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RESEARCH ARTICLE

TOXICITY OF PROPARGITE ON CHEMICAL COMPOSITION AND FATTY ACID PROFILE IN MURREL, *CHANNA STRIATUS.*

Mageswari. M, Chinnamani. S, Sathya. C, Murugaian. P, Ravikumar. S and *Sivasuriyan. S.
PG and Research Dept. of Zoology, Rajah Serfoji Govt. College (Autonomous), Thanjavur- 5,Tamil Nadu, India.

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Abstract

In this study, effects of propargite is an organosulfiteacaracide/miticide pesticide were investigated in *Channa striatus*, muscle and liver chemical composition, the total fatty acid profile and free fatty acid. Fish were exposed to sub lethal concentration as control, 1ppm, 2ppm of 15 days and 30 days of propargite. As a result of a study, chemical composition of muscle and liver of *Channa striatus* exposed moisture, crude protein and ash were significantly (P>0.05) different in the propargite concentration of 1ppm and 2ppm of 30 days then compared to 15 days and control. Estimation of muscle and Liver tissue saturated fatty acids (SFAs) as palmitic acids were increased in propargite 2ppm of 15 days while compared to control. Correspondingly, MUFAs, Oleic acid, were significantly differ and averagely increased in the concentration of propargite 1ppm of 15 days according to control group. Simultaneously PUFAs, C22:6n3 Docosahexaenoic acids were increased. In conclusion, changes observed among the chemical composition, fatty acid profile and total free fatty acid of muscle and liver in gas chromatography effect of propargite.

Introduction:-

Pesticide is one of the major categories of toxic substances used worldwide for management of pests in agricultural lands and control of insect vectors of human disease (Mekkawy, 2007; Begum, 2004; Yadav*et al*., 2010). They are a major group of toxicants, which have serious toxic impacts on aquatic life and still represent a significant risk due to their toxicity on non-target organism including fishes (Soloneski and Larramendy, 2012; Ghazala*et al*; 2014).
These pesticides can reach natural waters either via transfer of the chemicals from the soil or by direct spraying on the target organisms (EnisYonar*et al*., 2012). The accumulation and persistence of pesticide in the aquatic environment found a biological life the chronic poisoning of aquatic organisms (Hemmer, 2001; Wirth *et al*; 2001). Besides, pesticides affect a wide range of non target organisms, such as invertebrates and fish inhabiting aquatic environment (Burkepile, 2000; Peter, 2013; Saravanan*et al*., 2011).

Propargite, an organosulphiric pesticide, is being widely used in agriculture as well as in integrated agriculture-aquaculture farming systems to product important food crops (Royal Society of Chemistry, 1987). Although it is increasingly decline in most industrialized countries, still it is being used in tropical and sub tropical region, causing health of fish, water and food in various part of the world (Hardersen and Wratten, 1998; Sarma*et al*., 2013). Elevated residue levels of propagate in plant ingredients have also been reported (Tulgar and Celik, 2015) and many of these plant ingredients are now increasingly used in aqua-feeds for sustainable aquaculture, thus exposing the

Corresponding Author: - Dr. Sivasuriyan. S.
Address:-PG and Research Dept. of Zoology, Rajah Serfoji Govt. College (Autonomous), Thanjavur-5, Tamil Nadu, India.

aquatic animals to pesticide. It has been reported that exposure to propargite, even at sub-lethal doses, induces white blood cells and biochemical changes in common carp (Tulgar and Celik, 2015).

Channa striatus, locally known as haruan or snakehead murrel, an eminent tropical freshwater fish widely used for medicinal and pharmaceutical purposes (Michelle *et al*., 2004), is also an important food source in the Asia-Pacific region (Hossain*et al*., 2008). The freshwater snakehead was *Channastriatus*, from the family Channidae. Their natural populations are extensively distributed across southern Asia, southern China, Indochina and Sunda Islands (Hossain*et al*., 2008). This carnivore snakehead murrel, to adverse environments due to its hardiness and air-breathing capabilities assisted with a suprabranchial chamber, an air-breathing organ (Chandra and Banerjee, 2004; Arockiaraj*et al*., 2015) which is unique to Channidae but exclusive in other freshwater fish families (Song *et al*., 2013).

