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Biomarkers of Oxidative Stress and Some Immunological Disturbance Induced by Deltamethrin and Diazinon on Fattening Buffaloes Calves

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Abstract

The present study was carried out to evaluate oxidative stress and some immunological parameters of deltamethrin and diazinon in fattening buffalos' calves. A total of 15 healthy calves, 8-12 months of age were divided into 3 groups (5 in each). Gp (1) control, Gp (2) calves sprayed with 1ml deltamethrin/liter water 3 times one week apart and Gp (3) calves sprayed with 1ml diazinon/liter water 3 times one week apart. On the 1st, 15th, and the 30th-day post spraying 3 blood samples were taken from control and tested calves for determination of some immunobiochemical parameters. Deltamethrin or diazinon each alone induced significant elevation in WBCs, neutrophils, eosinophils, MDA, AST, ALT, ALP, LDH, CK, total lipid, triglycerides, cholesterol, urea, and creatinine associated with a significant reduction on phagocytic %, phagocytic index, killing %, serum IgG, IgM, IgA, total protein, albumin, α, β, γ globulin, total globulin, A/G ratio, CAT, SOD, GSH and GSH-px beside insignificant decrease in lymphocyte, monocyte and basophils at 1st and 15th days post spraying. All biochemical parameters improved after 30 days post-spraying as compared with the control. It was concluded that deltamethrin and diazinon induce some adverse effects in leukogram biochemical parameters and have immunosuppressive effects in calves.

KEYWORDS
Buffalo calves, Deltamethrin, Diazinon, Leukogram, Biochemical

INTRODUCTION

Systemic insecticides are available to control lice and parasites and it's a major source of potential environmental hazards to man and animals (Pruett, 1999). Our land suffers from pollution which is one of the most deleterious agents of biological life (Landis and Hoyu, 1995). Increasing industrialization led to increasing pollution (Kanu and Achi, 2011). Insecticides exposure constitutes a source of potent hazard in humans and animals (Menegaux *et al*., 2006).

Pyrethroids are synthetic insecticides widely used for the elimination of ectoparasite in animals (Doherty *et al*., 1987). Pyrethroid insecticides are divided into two classes based on their biochemical action. Both types of pyrethroids have effects on sodium conductance and type II pyrethroids have been reported to antagonize gamma amino-butyric acid by interacting with t-butylbicy clophorothionate picrotoxinin binding site (Gilbert *et al*., 1989). Deltamethrin is rapidly absorbed from the intestinal and distributed into all fat-rich tissues and excreted through urine and feces in the first 24 hours after exposure (Godin *et al*., 2007). It's a synthetic pyrethroid insecticide used for agricultural and veterinary purposes (Abd El Daim *et al*., 2013). Its type II is used in agriculture and home pest control (Marwa *et al*., 2015). Parathyroids are low toxicity to mammals (Vinha *et al*. 2021).

Diazinon is used in industrial, veterinary, and agriculture practices that would be potentially an exposure risk to animals and humans (Larkin and Tjeerdema, 2000). Organo-phosphate pesticides inhibit acetylcholine esterase and pseudo choline esterase leading to the accumulation of acetylcholine leading to the activation of cholinergic muscarinic and nicotinic receptors (Kalender *et al*., 2006). Diazinon is an organophosphate insecticide used mainly in agriculture and in sheep dips and is designed as an irreversible acetylcholine esterase inhibitor (Alahyary *et al*., 2008). Diazinon is the common name of an organophosphorus insecticide used to control pest insects (Kassa *et al*., 2012). It is used in agriculture and public health programs as insecticide acaricides and nematicides, in veterinary medicine as an ectoparasite, and commerce as lubricants, plasticizers, and flame retardants (Büyükokurog *et al*., 2008). Insecticides used for agriculture and veterinary purposes and induce harmful effects in mammals and birds (Abd El Daim *et al*., 2015).

