALBINO RAT EMBRYO

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ABSTRACT

Gibberellic acid(GA_3) and Indole acetic acid (IAA) is an endogenous plant growth regulator used world wide in agriculture ;however, little is known about its biochemical and physiological effects on mammals. This study investigated possible toxic and teratogenic effects of GA_3 and IAA on the embryo of albino rats. Female Wistar rats were given daily 200 ppm / 0.2 ml saline from either GA_3 or IAA orally from the 1st day of pregnancy until the 14^{th}, 16^{th}, or after delivery. Toxicity was demonstrated by a significant increase in malondialdehyde level and a decrease in the antioxidant enzyme activities of catalase, superoxide dismutase, and glutathione peroxidase in the brain, spinal cord, eye, and liver of pups. A significant decline of glutathione content was also observed. The biochemical parameters were correlated histologically with an abnormal development of the external morphology and formation of the skeleton of either GA_3 or IAA-treated pups.

INTRODUCTION

Gibberellins are a group of plant growth regulators widely use to improve the yield of a wide variety of plants by increasing cell division, cell elongation that affect leaves as well as stems (Silverstone and Sun, 2000) and accelerate the growth of fruits and vegetables in the world (Arous *et al*., 2001).

The World Health Organization (WHO, 1990) listed gibberellin-A_3 as a plant growth regulators related to pesticides.

Indole acetic acid is a plant hormone detected in human urine (Qureshi and Baig, 1993), blood plasma (as a metabolite of tryptophan) (Bertuzzi *et al*., 1997) and central nervous system (Hu and Dryhurst, 1997). It is also, found in cerebrospinal fluid and in several organs such as liver, kidney, lungs and brain (De Melo *et al*., 1998). IAA is predominantly formed as a result of the mono amin oxidase - mediated oxidative de amination of tryptamine, a putative neurotransmitter or neuromodulator in CNS (Artigas *et al*., 1983). The plasma levels of IAA and its metabolites were elevated in some human diseases such as insulin dependent diabetes mellitus (Rogerson *et al*., 1991), renal dysfunction and phenylketonuria (Qureshi and Baig, 1993). The combination of IAA and horseradish peroxidase (HRP) was found to cause cytotoxic toward mammalian cells (Folkes *et al*., 1999) and increase lipid peroxidation (Candeias *et al*., 1996; Folkes *et al*., 1999).

The toxic effects of these chemicals on animals are limited; therefore, this subject has attracted the interest of many researchers recently. Many

chemicals are currently used in agriculture, and PGRs are among those widely used. The amounts of these substances placed into the environment may soon exceed those of insecticides (Mickey, 1978). The effects of different PGRs on insects have been investigated (Visscher, 1983; De Man *et al*., 1991), but reports concerning vertebrates are very limited (El-Mofty and Sakr, 1988; Ustun *et al*., 1992; Ozmen et al., 1995; de Melo *et al.*, 2004; Furukawa *et al*., 2004; Hsiao *et al*., 2004). In the literature, it is reported that fecundity, longevity, and egg viability have been changed in different insects by PGRs treatment (De Man *et al*., 1991). Furukawa *et al.* (2004) indicate that indole acetic acid (IAA) might induce the neuronal apoptosis in the S phase and lead to microencephaly.

Concerning its effect on apoptosis, Furukawa *et al*. (2004) that IAA induces neuronal apoptosis in S phase and leads to microencephaly. According to previous studies (Candeias *et a*l., 1995; Celik and Tuluce, 2006; Tuluce and Celik, 2006; Celik *et al*., 2007). Gibberellic acid(GA_3) is the most commonly used PGRs in agriculture in many countries, including Tunisiain order to enhance fruit growth like date palm (Ben Abdallah *et al*.,2000) and some vegetables such as pepper(Arous *et al*.,2001) and olive (Chaari-Rkhis *et al*., 2006). GA_3 has also been shown to cause alarming toxicity to mammalian systems, particularly in the breast, lung (El-Mofty *et al*., 1994), kidney and liver (Ustun *et al*., 1992) of adult mice. In addition, GA_3 administration by gavage for 22 months induces carcinogenic effects in adult Swiss Albino mice (El-Mofty *et al*., 1994). According to Ozmen *et al*. (1995) treatment with GA_3 affects sexual differentiation and some physical parameters in laboratory mice. Recent reports indicate that this PGRs may induce oxidative stress, leading to the generation of free radicals and causing cells damage in many organs, including the heart, kidney, stomach and spleen of adult rats (Celik and Tuluce, 2006) and the liver of GA_3 treated suckling rats (Troudi *et al*.,2010).

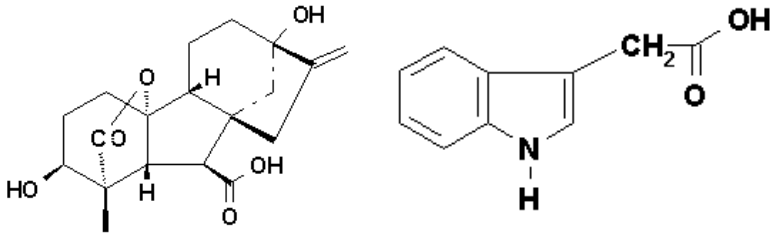
MATERIALS AND METHODS

All experiments were conducted in accordance with the national laws for the use of animals in research and approved by the local ethical committee.

