Egypt. J. Plant Prot. Res. Inst. (2019), 2 (4): 534 -540

Egyptian Journal of Plant
Protection Research Institute
www.ejppri.eg.net

Effect of magnetic field on some biological and physiological aspects of the glassy clover snail *Monacha cartusiana* (Stylommatophora: Hygromiidae)

Mona, A. Ali and Hussein, A. M.
Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.

ARTICLE INFO
Article History
Received: 21/ 9 / 2019
Accepted: 22 / 12 /2019

Keywords
Land snail, *Monacha cartusiana*, magnetic field, egg hatchability, incubation period and biochemical parameters.

Abstract :

The present work was carried out to investigate the effect of magnetic field (MF) on the biological and physiological responses of *Monacha cartusiana* (Müller) (Stylommatophora: Hygromiidae) and land snail one of the serious agricultural pests in Egypt. Snails exposed to magnetic field (5 similar magnet piece each one with a magnetic power 18 milli–tesla).The obtained results showed reduction in the percentage of egg hatchability (fertility) which recorded 62.16% for magnetic field and 91.01% for control groups and mean incubation period of *M. cartusiana* eggs for magnetic field was (35.5 days) compared to control (23.5 days). Also, result showed that magnetic field caused significant increase in the activity of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) in the hemolymph of tested land snail. While, exhibited significant decrease in the activity of alkaline phosphatase (ALP), acid phosphatase (ACP) and Lactate oxidase (LO) enzymes. On the other hand, the levels of total protein, total lipid and cholesterol content were significant decrease after exposure *M. cartusiana* to magnetic field.

Introduction

Land gastropods have greatly increased in economic importance and they are considered a group of the most serious pests attacking agricultural crops around the world (Barker, 2002). They cause great damage to vegetables, field crops, orchard trees as well as ornamental and medical plants (Abed, 2011 and Lokma, 2013). The glassy clover snail *Monacha cartusiana* (Müller) (Stylommatophora: Hygromiidae) causes damage to vegetables and field crops (El-Deeb *et al*., 2003). Magnetism and using magnetic field seems to be promising physical method in pest control (Hussein *et al*., 2014). Changes and alteration of the main components such as protein and lipids as well as the enzyme activity only appears under such stresses that pest exposed to stresses may be physical factors e.g. temperature, different types of waves e.g. gamma rays (Hussein *et al.,* 1999) and electro-magnetic waves (Hussein *et al.,* 2014).

The magnetic fields effects on chordates, fishes behavior (Krylov *et al*., 2013), orientation of reptiles and birds migration (Schneider *et al*.,1994), some mammals development and growth like mice (Sathon *et al.,* 1996), orientation and metabolismof snails (Brown and Webb, 1960) and insect

orientation, development, behavior (Kandil *et al.*, 2018). Magnetic fields can induce changes in enzyme activity (Chen *et al*., 2009), the synthesis and release of neurohormons (Perić-Mataruga *et al*., 2008) and influence on nucleic acids and protein synthesis (Schmitz *et al*., 2004).

The aim of this work was to investigate the effect of magnetic field (MF) on some biological aspects such as egg hatchability and incubation period of land snail *M .cartusiana*. Also, to determine some physiological effect in hemolymph of *M. cartusiana*. The investigated biochemical parameters were the activity of vital enzymes such as aspartate amino transaminase (AST), alanine amino transaminase (ALT), alkaline phosphatase (ALP), acid phosphatase (ACP) and Lactate oxidase (LO) as well as total protein (TP), total lipid (TL) and cholesterol content.

Materials and methods

1. Collection and adaptation of snails:

Adults of the land snail *M. cartusiana* were handily collected from infested Egyptian clover and lettuce fields from Dakahlia Governorate. Healthy individuals were kept in a pot (50× 30 × 25cm), containing moist clay of about 7- 10cm height and were covered with muslin to prevent snails from escaping (Baker and Hawke, 1991). Snails were fed on fresh leaves of lettuce for 14 days to be a laboratory acclimatized. Dead and unhealthy snails were removed and only healthy ones with the same shell diameter were used in the experiments. Laboratory conditions at 25± 2ºC and 75± 5% soil moisture.