The present study was designed to investigate the possible adverse effects of diazinon and deltamethrin in buffalos' calves.

MATERIALS AND METHODS

Insecticides

Diazinon (Diazitine®) produced by Kemet Company for drugs and chemical production. Each ml contains 600 g of Diazinon.
Deltamethrin (Diazitine)® produced by Kemet Company for drugs and chemical production. Each ml contains 600 g of Diazinon.

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Animals and Experimental design

About 15 fattening buffalos' calves aged 8-12 months from Abo Hamad city were divided into 3 equal groups. Gp (1) calves were left without any treatment (control), Gp (2) calves sprayed with deltamethrin (1ml/liter) 3 times one week apart, and Gp (3) calves sprayed with diazinon (1ml/liter) 3 times one week apart.

Blood samples

On the 1st, 15th, and 30th-day post spraying, three blood samples were taken from each calf.

The 1st sample was taken in a tube containing EDTA for estimation of total and differential leukocytes count according to Jain (1986).

The 2nd sample was taken in a tube containing heparin for estimation of Phagocytic%, index, and killing% (Rouse *et al*., 1980; Woldehiwet and Rowan, 1990).

The 3rd sample was taken for obtaining serum for the estimation of total protein (Doumas *et al* 1981). Quantitative estimation of serum protein fractions was performed by cellulose acetate electrophoresis test (Henry *et al*., 1974), serum immunoglobulin (IgA, IgG & IgM) was performed using SANDWICH ELISA according to Erhard *et al*. (1992), transaminases (AST and ALT) (Reitman and Frankel, 1957), ALP (John, 1982), lactate dehydrogenase (LDH) (Buhl and Jackson, 1978), creatine kinase (Horder *et al*., 1989), Creatine phosphokinase (Forster *et al*., 1974), total lipids (Knight *et al*., 1972) triglycerides (Royer, 1969) cholesterol (Richmond, 1973), MDA (Ohkawa *et al*., 1979), SOD (Nishikimi *et al* 1972) CAT (Aebi, 1984), reduced glutathione (GSH) (Ellman, 1959) glutathione peroxidase (GSH-px) (Palgia and Valentine, 1967).

Statistical analysis

The obtained data were analyzed by using the computerized SPSS program version 16 according to Tambane and Dunlop (2000).

RESULTS

In the current work, it has been found that calves sprayed with deltamethrin or diazinon showed significant leukocytosis, neutrophilia, and eosinophilia coupled with a non-significant decrease in lymphocyte, monocyte, and basophils (Table 1).

Calves sprayed with deltamethrin or diazinon showed significant reductions in phagocytic %, index, killing %, and serum immunoglobulin (IgG, IgM, and IgA) at the 1st and 15th days post spraying besides non-significant effect at the 30th days post spraying as compared with control calves (Table 2).

The present study revealed that significant reductions in total protein, albumin, α, β, γ globulin, total globulin & A/G ratio at the 1st and 15th days post spraying besides an insignificant effect at the 30th days post spraying as compared with the control calves (Table 3).

Buffaloes' calves sprayed with deltamethrin or diazinon revealed a significant increase in MDA beside a significant decrease in CAT, SOD, GSH, and GSH-px at the 1st and 15th days post spraying beside insignificant effect at the 30th days post spraying as compared with control calves (Table 4).

The present work revealed that there were significant increases in serum AST, ALT, ALP, LDH, CK, and CPK in calves sprayed with deltamethrin or diazinon at the 1st and 15th days post spraying besides non-significant effect at the 30th days post spraying as compared to the control calves (Table 5).

The analytical findings of the lipid profile of calves sprayed with deltamethrin or diazinon revealed a significant increase in serum total lipid, triglycerides, cholesterol, urea, and creatinine at the 1st and 15th days post spraying besides non-significant effect at the 30th days post spraying as compared with control calves (Table 6).