Chemicals:

Two applied plant hormones were used in the present work ; one belong to Gibberellin group (Gibberellic acid) and the other belong to auxin (indoleacetic acid) were purchased from Sigma Chemical Company (St. Louis, MO 6, USA). Both compounds`were dissolved in tap water at doses of 200 ppm / 0.2 ml saline for GA_3 and IAA.

Gibberellic acid **Indole acetic acid**:



Experimental work:

Seventy-two fertile male and virgin female rats weighing approximately 125g body weight were obtained from Hellwan Breeding Farm, Ministry of Health at ratio of 1:3 respectively and used for experimentation. Vaginal smears were carried out to give a precise determination of the onset of gestation.

The rats were arranged in to three groups, each was composed of 18 individuals as follows:

1– Control pregnant: the animals received basal diet and tab water.

2– Gibberellic acid (GA_3)-treated pregnant: Each individual received oral doses of 200 ppm / 0.2 ml saline for 40 days every other day and from the 1^{st} to 14^{th}, 16th, or delivery day of gestation.

3– Indoleacetic acid (IAA)-treated pregnant: Each individual received oral doses of 200 ppm/ 0.2 ml saline for 40 days every other day and from the 1^{st} to 14^{th},16^{th}, or delivery day of gestation.

RESULTS

From table (1), treating pregnant with either gibberellic or indole acetic acid on pregnant mothers revealed 5/25 of pregnant mothers failed to complete pregnancy especially of those subjected to indole acetic aci treatment. Experimental group receiving gibberellic acid -treatment showed marked decrease of the number of delivered pups. There was a marked reduction of both body weights and crown-rump size of prenatal embryos at 14 & 16 days old as well as pups maternally subjected to plant growth hormone-treatment especially of those subjected to indole acetic acid-treatment.

Examining the gross morphology of pups of experimental treated groups revealed the presence of different pattern of congenital malformations. Superficial haematomas and fore limb deformation were detected in delivered newborn of studied experimental groups. Highest incidence was recorded in experimental epileptic group receiving indole acetic acid– treatment (Table (2-5), Figs. 1-9).

Table (1): Effect of experimentally either Gibberellic acid (GA_3) or Indole Acetic acid (IAA) treated female albino rats during pregnancy on pregnant mothers and their fetuses and pups.

	Control	(GA_3)	(IAA)
Total number of mothers	20 (100%)	25 (100%)	25 (100%)
Total number and percentage of aborted mothers	0 (0%)	5 (20%)	5 (20%)
Total number and percentage of pregnant	20 (100%)	20 (80%)	20 (80%)
Total number of fetuses and newborn	120 (100%)	60 (100%)	750(100%)
% of numerical reduction of fetuses & newly born from control	0 (0%)	(50%)	(62.5%)
Total number (% of fetal mortality)	0 (0%)	17 (28.4%)	21 (28%)
Total number & % of alive fetuses & newly born	120 (100%)	43 (71.6%)	54 (72%)

Control (C) Gibberellic acid (GA_3) Indole Acetic acid (IAA)

Table (2): Body weight (gm) and size (ml^3.) of fetuses (14&16 -days) and pups treated with either (GA_3) or (IAA).

Pregnancy Day	14 day prenatal			16 day prenatal			pups		
	C	GA_3	IAA	C	GA_3	IAA	C	GA_3	IAA
weight	4.01± 0.04	3.60± 0.03*	3.30± 0.01*	4.50± 0.06	4.10± 0.04*	3.90± 0.06*	5.30± 0.01	4.59± 0.04*	4.67± 0.04*
size	3.9± 0.07	2.4± 0.051*	2.8± 0.056*	5.6± 0.051	4.1± 0.088*	4.5± 0.052*	15.8± 0.094	9.5± 0.13*	9.2± 0.121*

Each result represents the mean ± SD of 10 replicates.

*** Significant at p < 0.05. Control (C) Gibberellic acid (GA_3) Indole Acetic acid (IAA)**

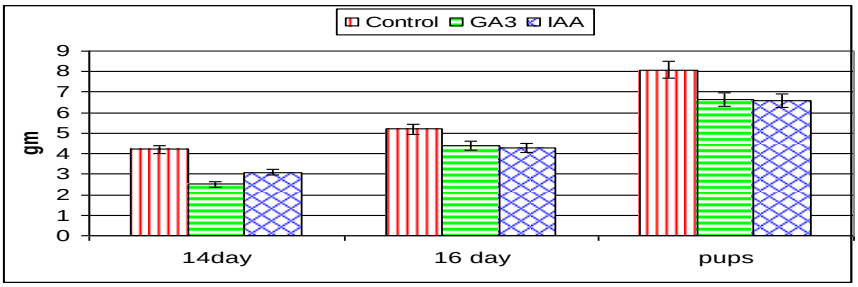


Fig. 1: Body weight (gm.) of fetuses (14, 16) and pups treated with either (GA_3) or (IAA).