2. The procedures of the experiment:

The magnetic field was created in each treated pots by adjusting and fixing 5 similar magnet pieces in the four main directions of the pot in addition to the 5^{th} piece in the central point. Each magnet piece with a magnetic power 18 milli– tesla (m.t.) measurements were carried out using Teslameter apparatus (Faculty of Engineering / Menoufia University). Each pot (15 cm diameter) contained five adult land snails, *M. cartusiana* and replicated thouree times, while control pots were with the same diameter and contain five snails without magnets pieces.The pots of control were in the same laboratory but far 1 meter from the magnets pots (treatment).Fresh food and moisture were supplied as required.The soil of each pot was examined daily (Staikou and Lazaridou- Dimitriadou, 1990) to search new clutches of eggs.

3. Incubation period and hatchability:

Newly deposited clutches of eggs laid under laboratory conditions were collected by a fine hair brush. Date of egg lying was estimated.Each batch of eggs was placed in pots containing 5 g of sterile moist soiland covered with black cover.The eggs were examined daily to record the date of hatching and incubation period. Percentage of egghatchability was calculated according to the following equation:

$$\text{Percentage of hatchability} = \frac{\text{No.of hatching eggs}}{\text{The total No. of eggs}} \times 100$$

4. Biochemical analysis:

4.1. Samples preparation:

Samples wee prepared according to El-Gohary and Genena (2011). Shells of tested snails were removed by making a cut around the whorls in a continuous manner starting at the aperture opening using bone scissors. Snails tissues were dissected out and all tissues of treated and control groups were homogenized in distilled water. The homogenates were centrifuged at 3000 rpm for 20 min. at 5^{o}C in refrigerated centrifuge. The deposits were discarded and the supernatants were kept in a deep freezer till use to determine the activities of biochemical parameters, such as aspartate amino transaminase (AST), alanine amino transaminase (ALT), alkaline phosphatase (ALP), acid phosphatase (ACP), Lactate oxidase (LO) enzymes as well as total protein, total lipid and cholesterol content in hemolymph of control and treated snails.

4.2. Biochemical measurements:

- Aminotransferases (AST and ALT) activities were estimated by the method of **Reitman and Frankel (1957)**.
- Alkalinephosphatase (ALP) activity was estimated according to the method of Deutsche Gesellschaft für Klinische Chemie (DGKC) (1972).While, Acidphosphatase (ACP) activity according to the method of Kind and King (1954).
- Lactate oxidase (LO) was measured according to Babson and Babson (1973).
- Total proteinwas determined according to themethod of Bradford (1976), total lipid according to Frings *et al*. (1972) and total cholesterol according to Ellefson and Caraway (1976).

5. Statistical analysis:

Data were calculated analyzed using analysis of variance technique (ANOVA). Probability of 0.05 or less was considered significant. All statistical analysis was done with Cohort Software (2004).

Results and discussion

1. Effect of magnetic field on the total number of laid eggs and its hatchability of *Monacha cartusiana*:

Data in Table (1) showed reduction in the total number of eggs laid and number of hatching eggs resulted from exposed *M. cartusiana* to magnetic field. Results recorded 148 and 267 eggs for total number of laid eggs and number of hatching eggs were 92 and 243 eggs for magnetic field and control groups, respectively. Therefore, the percentage of hatchability (fertility) was 62.16% for magnetic field and 91.01% for control groups.

Table (1): Effect of magnetic fieldon the total number of laid eggs and its hatchability of *Monacha cartusiana*.