The freshwater snakehead striped murrel, *Channa striatus* is a commercially important fish available in India and Africa (Ng and Lim, 1990; Peter, 2013). It is also known as snake-head fish or serpent-headed fish. A habitat has wide ranging from mostly rivers, swamps, ponds, canals, lakes and land of rice fields (Marimuthu and Haniffa, 2007). *C. striatus* were cultured in cages and ponds in some of the Southeast Asian countries (Wee, 1982). The local market demand on *C. striatus*is greatly expanding due to its commercial value, agreeable flavor local food (Hossain*et al*., 2008) and its postoperative medicinal application to enhance wound healing and reduce postoperative pain and discomfort (Mat Jais*et al*., 1997; Burkepile, 2000; Peter, 2013; Saravanan*et al*., 2011).

Liver plays a major role in metabolism and has a number of functions in the body, including glycogen storage, decomposition of red blood cells, protein synthesis, hormone production and detoxification (Aguiar, *et al*., 2004; Hansen, *et al*., 2011). In fish lipids and protein are the main organic constituents and play many important roles in the fish and physiology, which includes growth, reproduction and migration (Tocher, 2003 and Froyland*et al*., 2000). Any alteration in lipid metabolism will significantly affect the health and energy metabolism in fish. In view of the above, present experiment was undertaken the effect of sub-lethal propargite exposure on chemical composition, fatty acid and free fatty acid profile in*C.striatus.*

Materials and methods:-

Fish collection and maintenance

Channa striatus, a common tropical fresh water fish air-breathing fish (average length of 12.5 cm and average weight of 15.0 g) and widely cultivable were obtained collected from ponds in around Thanjavur. They were safely transported to the laboratory in well packed polythene bags containing oxygenated water. Fish were stocked in plastic tank (300/L) containing tab water and acclimatized to conditions for 30 days to their use in the experiment.

Chemicals

Propargite 57% EC was chosen to evaluate, its toxicity on fresh water fish at acute and sub-lethal level. 2-(4-tert-butyl phenoxy) cyclohexyl prop-2-ynyl sulphite is a non-systemic insecticide. The sub-lethal concentrations of propargite were applied. The LC_{50} has been reported that highly toxic for LC_{50} value for 330ppb (Turner, 2002), exposure duration was 15-30 days the water and propargite were completely replenished each day during experimental period.

Experimental design

The experiment was carried out in 30 days in identical plastic tanks. A group (3 replicate) of ten fish were distributed in three tanks and were exposed to sub-lethal concentration of propargite for varying period (24, 48, 72 and 96h). Water was exchanged daily with fresh concentration of pesticide with minimum disturbance to the test animal. Round the clock, aeration was provided through a centralized pump. The fish were not fed during the experiment. The average water quality parameters were as follows: temperature 26-29°C, pH 7.4-7.8, dissolved oxygen 6.4 mg^{-1} and total hardness 18.4 mg^{-1}.

Sample preparation

Ten fish (two from each replicate) were drawn at the beginning and end of 24, 48, 72 and 96hr. They were anesthetized using clove oil (50 µg/lit), sacrificed and then dissected to remove the tissues, liver and muscle. The moisture, crude protein (Sweeney &Rexroad, 1987), ash and lipid were estimated (Marsh and Winstein, 1966). After Morphometric measurements, each fish was dissected to collect diverse organs and tissues. These fish were then

muscle and liver transferred in to mark sterilized polythene bags and stored in a freezer at 20°C until further analysis.