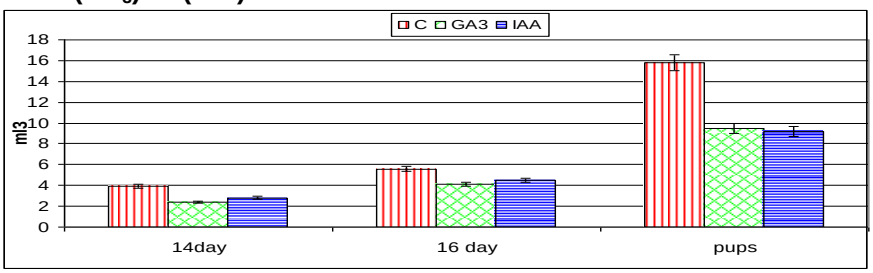


Fig. 2: Body size (ml3.) of fetuses (14&16days) and pups treated with either (GA_3) or (IAA).

Table (3): Crown-rump length (cm.) of fetuses (14&16) days and pups treated with either (GA_3) or (IAA).

14 day prenatal			16 day prenatal			21 day		
C	GA_3	IAA	C	GA_3	IAA	C	GA_3	IAA
1.99±0.08	1.76± 0.063*	1.7± 0.053*	2.55± 0.223	2.03± 0.144*	2.02± 0.108*	4.1± 0.047	3.74± 0.054*	3.84± 0.107*

Each result represents the mean ± SD of 10 replicates.

*** Significant at p < 0.05.Control (C) Gibberellic acid (GA_3) Indole Acetic acid (IAA)**

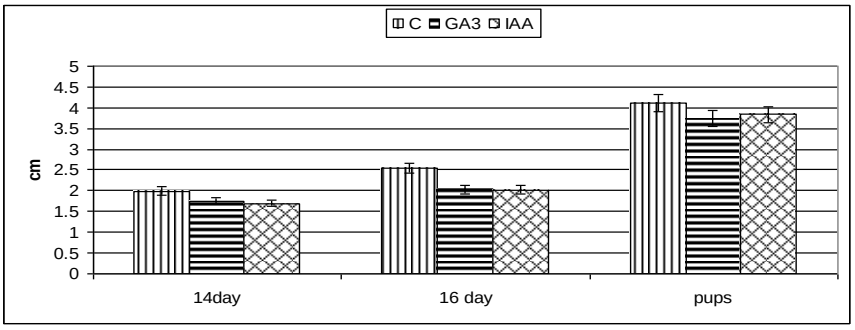


Fig.3: crown-rump length (cm.) of 14&16 days fetuses and pups treated with either gibberellic (GA_3) or indole acetic acids (IAA).

Table (4): Incidence of gross morphological and skeletal abnormalities of 14&16 days fetuses and pups treated with either (GA_3) or (IAA).

	Control	GA_3	IAA
Total number & % of alive fetuses & newly born	**120 (1000%)**	**43 (71.6%)**	**54 (72%)**
Superficial haematomas	0 (0%)	9 (20.93%)	10 (18.51%)
Abnormal fore limb			
-Unilateral	0 (0%)	12 (27.9%)	15 (27.8%)
-Bilateral	0 (0%)	20(46.51%)	25 (46.29%)
Abnormal hind limb			
-Unilateral	0 (0%)	9 (20.93%)	7 (12.96%)
-Bilateral	0 (0%)	20 (46.51%)	30(55.55%)
Incomplete ossification of sternum	0 (0%)	8(18.60%)	6(11.11%)
Kyphotic body	0 (0%)	10(23.25%)	5(9.25%)
Kinky tail	0 (0%)	16(37.20%)	14(29.92%)
Missing of caudal vertebrae	0 (0%)	11(25.58%)	13(24.07%)

Table (5): Head length & width (cm.) of 14&16 days fetuses and pups treated with either (GA3) or (IAA).

Pregnancy Day	14 day prenatal			16 day prenatal			21 day		
	C	GA_3	IAA	C	GA_3	IAA	C	GA_3	IAA
length	0.82± 0.032	0.65± 0.033*	0.59± 0.022*	0.9± 0.017	0.80± 0.012*	0.83± 0.021*	1.08± 0.01	0.93± 0.034*	0.91± 0.039*
width	0.49± 0.036	0.40± 0.025*	0.42± 0.014*	0.57± 0.009	0.47± 0.022*	0.49± 0.031*	0.71± 0.009	0.59± 0.038*	0.64± 0.024*

Each result represents the mean ± SD of 10 replicates.