Treatment	Total No. of laid eggs	No. of hatching eggs	Percentage of hatchability
Magnetic field	148	92	62.16
Control	267	243	91.01

2 .Effect of magnetic field on the incubation period of *Monacha cartusiana* eggs:

The tabulated results in Table (2) clear that,incubation period of *M. cartusiana* which exposed to magnetic field were ranged between (25 and 46 days) and (16 and 31 days) for magnetic field and control groups, respectively. So, mean incubation period of *M. cartusiana* eggs for magnetic field was (35.5 days) compared to control (23.5 days). Levin and Ernst (1995) observed that a 30 mT static magnetic field applied to sea urchin eggs produced alterations in the time of cell division and induced two developmental abnormalities, exogastrulation and collapsed embryos. Also, delays hatching relative tocontrol groups. Maciej *et al*. (2011) found that direct exposure of eggs of the two subspecies, *H. aspersa maxima* and *H. aspersa aspersa* to direct magnetic field or alternating electromagnetic field of 5–10 μT has a negative effect compared to the control group. The effect of alternating field on the survival rate and growth rate of *H. aspersa* is positive or neutral, while the influence of direct field is more negative compared to the control group. Hussein *et al.* (2014) Showed that there was a linear negative relationship between the force of the magnetic field and the hatchability percentage in *Sitotroga cerralella* hatching eggs decreased from 90% in the control to 22% with the magnetic field.

Table (2): Effect of magnetic field on the incubation period and egg hatchability of *Monacha cartusiana* eggs.

Treatment	Av. No. of hatched eggs after (days)											Range (in days)		Mean
	16	19	22	25	28	31	34	37	40	43	46	Min	Max	
Magnetic	-	-	-	14.3	19.7	24.3	34.9	46.7	51.3	56.6	60.3	25	46	35.5
Control	17.9	31.1	42.7	68.2	84.3	86.7	-	-	-	-	-	16	31	23.5

3. Effect of magnetic field on some biochemical parameters in hemolymph of *Monacha cartusiana:*

3.1.Effect on aspartate aminotransferase (AST) and alanine aminotransferase (ALT):

Data in Table (3) and Figure (1) indicated the effect of magnetic field on the activity of AST and ALT enzymes in the land snail *M. cartusiana*. Results showed that magnetic field caused significant increases in the enzymes activity 131.45 U/L and 141.35 U/L for AST and ALT, respectively than control group 90.55U/L and 51.05 U/L. Tiwari and Singh (2005) found induction transamination in different tissues of the fresh water snail *Lymnaea acuminate* Lamarck (Gastropoda: Lymnaeidae) after sublethal exposure to the *Euphorbia tirucalli* latex extract. Significant changes in AST and ALT activities in the land snails pointed out to the functional disorder of the liver (Arfat *et al*., 2014).

3.2.Effect on alkaline, acid phosphatase and lactate oxidase enzymes:

Data in Table (3) and Figure (1) illustrated the effect of magnetic field on the activity of alkaline, acidphosphatase andlactate oxidase enzymes in *M.cartusiana* snail. Results revealed that ALP, ACP and LO activity significantly decreased in snails exposure to magnetic field where recorded 229.65 U/L; 1.56 U/L and 1.05 mg/dL for ALP, ACP and LO respectively, comparing with 368.5 U/L, 4.45 U/L and 2.42 mg/dL in control group. Ljiljana *et al*. (2010) found that a significant decrease in acid phosphatase activity after exposed *Helix pomatia* land snail to alternating magnetic field (ELF-MF) compared to the control group. El-Bolkiny *et al*. (2000) reported that DDC molluscicides caused significant decrease in the activity of lactate oxidase (LO)is an enzyme known to activate vitellogenesis and responsible for the egg formation and production in schistosomiasis snails by inhibition of the egg laying capacity. Reduction of ALP activity may be related to thecessation of protein synthesis dueto the effect of the toxin on the general metabolism of the animal (Henderson and Triebskorn, 2002).