Fatty acid methyl esters preparation and Gas chromatography

During fatty acid analysis, each liver and muscle samples were freeze dried (lyophilized) and oven dried at 67°C for 24h. Then it was grounded finely with pestle and mortar. The analysis of fatty acid methyl esters (FAMEs) from these muscle and liver samples were performed by standard procedures. To 50 mg of muscle and liver samples were added to 1gm of 1.2M NaOH in 50% methanol with glass beads (3mm dia) in a screw-cap tube and then incubated at 100°C for 30 min in a water bath. The saponified samples were cooled at room temperature for 25 min, they were acidified and methylated by adding 2 ml 54% 6N HCl in 46% methanol and incubated at 80°C for 10 min in water bath. After rapid cooling, methylated FAS were extracted with 1.25 ml 50% methyl-tert butyl ether (MTBE) in hexane. Each sample was mixed for 10 min and the bottom phase removed with a pasteur pipette. Top phase was washed with 3ml 0.3M NaOH. After mixing for 5 min, the top phase was removed for analysis. Following the base wash step, the FAMEs were cleaned in anhydrous sodium sulphate and then transferred in to GC sample vial for analysis. FAMEs were separated by gas chromatograph (HP 6890 N, Agilent Technologies, USA). FAMEs profiles of the samples were identified by comparing the commercial Eucary data base with MIS Software package (MIS Ver. No. 3.8, Microbial ID. Inc., Newark, Delaware) (Bligh and Dyer, 1959).

Statistical Analysis

All the dates were subjected to one way ANOVA using statistical software of SPSS version 16.0. Duncan's Multiple Range test was used to determine the difference among treatment means at 5% level of significance.

Results:-

Muscle and liver chemical composition

The effect of sub-lethal exposure of propargite on moisture, fat, crude protein and ash levels in liver and muscle of *C.striatus*, at different periods of exposures were presented in table 1 and 2. The muscles composition of moisture, crude protein and ash were significantly decreased in the propargite concentration of 1ppm and 2ppm of 30 days (62.81±0.74, 50.36±0.80) then compared to 15 days (65.34±0.75, 53.24±0.82) and overall muscle composition were decreased in all treated group when compared to control (82.30±0.66), respectively (Table1).

The chemical composition of liver such as moisture, crude protein and ash were significantly decreased in the propargite concentration of 1ppm and 2ppm of 30 days (60.15±0.73, 28.18±0.59) then compared to 15 days (64.32±0.75, 39.20±0.74) and overall muscle composition were significantly decreased in all treated groups when compared to control (78.60±0.76), respectively (Table 2).

Composition of fat level such as muscle and liver of *C.striatus*, at different periods of exposures were significantly increased in all treated groups when compared to control, respectively (Table 1 and 2).

Profile of Fatty acids analysis through gas chromatography (GC)

Profile of fatty acid and free fatty acid levels in liver and muscle of *C.striatus*, at different periods of exposures were presented in table 3, 4, 5 & 6 and figure 1 & 2. Values of muscle tissue saturated fatty acids (SFAs) of Capric acid, Undecanoic acid, Lauric acid, Myristic acid and stearic acid (1ppm 15days) were higher in propargite 1ppm of 30 days, as well as palmitic acid were increased in propargite 2ppm of 15 days when compared to other concentration treated groups and control, (Table 3).

Free fatty acid profile in muscle tissue

Mono Unsaturated FAs of Elaidic acid and cis-11-Eicosenoic acid were not detected in all treated groups then control, as well as cis-10-pentadecenoic acid and Oleic acid were increased in propargite 1ppm of 15 days and 30 when compared to other groups and control (Table 3).

Poly Unsaturated FAs as Linolelaidic acid, Linoleic acid, Cis-5, 8, 11, 14, 17-Eicosapentaen acid and Cis-4, 7, 10, 13, 16, 19-Docosahexaenoic acid were gradually increased in all treated groups when compared to control. Concerning to PUFAs, alpha-Linolenic acid was not detected in all treated groups then control (Table 3 and fig 1). Total amount of muscle tissue of MUFAs and PUFAs were decreased in all treatment groups compared to control (Table 4 and fig 1).

Free fatty acid profile in liver tissue

Saturated fatty acids (SFAs) of Liver tissue such as Caprylic acid and Arachlic acid were dominant in propargite 2ppm of 15 days whereas the palmitic acid (C16:0) and stearic acid (C18: 0) levels were decreased when compared to control.