*** Significant at p < 0.05.Control (C) Gibberellic acid (GA_3) Indole Acetic acid (IAA)**

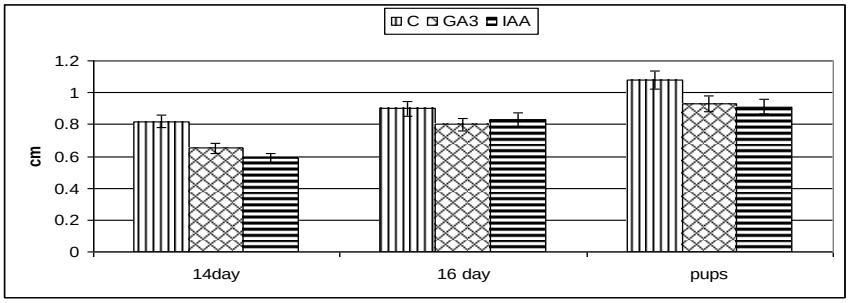


Fig.4: Head length (cm.) of 14&16 days fetuses and pups. Control (C) Gibberellic acid (GA_3) Indole Acetic acid (IAA)

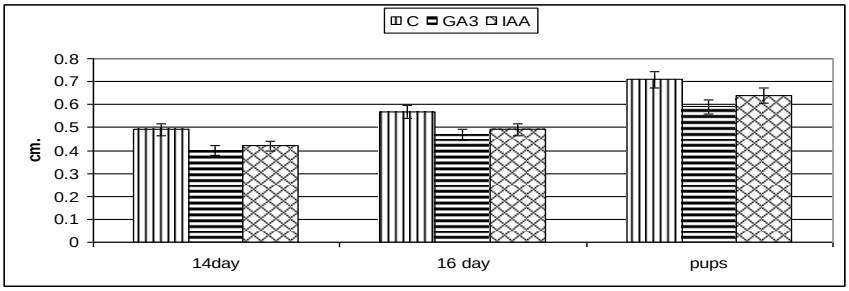


Fig.5: Head width (cm.) of 14&16 days fetuses and pups. Control (C) Gibberellic acid (GA_3) Indole Acetic acid (IAA)

Fig. 6 (C-G): photomacrographs of uterus of 16 days of gestation. C. control uterus showing symmetric distribution of implantation. G. Mother's uterus treated with (GA_3) & I. Mother's uterus treated with (IAA) showing resorption of fetuses and asymmetric distribution of implantation.

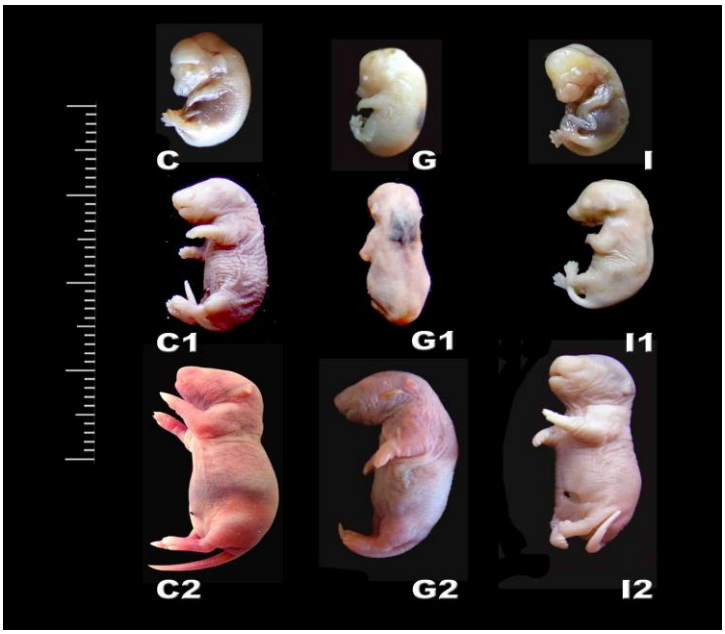


Fig. 7 (C-I2): Photomacrographs of lateral view gross morphology of 14, 16-days old fetuses and pups. C. Control 14-days old fetuses. G. 14-day old fetuse maternally treated with (GA_3) showing deformation of limbs and superficial haematomes. I. 14 days old fetuses maternally (IAA) showing deformation of limbs. C1. Control 16-days old fetuses. G1. & I1. 16-day old fetuses showing marked deformation in size, fore and hid limb, non demarkation of trunk region and superficial haematomes. C2. Control pups. G2. & I2. Pups showing marked deformation in size, deformation of fore and hid limb, exencephaly and superficial haematomes.

3. Effects of ossification of skeleton of delivered newborn:

Tables (6-7) revealed that pups maternally-treated with either gibberellic or indole acetic acid showed a marked retardation of ossification centers in axial and appendicular regions. Abscence of ossification center restrict mainly in interparietal, incus, malleus, stapes, and tympanic bone, exoccipital and supraoccipital regions. Abscence of ossification center were noted also in metacarpales, distal phalanx of fore limb, metatarsals, distal phalanx of hind limb and sternum. The highest incidence of missing ossification center was detected in prenatal embryos and pups maternaly treated with indole acetic acid (Figs.13).