Table (3): Effect of magnetic field on aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), acid phosphatase (ACP) and lactate oxidase (LO) enzymesactivity in *Monacha cartusiana.*

Treatment	Parameters				
	Aspartate transaminase (U/L)	**Alanine transaminase (U/L)**	**Alkaline phosphatase (U/L)**	**Acid phosphatase (U/L)**	**Lactate oxidase (mg/dl)**
Magnetic field	131.45^{a} ±2.61	141.35^{a} ±1.36	229.65^{b} ±1.01	1.56^{b} ±0.26	1.05^{b} ±0.09
Control	90.55^{b} ±2.59	51.05^{b}±1.70	368.5^{a}±3.18	4.45^{a}±0.32	2.42^{a}±0.17
LSD 0.05	10.15	6.05	9.25	1.13	0.54

Each value is the mean ± SE. Values followed by the same letter (s) in a column are not significantly different according to Duncan′ s test at level 0.05

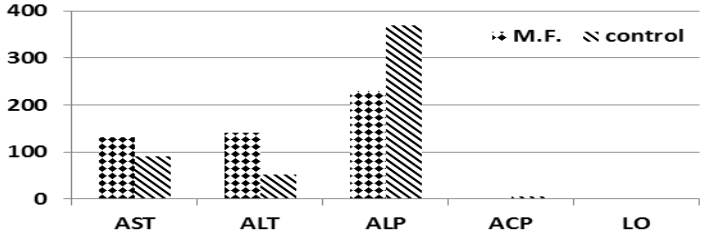

Figure (1):Effect of magnetic field on aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), acid phosphatase (ACP) and lactate oxidase (LO) activity in *Monacha cartusiana*.

3.3. Effect on total protein, total lipid and cholesterol:

Data presented in Table (4) and Figure (2) showed significant decrease in the levels of total protein, total lipid and cholesterol content. Result was recorded 1.6 g/dL, 1.76 mg/dL and 20.73 mg/dL for total protein, total lipid and cholesterol compared with control group 3.35 g/dL , 3.41 mg/dL and 46.05 mg/dL,respectively.These results agree with those reported by Thompson (1988) and Bielefeld (1991) they demonstrated that a depletion of hemolymph glycogen and lipids in *B. glabraia* snails caused inhibition of egg production and degenerative changes in its hermaphourodite gland. Gaber *et al*. (2007) reported that the depression in total lipid may be due to decline in lipid synthesizing capacity and / or due to an increase in the hydrolysis of hepatic lipid to combat the stress conditions. Hussein *et al*. (2015) investigated the effect of magnetic field of some insectsresults showed that each of body weight and growth rate as well as the physiological aspects was affected with the magnetic field.

Table (4): Effect of magnetic field on total proteins, total lipids and cholesterol content in *Monacha cartusiana*.

Treatment	Parameters		
	Total Protein (g/dl)	Total Lipid (mg/dl)	Cholesterol (mg/dl)
Magnetic field	1.6^{b} ±0.17	1.76^{b} ±0.16	20.73^{b} ±1.62
Control	3.35^{a} ±0.26	3.41^{a} ±0.11	46.05^{a} ±1.93
LSD 0.05	0.87	0.53	6.99

Each value is the mean ± SE. Values followed by the same letter (s) in a column are not significantly different according to Duncan′ s test at level 0.05

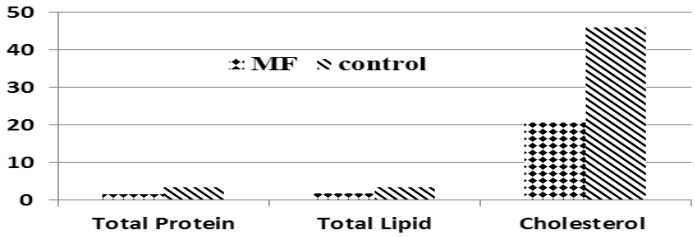

Figure (2): Effect of magnetic field on total proteins, total lipids andcholesterol content in *Monacha cartusiana*.

References

Abed, M. (2011): Biological studies on land snail *Monacha cartusiana* in Sharkia and Mounofia Governorates. M.Sc. Thesis, Fac. Sci., Al- Azhar Universty.

Arfat, Y.; Mahmoud, N.; Tahir, M.U.; Rashid, M.; Anjum, S.; Zhao, F.; Li, D.J.; Sun, Y.L.; Hu, L.; Zhihao, C.; Yin, C.; Shang, P. and Qian, A.R. (2014): Effect of imidacloprid on hepatotoxicity and nephourotoxicity in male albino mice. Toxicol. Rep., 1: 554–561.