Correspondingly, MUFAs, cis-10-pentadecenoic acid, Elaidic acid and Palmitoleic acid were significantly increased in the concentration of propargite 1ppm of 15 days and oleic acids (C18:1) significantly decreased when compared to control (Table 5 & fig 2).

For the liver tissues Polyunsaturated fatty acids (PUFAs), Linoleic acid and cis-8.11, 14- Eiosatrienoic acid(C20: 5n3) were increased in concentration of pesticide of 1ppm of 15 days whereas Docosahexaenioc acid (C20:6n3) were decreased then compared to control (Table 5 and fig 2).

Discussion:-

The present study constitutes the pesticide effect of sub-lethal exposure of propargite on chemical composition and fatty acid activities of *C. striatus.* The present study propargite chemical composition of muscle and liver tissues in the results moisture contents, while treatment groups had significantly decrease. However, the energy values were changes in the muscle tissue moisture content in chlorpyrifos treatments, in agreement this content in monocrotophos-exposed juvenile Indian carp *Labeo rohita* (Ramani*et al*., 2002).

In the present study the fat content was found to be muscle and liver tissues in the results as treatment groups had significantly increased. Gluer *et al*., (2008) reported that fat level attributed the rise might be due to disruption in the hepatic cell owing to stress induced toxicants and thereby releasing cholesterol to blood. Higher fat level in muscle might due to accumulation of cholesterol in the tissue (Firat*et al*., 2011) Jankowska*et al*., (2010) and Valfre*et al*., (2003).

The results of the present study showed that crude protein of muscle tissues has significantly decreases (Onyelike*et al*., 2000). Protein content also due to the rapid utilization of tissues as protein decreases when the animals were under stress conditions. It has been shown that ash muscle tissues decrease (Abii*et al*., 2007). Liver ash contents increase indicated that Alterations in moisture and ash contents have been suggested to be due to the reduction of food consumption and food conversion efficiency under stress (Nair &Sherief 1998).

The results of the present study showed that free fatty acid profile in muscle tissue were found that propargite exposure the hepatic fatty acids profile, the proportion of monounsaturated fatty acids (MUFA) increased, saturated fatty acid (SFA), and polyunsaturated (PUFAs) acids decrease was respectively. The n-3/n-6 ratio, the content of Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) were preventive effects on human coronary artery disease (Leaf & Webber, 1988). The presence of docosahexaenoic acids (DHA) in all fish species from the Indus River suggests that these fish species can have a healing effect to alleviate muscle pain and inflammation. Therefore, fish have been suggested as a key component for a healthy diet in humans (Rahman*et al*., 1995). Significant levels of EPA and DHA in fish species of this study indicated that these species can be used to supplement essential fatty acids in the human diet. Although the EPA and DHA percentages in the examined fish species muscle total fatty acids were low, they were found in significant levels in these fish species muscles, due to the large percentage of fat in the analyzed fish species. Changes according the influence of nutrients body composition have also on other major carp's rohu (Umer*et al*., 2011).

The patterns of fatty acid profile of fish compared well with those observed by (Hashim*et al*., 2007). However, the fatty acids compositions of the muscle cell membranes were especially important factors in determining the stability because oxidative changes were initiated from the membrane components of muscle (Buckley *et al*., 1989).

The results of the present study showed that Fatty acids profile in muscle tissue of *C. striatus*exposed to sub-lethal concentration of propargite among saturated (SFA) fatty acids of fish as palmitic acid (16: 0) increased those reported by previous study was comparable with fish in curing illness to improve the health process (Luczynska*et al*., 2008). It was reported that palmitic acid was predominant in fresh water channel catfish *Icataluruspunctatus* (Sathivel et al., 2002)). According to the palmitic acid increases the risk of developing cardiovascular diseases (WHO, 2003), indicating that it may increases LDL levels in the blood.