DISCUSSION

In the current study, it has been found that calves sprayed with deltamethrin or diazinon showed significant leukocytosis,

Table 1. Effect of deltamethrin and diazinon on leukogram, of calves (n=5).

	1st day			15th day			30th day		
	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3
Total leukocytic count (x10³/µl)	11.53±0.26b	12.82±0.44a	13.32±0.67a	11.38±0.50b	12.88±0.31a	13.54±0.59a	11.44±0.49b	12.07±0.91a	12.54±0.99a
Differential leukocytes count									
Lymphocytes (x10³/µl)	3.90±0.29a	3.78±0.32a	3.84±0.21a	3.85±025a	3.80±0.20a	3.84±0.32a	3.86±023a	3.77±0.19a	3.81±0.28a
Heterophils (x10³/µl)	2.72±0.24b	3.63±0.31a	3.80±0.59a	2.75±0.31b	3.66±0.25a	3.84±0.28a	2.77±0.29b	3.10±0.40a	3.12±0.62a
Eosinophils (x10³/µl)	1.75±0.18b	2.55±0.21a	2.70±0.35a	1.78±0.23b	2.53±0.17a	2.75±0.26a	1.80±0.27b	2.51±0.62a	2.78±0.57a
Basophils (x10³/µl)	1.50±0.20a	1.39±0.21a	1.43±0.18a	1.54±0.22a	1.40±0.28a	1.46±0.27a	1.58±0.20a	1.46±0.15a	1.48±0.15a
Monocytes (x10³/µl)	1.66±0.37a	1.47±0.34a	1.55±0.23a	1.46±0.23a	1.49±0.21a	1.60±0.28a	1.43±0.28a	1.53±0.28a	1.63±0.15a

Mean values with different letters of the same row indicate significant differences at P <0.05

Table 2. Effect of deltamethrin and diazinon on phagocytosis, Killing %, and Immunoglobulin of calves (n=5).

	1st day			15th day			30th day		
	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3
Phagocytic (%)	46.63±0.75a	43.77±0.73c	43.65±0.81c	46.21±0.92a	44.71±0.53b	44.96±0.83b	46.46±0.77a	46.21±0.85a	45.12±0.90a
Phagocytic index	4.61±0.63a	1.74±0.41c	2.91±0.56c	3.44±0.59a	3.55±0.43b	2.34±0.44b	4.52±0.46a	3.98±0.54a	3.99±0.52a
Killing (%)	43.27±0.72a	39.46±0.52c	39.76±0.94c	43.75±0.85a	41.95±0.97b	41.99±0.99b	43.57±0.95a	43.34±0.79a	42.21±0.84a
Immunoglobulins (g/l)									
lgG	17.23±0.51a	13.31±0.74c	13.28±0.88c	17.82±0.91a	15.83±0.69b	15.93±0.89b	17.38±0.85a	17.34±0.62a	16.18±0.65a
lgM	9.34±0.5a	6.89±0.47c	6.12±0.55c	9.73±0.48a	7.88±0.46b	7.63±0.61b	9.48±0.4a	8.54±0.32a	8.33 1.23a
lgA	2.62±0.15a	1.65±0.19c	1.34±0.30c	2.75±0.21a	1.90±0.16b	1.91±0.14b	2.68±0.18a	2.59±0.21a	2.50±0.49a

Mean values with different letters of the same row indicate significant differences at P <0.05

Table 3. Effect of deltamethrin and diazinon on protein picture of calves (n=5).