The ossified length of mandibular and fore-(Humerus, radius & ulna) and hind limb parts (femur, tibia and fibula) were markedly reduced in prenatal embryos (14&16 days) as well as in pups maternally treated with either gibberellic or indole acetic acid-treatment (Tables 8-9, Figs.8 - 10).

Tables (10&11) illustrate calcium content in maternal serum and femur bone as well as in skeleton of prenatal embryos (14&16 days) and pups

maternally subjected to either gibberellic or indole acetic acid treatment. In case of mothers, treatment with either gibberellic or indole acetic acid led a decrease of maternal serum and femur bone calcium. On the other hand, there was a marked reduction of total calcium content in prenatal embryos and pups maternally treated with either gibberellic or indole acetic acid (Figs. 11&12).

Table (7): Incidence of skull bone abnormalities of pups treated with either (GA_3) & (IAA).

Group	Control	GA3	IAA
Total number & % of alive fetuses & newly born	**120 (1000%)**	**43 (71.6%)**	**54 (72%)**
Nasal	0 (0%)	4 (9.30%)	11 (20.37%)
Frontal	0 (0%)	10 (23.25%)	15 (27.78%)
Parietal	0 (0%)	6 (13.95%)	8 (14.81%)
Inter parietal	0 (0%)	12 (27.90%)	11 (20.37%)
Maxilla	0 (0%)	4 (9.30%)	2 (3.70%)
Zygomatic arch	0 (0%)	6 (13.95%)	2 (3.70%)
Hyoid Arch	0 (0%)	4 (9.30%)	4 (7.40%)
Squamosal	0 (0%)	6 (13.95%)	4 (7.40%)
Incus	0 (0%)	8 (18.60%)	2 (3.70%)
Malleus	0 (0%)	12 (27.90%)	8 (14.81%)
Stapes	0 (0%)	12 (27.90%)	11 (20.37%)
Tympanic ring	0 (0%)	4 (9.30%)	4 (7.40%)
Supraoccipital	0 (0%)	7 (16.27%)	6 (11.11%)

Table (8): Ossified length (mm.) of Mandibular and fore limb of 14&16 days fetuses and pups treated with either (GA_3) or (IAA).

Pregnancy Day	14 day prenatal			16 day prenatal			pups		
	C	GA_3	IAA	C	GA_3	IAA	C	GA_3	IAA
Mandibular	4.2± 0.02	2.5± 0.01*	3.1± 0.02*	5.2± 0.011	4.4± 0.01*	4.3± 0.03*	8.09± 0.1	6.64± 0.46*	6.57± 0.14*
Humerus	4.7± 0.05	2.4± 0.06*	1.68± 0.07*	5.64± 0.05	4.1± 0.1*	3.92± 0.08*	6.45± 0.03	4.750± 0.08*	5.9± 0.11*
Radius	2.7±0.06	1.8± 0.04*	1.7± 0.06*	5.67± 0.07	3.8± 0.06*	3.08± 0.08*	9.03± 0.09	6.56± 0.07*	7.08± 0.09*
Ulna	1.60± 0.03	1.21± 0.04*	0.92± 0.05*	4.08± 0.05	2.7± 0.07*	2.8± 0.07*	5.85± 0.04	3.14± 0.10*	2.84± 0.05*

Each result represents the mean ± SD of 10 replicates.

*** Significant at p < 0.05. Control (C) Gibberellic acid (GA_3) Indole Acetic acid (IAA)**

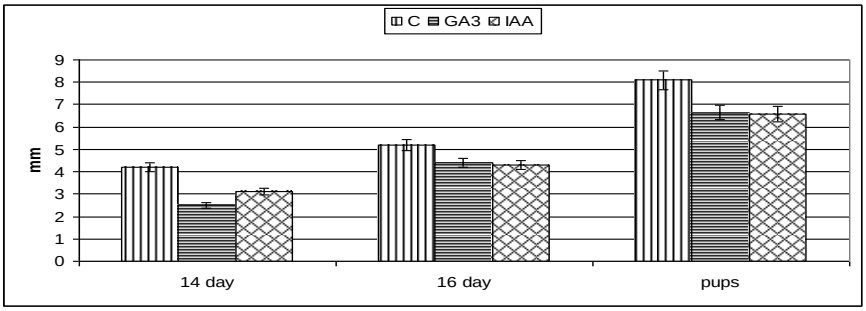


Fig.8: Ossified length (mm.) of Mandibular bone of 14&16 days fetuses and pups. Control (C) Gibberellic acid (GA_3) Indole Acetic acid (IAA)