However, in the present study, Oleic acid were increased Ackman, (1980) and Kolakowska*et al*., (2002) reported that monounsaturated fatty acids (MUFA) which good agreement with the present oleic acid were dominate in all fresh water fish of *C.carpio*, *L.rohita* and *O. mossambicus* respectively. Oleic acids along with other monounsaturated fatty acids in red blood cell membranes were positively associated with breast cancer risk (Andrea Micheli*et al*., 2001).

Among the polyunsaturated fatty acids (PUFAs) as docosahexaenoic acid (DHA, C22: 6n3) and eicosapentaenoic acid (EPA, C20: 5n3) were dominant (Ackman, 1986). DHA were as major component of the brain, retina, muscle and heart, plays a vital role in brain and eye development. The eicosanoids derived from EPA were positive effects, such as vasodilation and anti aggregation (Reilly *et al* 1998). DHA represents an extreme of the omega – 3 fatty acids and linked in a positive way to an enormous variety of human afflictions including cancer and heart disease, as well as to neurological and brain development (Stillwell, and Wassall, 2003). The most important factor affecting the pesticide of the quality of fish muscle is the percentage n-3 FA such as EPA and DHA.

The present study showed that propargite exposure liver influences the hepatic fatty acids, especially the saturated fatty acids (SFAs), monounsaturated (MUFAs) and polyunsaturated acids (PUFAs) were decreased. Montero *et al*., (1999) reported that stearic acid and oleic decreased remained almost same at the endosulfan exposure reduction in unsaturated fatty acid (USFAs) in liver could due to their utilization for energy purpose. Many nutritional of lipids based on the proportions reported that Jankowska*et al*., (2010) and Valfre*et al*., (2003).

Conclusion:-

The overall results demonstrated that sub-lethal exposure to propargite had significant impact of affect on lipid and total free fatty acid profile of C. *striatus*. The analysis of seasonal as well as annual variations of the FAs profiles of the fishes deemed by this study as most suitable sources of PUFAs and MUFAs, then the knowledge of the relative abundance of each fish species in different areas. This study provided new clue, it's that further investigation about the physiological effects of major enzyme activities. This study reiterates the important of judicial use of pesticide, in order to avoid to contamination of fresh water bodies.

Table 1:-Chemical composition of muscle of *C. Striatus* exposed to sub-lethal concentration of propargite

Treatment		**Muscle**			
		Moisture (%)	**Fat(mg/gm tissue)**	**Crudeprotein (mg/gm tissue)**	**Ash (%)**
Control		82.30±0.66[a]	18.62±0.75[e]	64.35±0.74[a]	12.08±0.84[a]
Propargite 1ppm	**15 days**	65.34±0.75[b]	36.58±0.56[c]	52.59±0.83[c]	10.83±0.75[b]
	30 days	62.81±0.74[c]	39.85±0.57[b]	50.18±0.80[d]	9.42±0.75[c]
Propargite 2ppm	**15 days**	53.24±0.82[d]	45.18±0.75[a]	58.09±0.84[b]	6.14±0.76[d]
	30 days	50.36±0.80[e]	25.12±0.52 [d]	47.54±0.76[e]	5.52±0.70[e]

Values are given as mean±SE. Values not sharing a common marking ([a, b, c, d, e]) different alphabets in columns differ significant at p< 0.05 (Duncan's Multiple Range Test).

Table 2:-Chemical composition of liver of *C.striatus* exposed to sub-lethal concentration of propargite

Treatment		**Liver**			
		Moisture (%)	**Fat(mg/gm tissue)**	**Crudeprotein (mg/gm tissue)**	**Ash (%)**
Control		78.60±0.76[a]	35.18±0.74 [e]	46.10±0.87[b]	12.08±0.76[a]
Propargite 1ppm	**15 days**	64.32±0.75 [b]	39.45±0.75 [d]	42.24±0.76[e]	10.12±0.73 [b]
	30 days	60.15±0.73 [b]	40.09±0.76 [c]	40.24±0.76 [c]	7.14±0.72 [c]
Propargite 2ppm	**15 days**	39.20±0.74 [c]	45.18±0.87 [b]	33.06±0.74 [d]	6.28±0.70 [c]
	30 days	28.18±0.59 [d]	51.07±0.94[a]	28.12±0.59 [e]	4.56±0.69 [d]

Values are given as mean±SE. Values not sharing a common marking (a, b, c, e) different alphabets in columns differ significant at p< 0.05 (Duncan's Multiple Range Test).