	1st day			15th day			30th day		
	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3
T. protein (g/dl)	6.89±0.69a	4.92±0.36b	4.68±0.55b	6.98±0.72a	4.89±0.55b	4.77±0.50b	6.92±0.48a	5.97±0.59a	5.89±0.66a
Albumin (g/dl)	3.90±0.31a	2.74±0.26b	2.56±0.41b	3.95±0.30a	2.70±0.39b	2.51±0.45b	3.90±0.37a	3.23±0.23a	3.09±0.43a
Globulins (g/dl)									
A (g/dl)	0.90±0.13a	0.66±0.16b	0.63±0.12b	0.93±0.31a	0.68±0.20b	0.70±0.11b	0.91±0.28a	0.87±0.14a	0.90±0.11a
B (g/dl)	0.96±0.23a	0.68±0.12c	0.66±0.14c	0.98±0.21a	0.70±0.18c	0.72±0.14c	0.94±0.25a	0.79±0.18a	0.89±0.16a
γ (g/dl)	1.13±0.21a	0.84±0.21b	.0.83±0.21b	1.14±0.22a	0.87±0.12b	0.89±0.12b	1.19±0.22a	0.99±0.24a	0.97±0.12a
Total globulins (g/dl)	2.99±0.27a	2.18±0.19b	2.12±0.16b	3.06±0.22a	2.25±0.26b	2.31±0.19b	3.05±0.26a	2.75±0.21a	2.80±0.14a
A/G Ratio	1.31±0.25a	1.25±0.31a	1.21±0.19a	1.30±0.18a	1.23±0.19a	1.11±0.18a	1.29±0.22a	1.20±0.16a	1.10±0.24a

Mean values with different letters of the same row indicate significant differences at P <0.05

Table 4. Effect of deltamethrin and diazinon on MDA, SOD, and CAT of calves (n=5).

	1st day			15th day			30th day		
	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3
MDA nmol/ml	72.97±1.94c	79.24±1.87a	79.94±1.99a	73.08±1.59c	75.90±1.47b	75.87±1.83b	72.89±1.33c	73.38±1.42c	73.57±1.48c
Antioxidants									
CAT U/ml	168.82±1.96a	161.58±1.77c	161.04±1.84c	168.14±1.89a	165.38±1.63b	165.61±1.94b	168.52±1.78a	167.89±1.98a	168.08±1.64a
SOD U/ml	89.80±1.94a	83.33±1.39c	82.54±1.86c	89.27±1.78a	85.83±1.92b	86.16±1.89b	89.44±1.39a	88.90±1.44a	87.82±1.38a
GSH µmol/ml	35.21±0.78a	31.73±0.57c	30.08±0.84c	35.89±0.68c	33.54±0.57b	33.76±0.58b	35.98±0.55a	34.76±0.74a	346.77±0.76a
GSH-px µmol/ml	15.61±0.87a	8.23±0.53c	7.98±0.44c	15.09±0.94a	12.35±0.85b	11.82±0.70b	15.32±0.89a	14.89±0.96a	14.77±0.89a

Mean values with different letters of the same row indicate significant differences at P <0.05

Table 5. Effect of deltamethrin and diazinon on some enzymes of calves (n=5).

	1st day			15th day			30th day		
	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3
AST (U/ml)	38.98±1.42c	46.24±1.20a	49.33±1.31a	38.89±1.38c	45.12±1.34b	45.09±1.21b	38.88±1.42c	39.74±1.78c	40.98±1.98c
ALT (U/ml)	32.53±1.23c	38.09±1.43a	39.23±1.54a	33.06±1.41c	35.12±1.12b	37.19±1.20b	33.21±1.57c	34.79±1.92c	35.87±1.43c
ALP (U/ml.)	25.17±1.36b	32.37±1.32a	34.55±1.49a	25.45±1.65b	30.28±1.45a	31.31±1.37a	25.28±1.57b	26.78±1.89b	27.89±1.55b
LDH (U/L).	389.1±2.89b	407.21±2.18a	417.23±2.26a	389.1±3.864b	397.31±2.69a	399.19±2.73a	387.23±2.55b	388.51±2.88b	390.55±3.32
CK (IU/L)	35.12±1.69b	43.24±1.02a	45.23±1.41a	35.31±1.51b	39.57±1.32a	40.62±1.15a	35.72±1.44b	36.09±1.44b	37.03±1.18b
CPK (U/L)	234.42±2.57b	243.22±2.81a	244.15±2.71a	234.8± 2.82b	240.16±2.31a	241.54±2.70a	234.55±2.48b	236.06±2.36b	237.51±2.83

Mean values with different letters of the same row indicate significant differences at P <0.05

neutrophilia, and eosinophilia coupled with a non-significant decrease in lymphocyte, monocyte, and basophils.