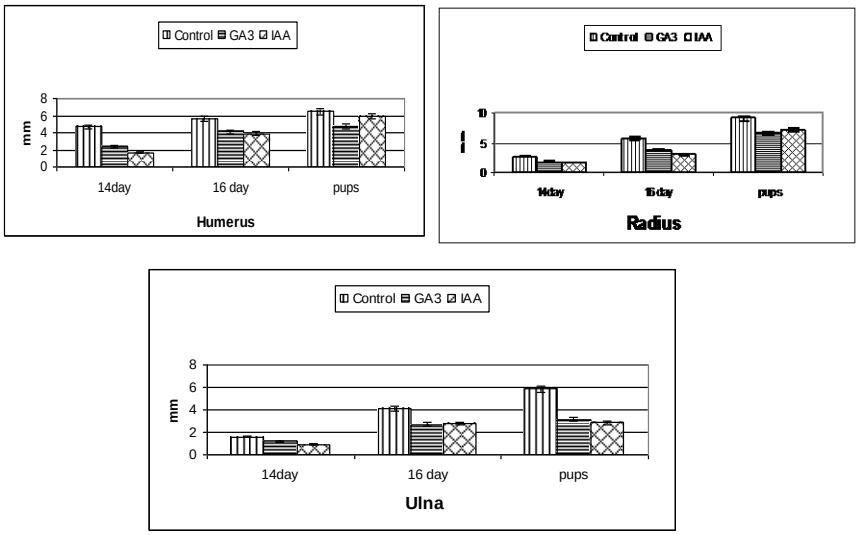


Fig.9: Ossified length (mm.) of fore limb of 14&16 days fetuses and pups. Control (C) Gibberellic acid (GA_3) Indole Acetic acid (IAA)

Table (9): Ossified length (mm.) of hind limb of 14&16 days fetuses and pups.

Pregnancy Day	14 day prenatal			16 day prenatal			pups		
	C	GA_3	IAA	C	GA_3	IAA	C	GA_3	IAA
Femur	3.32± 0.03	1.44± 0.06*	0.8± 0.02*	4.84± 0.05	2.44± 0.04*	2.8± 0.07*	5.85± 0.04	3.14± 0.10*	2.84± 0.05*
Tibia	2.96± 0.04	2.18± 0.05*	1.48± 0.05*	7.0± 0.05	4.1± 0.05*	2.6± 0.05*	6.25± 0.05	3.79± 0.07*	3.32± 0.16*
Fibula	2.8± 0.05	1.9± 0.05*	1.4± 0.04*	4.72± 0.04	3.12± 0.24*	2.72± 0.24*	4.82± 0.03	2.67± 0.10*	2.05± 0.11*

Each result represents the mean ± SD of 10 replicates.
*** Significant at p < 0.05. Control (C) Gibberellic acid (GA_3) Indole Acetic acid (IAA)**

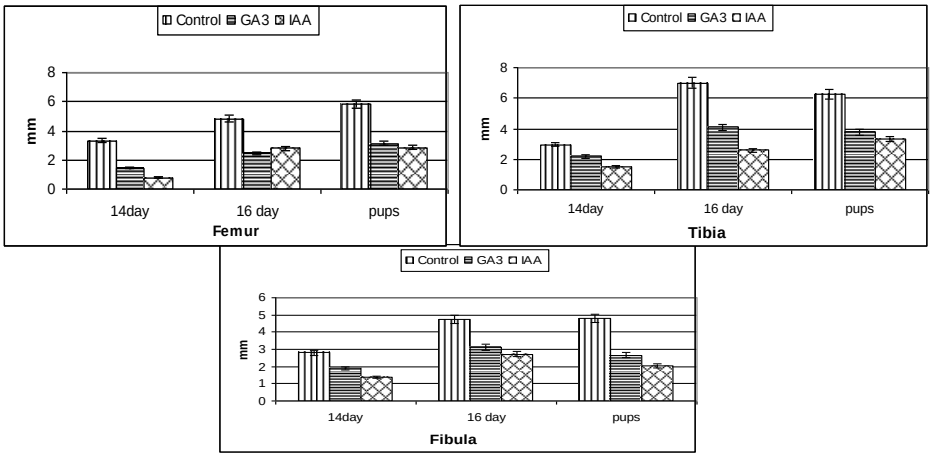


Fig.10: Ossified length (mm.) of hind limb of 14&16 days fetuses and pups. Control (C) Gibberellic acid (GA_3) Indole Acetic acid (IAA)

Table (10): Calcium content in Serum and femur bone of mothers intoxicated with either (GA3) or (IAA).

	C	GA3	IAA
Serum (µg / ml)	2.40 ± 0.10	2.07 ± 0.15*	1.70 ± 0.20*
Femur (g / g bone)	0.48 ± 0.01	0.40 ± 0.02*	0.39 ± 0.02*

Each result represents the mean ± SD of 10 replicates.* Significant at p < 0.05.

Table (11): Calcium content in the skeleton of 14&16 days fetuses and pups maternally treated with either (GA3) or (IAA).

14 day			16 day			pups		
C	**GA3**	**IAA**	**C**	**GA3**	**IAA**	**C**	**GA3**	**IAA**
0.13±0.01	0.10±0.02*	0.09±0.03*	0.15±0.01	0.12±0.01*	0.11±0.02*	0.19±0.01	0.16±0.02*	0.15±0.05*

Each result represents the mean ± SD of 10 replicates. * Significant at p < 0.05.