Babson, A.L. and Babson, S.R. (1973): Kinetic colorimetric measurement of serum lactate dehydrogenase activity. Gin. Chem., 79: 766 - 769.

Baker, G.H. and B.C. Hawke (1991): Fecundity of *Cochlicella acuta* (Muller), (Mollusca: Helicidea) in laboratory cultures. Inver. Repr. and Devlop., 20 (2): 243-247.

Barker, G.M. (2002): Molluscs as crop pests,1st edition, CAB International.

Bielefeld, U. (1991): Histological observation of gonads and digestive gland in starving *Dreissena polymorpha* (Bivalvia). Malac. Soc. Lond. , 39:203-215.

Bradford, M.M. (1976): A rapid and sensitive method for the quantization of microgram quantities of protein utilizing the principle of protein dye binding. Anal. Biochem., 72: 248-254.

Brown, F.A. and Webb, H.M. (1960): Acompassdirection effect for snails in constant conditions and its lunar modulation. Biol. Bull., 119: 307.

Chen, C.; Cui, Y.: Yue, J.; Huo, X. and Song, T. (2009): Enhancement of the hydrolysis activity of F (0) F (1)-ATPases using 60 Hz magnetic fields. Bioelectromagnetics, 30(8):663-668.

Cohort Software (2004): CoStat. (www.cohort.com Montery, California, USA).

Deutsche Gesellschaft für Klinische Chemie (DGKC) (1972): Empfehlungen der Deutschen Gesellschaft für Klinische Chemie. Recommendation of German Society of Clinical Chemistry (GSCC). J. Clin. Chem. Clin. Biochem., 10: 182-193.

El-Bolkiny Y.E.; El-Sayed, T.R. and Afaf, A.A. (2000): Effect of diethyldithiocarbamate on some biological and physiological parameters of *Biomphalaria alexandrina* snails. Egypt J. Aquat. Bioi. and Fist. , 4 (2):157- 181.

El-Deeb, H. I.; Zidan, Z. H. and Fouad, M. M. (2003): Survey of terrestrial snails and their malacophagous insects at thouree Governorates in Egypt. Egyp. Jour. Appl. Sci.,18:355-361.

El-Gohary, R.A. L. and Genena, A.M. (2011): Biochemical effect of the molluscicide baits against the two land snails, *Monacha obstructa* and *Eobania vermiculata* (Gastropoda: Helicidae). Inter. J. Agric. Res., 6 (9): 682- 690.

Ellefson, R. D. and Caraway, W.T. (1976): Fundamentals of clinicalchemistry . Ed. Titez NW, P. 506.

Frings, C.S.; Fendley, T.W.; Dunn, R.T. and Queen, C.A. (1972): Improved determination of total serum lipids by the Sulfo-Phospho-Vanillin Reaction. Clin. Chem., 18(7): 673-674.

Gaber, W.M.; Fatma, K.K. and Hussien, S.S. (2007): Molluscicidal activity of some pesticides against glassy clover snail *Monacha obstructa*. Muller. Egypt, J. Agric. Res., 8566: 2017 – 2025.

Henderson, I. and Triebskorn, R. (2002): Chemical control of terrestrial gastropods. In: Barker, G.M. (Ed.), Mollusks as crop pests. CABI Publishing, Wallingford, Oxon, UK., p.9.

Hussein, A.M.; Eweis, M.A.; Salwa, A.S. and Hatem, A.E. (2014): Potential benefits for utilization magnetism in plant protection. Minufia J. Agric. Res., 39, 1(2): 327-338.

Hussein, A.M.; Fatma, S.A. and Soliman, S.M. (1999): Utilization of gamma rays to control the two spotted spider mite *Tetranychus urticae* Koch. Minufia J. Agric. Res., 24(4): 1289-1300.