These changes in leukogram may be due to the toxic effect of chemicals on the same-poietic system (Varley *et al*., 1980). Similar results were recorded by Emam (2008) who found that deltamethrin induced leukocytosis, neutrophilia, and eosinophilia coupled with a significant decrease in lymphocytes, and monocyte in fattening calves. In the same line, Khan *et al*. (2009) recorded that other pyrethroids (cypermethrin) induced neutron-philia, and eosinophilia in goats. Our result was supported by Adil *et al*. (2013) stated that deltamethrin induces significant leukocytosis, neutrophilia, and eosinophilia in goats.

The obtained results go hand in hand with those obtained by Ibrahim and El-Gamal (2003) who found that diazinon induced leukocytosis, neutrophilia, and eosinophilia. The change in leukogram may be due to oxidative stress induced by diazinon leading to hematological changes (Sadiq and Jarjees, 2018). The same result was recorded by Assaraj *et al*. (2018) who reported that diazinon induced leukocytosis, neutrophilia, and eosinophilia.

The present work revealed that calves sprayed with deltamethrin or diazinon showed a significant reduction in phagocytic %, index, killing %, and serum immunoglobulin (IgG, IgM, and IgA) at the 1st and 15th days post spraying beside non-significant effect at the 30th days post spraying as compared with control calves.

These results agree with those of Emam (2008) who stated that deltamethrin induced significant decreases in phagocytic %, index, and killing % in fattening calves. These results agree with those of Adil *et al*. (2013) who mentioned that deltamethrin induces significant decreases in phagocytic %, index, and killing % in goats. These findings were similar to that reported by Ibrahim and El-Gamal (2003) who mentioned that diazinon induces significant decreases in phagocytic %, index, and killing %. Similar results were recorded in an earlier study by Assaraj *et al*. (2018) who found that diazinon induced decrease in phagocytic % and phagocytic index.

A close similarity was seen between this finding and those obtained by Tamang *et al*. (1988) who stated that other pyrethroid (cypermethrin) induced a decrease in serum immunoglobulin in goats. Deltamethrin has a suppressive effect on the humoral immune response (Jolanta and Jergy 1992). Similar results were recorded by Metawie (1999) who reported that deltamethrin induces a decrease in serum IgG, IgM, and IgA in rats. The observed result agreed with Undeğer and Başaran, (2001) who stated that pyrethroids induced a decrease in serum immunoglobulins. Another pyrethroid (cypermethrin) induced a significant decrease in serum immunoglobulin (Desi *et al*., 1986). The same result was recorded by Aroonvilairat *et al* (2015) who found that pesticides induced significant decreases in serum IgG, IgM, and IgA levels. The same observation was reported by Assaraj, *et al*. 2018) who stated that diazinon induces a significant decrease in serum IgG, IgM, and IgA in rats.

The present investigation revealed that significant reduction in total protein, albumin, α, β, γ globulin, total globulin, and A/G ratio at the 1st and 15th days post spraying besides a non-sig-

Table 6. Effect of deltamethrin and diazinon on lipid profile, urea, and creatinine of calves (n=5).