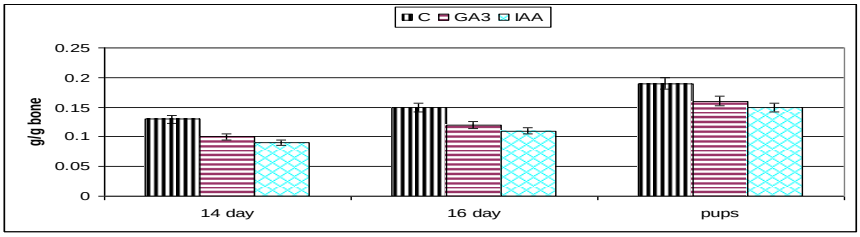


Fig. 11: Calcium content in the skeleton of 14&16 days fetuses and pups.

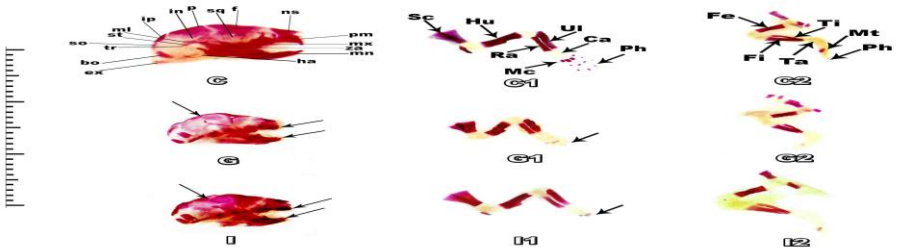


Fig.12 (C-I): Lateral view macrograph of skull, fore limb and hind limb of Alizarin red S preparation of pups intoxicated with applied plant growth hormones. C. Control skull bones. G. Pups skull maternal treated with (GA_3) Showing reduction of flat skull bones and absence of incisors. I. Pups skull maternal treated with (IAA) showing reduction of ossification center of parietal bones and absence of incisors. C1. Control pups fore limb. G1. Pups fore limb maternal treated with (GA_3). I1. Pups fore limb maternal treated with (IAA). Note reduction of ossified bones and lack ossification of phalanges. C2. Control pups hind limb. G2. &I2: Pups hind limb maternal treated with (GA3) & (IAA). Note reduction of ossified bones and lack ossification of phalanges.

(Abbreviations: ns: Nasal, f: Frontal, p: Parietal, ip: Inter parietal, mx: Maxilla, za: Zygomatic arch, ha: Hyoid Arch, sq: Squamosal, in: Incus, ml: Malleus, st: Stapes, tr: Tympanic ring, so: Supraoccipital, ex: exoccipital, bo: basocipital, Sc: scapula, Hu: humerus, Ra: radius, Ul: ulna, Ca: carapace, Mc: metacarapace, ph: phalanges, Fe: femur, Ti: tibia, Fi: fibula, Ta: tarsas, Mt: metatarsas, ph: phalanges.)

DISCUSSION

Recently plant growth hormones are among those widely used chemicals in agriculture accelerated the growth of fruits and vegetables (Serrani *et al*., 2007a&b). The amounts of its placed into the environment exceed those of the insecticides (Mickel, 1978). Although, the consumption of contaminated food products led these growth hormones to find their ways in our body, however, the toxicological aspects are very limited (El-Mofty and Sakr, 1988; Ustun *et al*., 1992; Ozmen et al., 1995; de Melo *et al.*, 2004; Furukawa *et al*., 2004; Hsiao *et al*., 2004).

From the present findings, oral administration of either gibberellic or indole acetic acid at doses of 2،0 ppm for 40 days every other day and from the 1st to 14th day of gestation led to alterations in maternal hepatic tissues and femoral bone. Liver hepatitis was characterized by either cytoplasmic vacuolization of the hepatocytes with increased incidence of pyknotic nuclei. There was a marked increase of dissolution of hepatic cords with prominent dilated blood sinusoids and ill defined cell boundaries of hepatocytes. Numerous hypertrophied kupffer cells were detected in the sinusoidal wall. The blood vessels become either congested or hyalinized with apparent degeneration of their lining endothelium as well as had perivascular leukocytic infiltration. Drastic effects of maternal livers were reflected on the liver of their pups of almost identical histopathological lesions in the form of massive cell death characterized by massive necrosis of hepatocytes, distortion of blood sinusoids and abnormal congestion of blood vessels with apparent degeneration of their endothelial lining cells.

Similar findings were reported in pregnant rats previously received daily 200 ppm gibberellic acids in drinking water from the 14th day of pregnancy until 14 days post partum (Trodi *et al*., 2010) as well as in rat received 25 ppm for 21 days (Sakr *et al*., 2003) or 75 ppm GA_3 for either 50 days (Soliman *et al*., 2010) or six weeks (Hussein et al., 2011).

The observed hepatitis of both mothers and their pups was supported by abnormal biochemical markers of liver functions including sera ALT & AST, billirubin, albumen, arginase and D-L- Fucosidae.

