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EFFECT OF GAMMA-IRRADIATION ON THE IONIC CONTENT OF LARVAE OF FLESH FLY *PARASARCOPHAGA ARGYROSTOMA* (ROBIEAU-DESVOIDY) (DIPTERA-SARCOPHAGIDAE)

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SUMMARY

The flesh fly *Parasarcophaga argyrostoma* were irradiated as one day old larvae at five dose levels of gamma radiation 5,7,10,15 and 30 Gy. In general the concentration of the monovalent and divalent ions was increased by increasing the doses of gamma-rays. This ranged from sharp increase for (K^+, Mg^{++} and Pb^{++}) to a gradual one (for Na^+ and Mn^{++}) depending on the doses used.

INTRODUCTION

Information about the biological imbalances produced in a postnuclear attack environment could be useful in controlling insects by irradiation. Some workers have related insect radiation sensitivity to several biological parameters.

Insects have been found to concentrate major and trace elements in their tissues. Analysis of the ash of several species of adults and immature insects have resulted in qualitative indication of the relative differences in the amounts of elements present in these tissues (Levy and Cromary, 1973a). Few work have been done concerning the quantitative determination of the concentration of several major and trace elements in whole insects.

The intent of this study was to determine if a correlation existed between the total body concentration of several elements (Na^+, K^+, Mg^{++}, $Mn^{++}$and Pb^{++}) and gamma radiation exposure of the one day old larvae of the flesh fly *Parasarcophaga argyrostoma*. Selection of these elements was based on their important physiological and biochemical roles in maintaining the normal homeostatis of organisms (Christian and Feldman, 1970 and Schutt, 1964). These elements were generally essential to the insect's diet (Engelman, 1970) and have been shown to be extremely important in maintaining an ionic balance suitable to the activity of insect cells, as cofactors of some enzyme system and as integral parts of others (Chapman, 1969 and Gilmour, 1965).

MATERIAL AND METHODS

The strain of *Parasarcophaga argyrostoma* used was obtained from a stock laboratory culture reared under controlled conditions (28 + 1°C and 60-70% R.H.).

Gamma radiation has been produced using aself-contained cobalt-60 facility of type AE cl-220 at the National Centre for Radiation Research and Technology, Atomic Energy Establishment, Cairo, Egypt.

One-day old larvae were subjected to five doses of gamma radiation 5,7,10,15,30 Gy. The irradiated larvae were given fresh meat and left to develop under the previous controlled conditions till they reached the last larval instar.

To detect the concentration of these different cations (Na^+, K^+, Mg^{++}, $Mn^{++}$and Pb^{++}) the method of El-Mashak and Abdel-Meguid (1987)

was used.

RESULTS

Table 1 presents total body concentration of several monovalent (Na^+ and K^+) and divalent (Mg^{++}, $Mn^{++}$and Pb^{++}) ions in last instar larvae of *Parasarcophaga argyrostoma* resulting from normal and irradiated one-day old larvae. The data in the table reveals that in case of the control experiment the relative concentration of the monovalent ions (Na^+ and K^+) exceeded that of the divalent ones (Mg^{++}, $Mn^{++}$and Pb^{++}) . It is also clear that the total ionic concentration of the different ions was greatly affected by radiation. In general, the level of each of the monovalent and divalent ions was increased by increasing the doses of gamma-rays.

In case of Na^+ ion the increase in its level was maximum (44.6% and 46.3%) at 15 and 30 Gy respectively. On the other hand their level was about that of the control at doses 5 and reached its minimum content at dose 7 Gy. By applying 10Gy. The concentration of Na^+ ions were less than that at each of 15 and 30Gy but more than that at 5 and 7 Gy.

Potassium ion concentration was found to be about 4 folds that of the control experiment at 10, 15 and 30 Gy and only 2 folds at 5 and 7 Gy.

A brief inspection of the Table might suggest that the ratio of sodium to potassium ions was about 2: 1 in case of normal tests. After irradiation this ratio changes to a value of about 1:1 allover the doses used except at 10 Gy where it was about 1:15.

The divalent Mg^{++} ions showed a sharp increase in their ionic concentration with increasing the doses of gamma radiation (Table 1). It was maximum (about 7-8 times) at 15 and 30 Gy where as it ranged between 4-6 times that of the control at 5-10 Gy respectively.

Table (1): Effect of Gamma-Irradiation on concentration of inorganic cations of larvae of *Parasarcophaga argyrostoma*.

Dose Gy	Cations (%)				
	Na^+	K^+	Mg^{++}	Mn^{++}	Pb^{++}
Control	23.75	12.19	1.06	0.26	0.77
5	23.48	26.31	4.44	0.35	1.43
7	22.80	24.00	6.61	0.35	1.57
10	30.86	47.70	5.39	0.30	1.14
15	44.60	46.80	7.39	0.40	1.28
30	46.30	49.80	8.26	0.40	1.24

The results are the mean of two duplicate experiments.

DISCUSSION

Generally speaking, gamma-radiation caused a noticeable increase in the concentration fo each of Na^+, K^+, Mg^{++}, Mn^{++} and Pb^{++} This ranged from sharp increase (for K^+, Mg^{++} and Pb^{++}) to a gradual one for (Na^+ and Mn^{++}) depending on the doses used. Similar results were obtained by Abdel Rahman (1986) for *Culex pipiens molestus,* and by Levy et al. (1973b) for some blood feeding species. Matutani et al., (1983) noticed the variation in the concentration of sodium in haemolymph of *Aedes togoi* in respect to temperature. The level of sodium ions decreased at 23°C and 28°C, whereas it was increased at 40 and 10°C. Also, some insecticides induced similar effects (Williams and Beyenbach 1983).

From the present data it is evident that the ratio Na^+/K^+ was much decreased by gamma irradiation. It seems that gamma rays could interfere with the hormonal system as it has been speculated that intracellular Na^+/K^+ ratio, while juvenile hormone may increase the relative or absoulte sodium concentration (Kroger, 1963 and 1966).

The results also show that in the control experiments, the concentration of Na^+ exceeded that of K^+ which agrees with the findings of (Kroger and Muller., 1973) in case of *Chironomus thummi.* The decrease of this ratio due to irradiation may explain the lethality of gamma rays to the flesh fly larvae *Parasarcophaga argyrostoma.*

Exposure of gamma rays specially at higher doses have been shown to produce dramatic changes (i.e. gross rupture and/or disorganization) in the membrane systems of various cells and organelles such as plasma and mitochondrial membranes (Casarett, 1968). In addition, more subtle permeability changes have been shown to occur which might be due to alterations in the protein-lipid structure of the membrane (Casarett, 1968).. Among these are changes in transfer of single ions such as Na^+, K^+ and Ca^{2+} which are important to cellular function.

A total body exposure to gamma radiation would induce free radical oxidation of free and/or organically bound cations in the insect body and would disrupt normal metabolic pathways by affecting ionization potentials.

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