	1st day			15th day			30th day		
	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3	Gp1	Gp2	Gp3
Lipid profile									
Total lipids (mg/dl)	368.48±4.58c	376.14±4.32a	377.45±4.87a	369.36±4.55c	370.45±4.12b	371.55±3.65b	368.79±5.88c	369.93±5.49c	369.78±4.82c
Cholesterol (mg/dl)	65.76±1.43c	71.35±1.78a	73.03±1.98a	64.99±4.69c	68.90±1.04b	69.21±1.12b	645.34±2.79c	646.83±3.98c	648.28±4.57c
Triglycerides (mg/dl)	405.4±577c	413.45±6.98a	414.84±6.65a	404.89±4.68c	409.23±5.67b	410.12±4.81b	405.86±6.67c	406.97±5.77c	408.74±6.48c
Kidney function									
Urea (mg/dl)	22.15±1.26c	28.38±1.27a	30.43±1.44a	22.62±1.43c	25.22±1.17b	27.34±1.21b	22.48±1.39c	23.76±1.42c	23.96±1.35c
Creatinine (mg/dl)	1.54±0.11b	2.21±0.17a	2.54±0.21a	1.65±0.13b	1.91±0.10b	2.05±0.11b	1.69±0.18b	1.8±0.15b	1.98±0.18b

Mean values with different letters of the same row indicate significant differences at $P < 0.05$

nificant effect at the 30th days post spraying as compared with control calves.

Reduction in serum albumin is the one of most frequent findings in the hepatotoxicity of deltamethrin (Coles, 1986). The decline in the level of serum total protein and albumin may be due to liver damage and the inability of the liver to synthesize albumin due to the effect of deltamethrin (Misra *et al*., 1996). Our results are compatible with Kaur and Sandhu (2000) who stated that deltamethrin produced a significant decrease in total protein, albumin, α, β, γ, and globulin. The obtained results agreed with Emam (2008) who found that deltamethrin induces a significant decline in total protein, albumin, α, β, γ, globulin, and A/G ratio. The same changes in protein picture were reported by Enas *et al*. (2021) in cows and buffaloes sprayed with deltamethrin. Deltamethrin induces a significant decrease in serum total protein and albumin (Eman *et al*., 2022).

Results from this study were supported by Elias (2010) stating that diazinon induces hepatotoxicity and reduces total protein, albumin, and globulin. Reduction in albumin and total proteins may be due to the hepatoxicity of diazinon (Hazarika *et al*., 2003). Reduction in total protein and albumin α, β, γ globulin induced by diazinon may be due to reactive oxygen species generated and induce damage to cellular macromolecules as albumin (Cetin *et al*., 2010). Diazinon induces a reduction in protein profile due to a failure of the antioxidant defense system to protect against free radicals and tissue oxidative damage (Salehi and Jafary, 2010). A similar change in protein picture was reported by Sadiq and Jarjees (2018) reported that diazinon induces hepatotoxicity and a decrease in total protein, and albumin in α, β, γ globulin.

In the present study, it has been shown that buffaloes calves sprayed with deltamethrin or diazinon revealed a significant increase in MDA besides a significant decrease in CAT, SOD, GSH, and GSH-px at the 1st and 15th days post spraying besides insignificant effect at the 30th days post spraying as compared with control calves.

These findings were supported by Yarsan *et al*. (2002) who stated that deltamethrin induces an increase in MDA besides a decrease in CAT, SOD, GSH, and GSH-px. Our result is supported by Sinan *et al*. (2010) who concluded that deltamethrin induces an increase in MDA and a decrease in activities of CAT and SOD in buffaloes. In addition, Abd El Daim *et al*. (2013) stated that deltamethrin induced lipid peroxidation in a dose-dependent manner and increase MDA and decrease CAT, SOD, GSH, and GSH-px. Deltamethrin intoxication increased MDA and reduced CAT and SOD (Abdou and Abd El Daim2014). Deltamethrin induced an increase in MDA and a decrease in CAT, SOD, GSH, and GSH-px (Marwa *et al*. 2015). In addition, Tekeli *et al*. (2020) reported that deltamethrin increases MDA and decreases SOD and CAT. Deltamethrin induces a significant increase in serum MDA besides a decrease in serum SOD, CAT, and GSH-px levels (Enas *et al*., 2021; Eman, *et al* 2022).