Hussein, A.M.; Hatem, A.E.; Abbas, M.K.; Ghada, E.A.; Rady, K.E. and Salwa, A.S. (2015): Effect of magnetic field on metabolism and enzyme activity in some harmful insects. Minufia J. Agric. Res., 40, 4(1): 999-1009.

Kandil, A.A. M.; Rania, M.S. and Ameir, A.M.A. (2018): Impact of magnetic fields and temperature on biological, life table, morphological and biological parameters in *Earias insulana*. Egypt J. Agric. Res., 96 (3): 35-42.

Kind, P.R.N. and King, E.J. (1954): Estimation of plasma phosphatase by determination of hydrolyzed phenol with aminoantipyrine. J. Clin. Path., 7: 322-326.

Krylov, V.; Lzyumov, Y.G.; Lzvelov, E.L. andNepomny, V.A. (2013): Magnetic fields and fish behavior. Zhurnal Obshchei Biologi., 74 (5): 354-365.

Levin, M. and Ernst, S.G. (1995): Applied AC and DC magnetic fields cause alterations in the mitotic cycle of early sea urchin embryos. Bioelectromagnetics, 16(3): 231-240.

Ljiljana, M. N.; Milos, B.R.; Natasa, V.T.; Gordana, S. K.; Miodrag, S.N. and

Joanna, S.Z. (2010): Effect of alternating the magnetic field on phosphate metabolism in the nervous system of *Helix pomatia*. Biol Res.,43: 243-250.

Lokma, M. H. E. (2013): Studies on some terrestrial molluscs injurious to vegetables and field crops in east delta locality (Sharkia and Ismelia). Ph.D. Thesis, Fac. Agric. Moshtohor, Benha Universty**.**

Maciej, L.; Andrzej, Y.; Piotr, J. and. Mach-Paluszkiewicz, Z. (2011): The effect of magnetic field on farmed populations of *Helix Aspersa* O. F. MÜLLER, 1774. Folla Malacologica., 19 (1): 41-49.

Perić-Mataruga, V.; Proli, Z.; Nenadović, V. ; Vlahović, M. and Mrdaković, M. (2008): The effect of a static magnetic field on the morphometric characteristics of neurosecretory neurons and corpora allata in the pupae of yellow mealworm *Tenebrio molitor*(Tenebrionidae). Int. J. Radiat. Biol., 84:91-98.

Reitman, S.M. and Frankel, S. (1957): Acolorimetric method for the determination of serum glutamic oxaloacetic and glutamic pyruvic transaminase. Am. J. Clin. Path., 28: 56 – 63

Sathon, M.; Tsuji, Y.; Watanabe, Y. ; Okonogi, H.; Suzuki, Y.; Nakegawa, M. and Shimizu, H. (1996): Metallothinein content increased in the liver of mice exposed to magnetic fields. Arch Toxicol., 70: 315-318.

Schmitz, C. ; Keller, E.F.; Silny, J. and Korr, H. (2004): 50-Hz magnetic field exposure influences DNA repair and mitochondrial DNA synthesis of distinct cell types in brain and kidney of adult mice. Acta Neuropathol (Berl.), 107:257-264.

Schneider, T.; Thalau, H.P. and Semm, P. (1994): Effects of light or different earth strength magnetic fields on the nocturnal melatonin concentration in a migratory bird. Neurosci. Lett., 168: 73-75.

Staikou, A. and Lazaridou- Dimitriadou, M. (1990): Aspects of the life cycle, population dynamics, growth and secondary production of the snail *Monacha cartusiana* (Muller), (Gastropoda, Pulmonata) in Greece. (Malacologia, 31 (2): 353-362).

Tiwari, S. and Singh, A. (2005): Alterations in carbohydrate and protein metabolism of the harmful freshwater vector snail *Lymnaea acuminate* induced by the *Euphorbia tirucalli* latex extract. Environ. Res., 99 (3): 378-386.

Thompson, S.N, (1988): Experimental maintenance of the Schistosoma vector *Biomphalaria glabrata* on an improved alginate gel. Ann. Trop. Med. and Parasit., S2: 59-63.