The present data revealed that pups and fetuses maternally treated with gibberellic or indole acetic acid exhibited marked reduction of body weight and crown-rump length. The rate of morphological abnormalities was markedly increased and characterized by kyphotic body, malformed fore and hind limb, kinky tail, reduced neck region and superficial haematomas. Similar findings were reported by Furukawa *et al*. (2004) who observed microencephaly and cleft palate in rat pups maternally treated with indole acetic acid.

The observed intrauterine growth retardation may be attributed to transplacental passage of the used plant growth hormones or their metabolites interfering with growth differentiation of developing fetuses.

In general, ossification of skull regions carries out by two mechanisms; endochondral and intramembranous ossification. During endochondral ossification, precursor cell condense in area destined to become bone and

acquire the general shape of the bone segments, thus providing the template for future skull elements (Hall and Miyake, 1995). This mechanism is prevalent leading to the formation of base and caudal parts of skull (chondrocranium). The rest of the skull, including cranial vault and maxilla-mandibular bones, is formed by intramembranous ossification, a process which involved the condensation of mesenchymal precursors and the transition to the differentiated bone cells, without an intermediate cartilaginous template (Hall and Miyake, 1992).

The observed findings revealed that pups maternally intoxicated with gibberelic or indole acetic acid exhibited marked inhibition of both kinds of axial and appendicular bones. Delayed ossification may be attributed to the impaired osteoblast maturation and function causing skull abnormalities. The observed results revealed that fetuses and pups of experimental treated groups exhibited marked reduction of ossified bones including mandible, humers, radius, ulna, femur, tibia, fibula, ilium and ischium.

The skeletal defects of fetuses and pups may be resulted from both pathological alterations of the maternal liver which intern reflected on liver of pup causing marked reduction of both protein and calcium (Bellomo and Orrenius, 1985; Vessey, 1996) and vitamin D synthesis (Kochupillai, 2008; Lehmann and Meurer, 2010).

The observed gross deformity and delayed ossification of bones may be attributed to the increased oxidative stress which influenced by DNA damage and intern interfere with cell replication leading to growth defects (Troudi *et al.*, 2011).

The authors finally concluded that to advise farmers to reduce application of plant growth hormones in their green house to reduce their impacts on health along run of life.

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إيضاح التأثير السام والمسبب للتشوهات لبعض الهرمونات النباتية على أجنة الجرذان البيضاء

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 # معهد بحوث وقاية النبات ، وزارة الزراعة

تهدف الدراسة إلى إيضاح التأثير السام للهرمونات النباتية والتى تستخدم بصفة واسعة فى الزراعة. أحد هذه الهرمونات النباتية هو(حامض الجبريلليك) والثانى هو (الإندول حامض الخليك)؛ ولقد تم إعطاء كلا من اللهرمونين النباتيين إلى الجرذان بنسبة 200 جزء فى المليون لكل ٠.٢ محلول ملح يوم بعد يوم ولمدة أربعين يوم قبل الحمل وحتى اليوم الرابع عشر أو السادس عشر أو الولادة.

وتتلخص نتائج تلك الدراسة فى الآتى :-

التأثير على الحمل والأجنة والولاند :

أظهرت الأمهات المعاملة بالهرمونات النباتية زيادة ملحوظه من حالات الاجهاض . ولقد تم تسجيل زيادة ملحوظة في الأمهات المعاملة مقارنة بالمجموعة الضابطة ولقد صاحب ذلك العديد من التشوهات الخلقية سواء تقوس الظهر وتشوه الذيل ووجود تجمعات دموية الى غير ذلك من تشوهات الأطراف.كما لوحظ تقلص وزن الجسم فى أجنة الأمهات المعاملة بالهرمونات النباتية. كما لوحظ ازدياد معدل امتصاص الأجنة فى أجنة الأمهات المعاملة مقارنة بالمجموعة الضابطة.

أظهرت ولائد الأمهات المعاملة بكلا اللهرمونات النباتية بعد إنتهاء المعاملة بعض التشوهات الخلقية متمثلة فى نقص تكون كل من الطرفين الأمامى والخلفى، اختزال ملحوظ لوزن الجسم وطوله، بالإضافةإلى ما سبق فلقد أظهرت المعاملة تقلص عظام الهيكل متمثلة فى اللحى - اللوح -الحوض - الطرف الأمامى والخلفى .

التأثير على مراكز التعظم :

كما سجلت الدراسة أن أجنة الأمهات المعاملة بالهرمونات النباتية ظهور تخلف ملحوظ في مراكز التعظم في المناطق المحورية والطرفية. وتمثلت تخلف مناطق التعظم فى المناطق المحورية في القوس اللامي ، سندان ، المطرقة ، ومنطقة الطبلة و الركاب . بالاضافة الى ذلك تم الكشف عن عدد الحالات المصحوبه بتشوه اليافوخ الأمامية والخلفية في الأجنة لأمهات المعاملة بالهرمونات النباتية . كما سجلت الدراسة تقلص مراكز التعظم فى منطقة الفك السفلى وعظام الطرف الأمامى والخلفى.

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