The obtained data fit with Mustafa *et al*. (2010) reported that Organophosphate induced an increase in MDA and a decrease in CAT, SOD, GSH, and GSH-px. Diazinon induced an increase in MDA with a decrease in CAT and SOD (Teimouri *et al*., 2006). Diazinon induces an increase in MDA and decreases in CAT and SOD (Abd El Daim, *et al* 2015). The same results were reported by Sadiq and Jarjees (2018) stated that diazinon induced an increase in MDA with a decrease in CAT, SOD, GSH, and GSH-px.

The present work revealed that there were significant increases in serum AST, ALT, ALP, LDH, CK, and CPK in calves sprayed with deltamethrin or diazinon at the 1st and 15th days post spraying besides non-significant effect at the 30th days post spraying as compared to with control calves.

The same conclusion was suggested by Abd El Daim *et al*. (2013) who stated that deltamethrin has hepatic toxicity and an increase in serum AST, ALT, and APL. Data from the current study reinforced by Marwa *et al*. (2015) who concluded that deltamethrin increased AST, ALT, ALP, and LDH. Deltamethrin induces significant increases in serum liver enzymes (AST, ALT, and LDH) (Eman *et al*. 2022).

These results agreed with Al-Attar and Abu Zeid (2013) who observed that diazinon induced increases in AT, ALT ALP. Observation from this study was in accordance with Al-Attar (2015) who mentioned that diazinon induced an increase in serum AST, ALT, ALP, and LDH. Serum AST, ALT, ALP, and LDH increased in rats post-using diazinon (Abd El Daim *et al*., 2015). Also, Sadiq and Jarjees (2018) reported that diazinon induced significant increases in AST, ALT, and ALP activities.

The analytical findings of the lipid profile of calves sprayed with deltamethrin or diazinon revealed significant increases in serum total lipid, triglycerides, cholesterol, urea, and creatinine at the 1st and 15th days post spraying besides non-significant effect at the 30th days post spraying as compared with control calves.

Changes in lipid profile post-using insecticide may be attributed to the oxidative effect of insecticide (Goldberg *et al*., 1982). Another explanation for the elevation in serum total lipid, triglycerides, and cholesterol may be due to an inhibition of lipase enzyme activity of both hepatic triglycerides and plasma lipoproteins (Yonar, 2013).

The same change in lipid profile was reported by Yousef *et al*. (2006) where deltamethrin induced oxidative damage and induced significant increases in total lipid cholesterol, triglycerides, urea, and creatinine levels. The same results were observed by Abd El Daim *et al*. (2013) who mentioned deltamethrin renal toxicity and an increase in serum urea and creatinine levels. These results agreed with those reported by Abd El Daim *et al*. (2015) as deltamethrin increased serum total lipid cholesterol, triglycerides, urea, and creatinine levels, Same changes in lipid profile were reported by El-Sheshtawy *et al*. (2019) in rabbits received other pyrethroids (cypermethrin).

The same results were reported by Ibrahim (2003) who found that diazinon induced significant increases in total lipids, cholesterol, and triglycerides levels. These recorded results were supported by Al-Attar and Abu Zeid (2013) who stated that diazinon induced increases in total lipids, triglycerides, and cholesterol levels. Rats exposed to diazinon, induced increases in serum total lipid, triglycerides, cholesterol, urea, and creatinine levels (Al-Attar 2015). These results agree with Abd El Daim *et al*. (2015) who stated that diazinon exhibited significant increases in cholesterol, triglycerides, urea, and creatinine. Also, Sadiq and Jarjees (2018) reported that diazinon induces hepatotoxicity leading to signif-

icant increases in cholesterol, triglycerides, uric acid, and creatinine levels.

CONCLUSION

It could be concluded that deltamethrin and diazinon each alone induce many adverse alterations in oxidative and immunological parameters in calves but diazinon is more toxic than deltamethrin.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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