Table 3:-Fatty acids profile in muscle tissue of *C. striatus*exposed to sub-lethal concentration of propargite

Carbon chain	Fatty acids	Control	Propargite 1ppm		Propargite 2ppm	
			15 days	30 days	15 days	30 days
C6:0	Caproic acid	0.263±0.01	ND	ND	ND	ND
C8:0	Caprylic acid	0.084±0.002	ND	0.057±0.01	0.354±0.02	0.163±0.01
C10:0	Capric acid	0.078±0.001	0.030±0.001	0.102±0.007	0.026±0.001	0.018±0.001
C11:0	Undecanoic acid	0.016±0.001	0.045±0.004	0.211±0.02	0.295±0.03	0.140±0.01
C12:0	Lauric acid	0.065±0.003	0.043±0.003	0.127±0.01	0.112±0.01	0.076±0.001
C13:0	Tridecanoic acid	0.034±0.002	ND	ND	0.019±0.004	ND
C14:0	Myristic acid	0.094±0.001	0.052±0.003	0.138±0.01	0.132±0.01	0.090±0.002
C15:0	Pentadecanoic acid	0.185±0.02	0.071±0.003	0.127±0.01	0.144±0.01	0.071±0.003
C16:0	Palmitic acid	0.047±0.001	0.352±0.01	2.284±0.02	2.414±0.02	1.214±0.02
C17:0	Heptadecanoic acid	0.311±0.02	0.010±0.001	0.102±0.007	0.106±0.002	0.060±0.001
C18:0	Stearic acid	0.031±0.001	1.963±0.01	0.166±0.01	0.281±0.01	0.168±0.02
C20:0	Arachlic acid	0.021±0.004	0.123±0.02	ND	ND	ND
C21:0	Henicoasanoic acid	0.035±0.002	ND	0.050±0.001	0.064±0.001	ND
C22:0	Behenic acid	0.019±0.004	ND	ND	ND	ND
C23:0	Tricosanic acid	0.094±0.001	0.675±0.02	0.092±0.001	0.101±0.007	0.092±0.001
∑ of SFA		**1.377**	**3.293**	**3.456**	**4.048**	**2.092**
C14: 1	Myristoleic acid	0.042±0.03	0.062±0.002	0.065±0.001	0.071±0.003	0.041±0.001
C15:1	cis-10-pentadecenoic acid	0.694±0.02	0.821± 0.01	0.017±0.001	0.019±0.002	0.193± 0.02
C16:1	Palmitoleic acid	0.072±0.003	0.016±0.001	0.041±0.002	0.044±0.002	0.027±0.001
C17:1	cis-10-Heptadecanic acid	0.669±0.02	ND	0.019±0.002	0.014±0.002	ND
C18:1n9c	Oleic acid	0.032±0.002	0.142±0.01	0.226±0.03	0.123±0.01	0.133±0.01
C18:1n9t	Elaidic acid	0.076±0.001	ND	ND	ND	0.443±0.04
C20:1n9	cis-11-Eicosenoic acid	0.031±0.002	ND	ND	ND	ND
C24:1n9	Nervonic acid	ND	ND	0.137±0.01	0.068±0.03	0.054±0.02
∑ of MUFAs		**1.895**	**1.041**	**0.505**	**0.339**	**0.891**
C18:2n6c	Linolelaidic acid	0.014±0.001	0.040±0.002	0.056±0.004	0.050±0.002	0.017±0.002
C18:2n6t	Linoleic acid	0.212±0.02	0.193±0.02	0.118±0.01	0.018±0.002	0.065±0.02
C18:3n3	alpha-Linolenic acid	0.022±0.001	ND	ND	ND	ND
C18:3n6	gamma-Linolenic acid	0.016±0.001	0.076±0.004	0.105±0.002	0.119±0.01	0.117±0.01
C20:2	cis-11,14-Eicosanoic acid	0.034±0.002	0.055±0.003	0.113±0.01	0.027±0.004	0.055±0.003
C20:3n3	cis-11,14,17-Eicosatrie acid	0.042±0.002	0.053±0.003	0.013±0.001	0.015±0.001	0.006±0.001
C20:3n6	cis-8.11,14- Eiosatrienoic acid	0.077±0.001	0.064±0.003	0.112±0.01	0.141±0.01	ND
C20:5n3	Cis-5,8,11,14,17-Eicosapentaen acid	0.115±0.01	0.434±0.01	0.310±0.01	0.330±0.02	0.223±0.03
C22:2	Cis-13,16-Docosadienoic	ND	ND	0.025±0.003	0.065±0.001	ND
C22:6n3	Cis-4,7,10,13,16,19-Docosahexaenoic acid	0.676±0.02	0.138±0.01	0.138±0.01	0.142±0.02	0.112±0.01
∑ of PUFAs		**1.591**	**0.621**	**1.016**	**1.049**	**0.763**

Values are given as mean±SE, not detected (ND)

Table 4:-Free fatty acids profile in muscle tissue of *C. striatus*exposed to sub-lethal concentration of propargite

Treatment		Muscle		
		∑SFA	**∑MUFA**	**∑PUFA**
Control		1.377±0.04^{d}	1.895±0.03^{a}	1.591±0.01^{a}
Propargite 1ppm	**15 days**	3.293±0.05^{b}	1.041±0.02^{b}	0.621±0.02^{d}
	30 days	3.456±0.05^{b}	0.505±0.79^{d}	1.016±0.001^{b}
Propargite 2ppm	**15 days**	4.048±0.01^{a}	0.339±0.04^{e}	1.049±0.03^{b}
	30 days	2.092±0.01^{c}	0.891±0.03^{c}	0.763±0.04^{c}

Values are given as mean±SE. Values not sharing a common marking ($^{a, b, c, d, e}$) different alphabets in columns differ significant at $p< 0.05$ (Duncan's Multiple Range Test).Not detected (ND).

Table 5:-Fatty acids profile in liver tissue of *C. striatus* exposed to sub-lethal concentration of propargite

Carbon chain	Fatty acids	Control	Propargite 1ppm		Propargite 2ppm	
			15 days	30 days	15 days	30 days
C6:0	Caproic acid	0.209±0.01	0.013±0.001	0.133±0.01	ND	ND
C8:0	Caprylic acid	0.014±0.001	0.026±0.001	0.012±0.008	0.063±0.001	0.035±0.002
C10:0	Capric acid	0.065±0.001	0.039±0.001	0.027±0.001	ND	0.037±0.001
C11:0	Undecanoic acid	0.074±0.001	0.040±0.001	0.039±0.002	0.083±0.001	ND
C12:0	Lauric acid	0.054±0.001	0.057±0.001	0.058±0.001	0.045±0.004	0.038±0.001
C13:0	Tridecanoic acid	0.068±0.002	0.034±0.002	0.030±0.001	0.021±0.002	0.023±0.001
C14:0	Myristic acid	0.052±0.01	0.093±0.021	0.032±0.001	0.059±0.003	0.040±0.001
C15:0	Pentadecanoic acid	1.127±0.04	0.181±0.04	0.595±0.03	0.050±0.002	0.034±0.002
C16:0	Palmitic acid	0.066±0.002	0.288±0.02	0.047±0.001	0.643±0.02	0.602±0.03
C17:0	Heptadecanoic acid	1.875±0.03	0.018±0.001	1.198±0.01	0.039±0.001	0.024±0.002
C18:0	Stearic acid	0.070±0.002	0.509±0.02	0.028±0.002	0.121±0.01	0.582±0.03
C20:0	Arachlic acid	0.058±0.001	0.037±0.001	0.015±0.002	0.038±0.002	0.020±0.002
C21:0	Henicoasanoic acid	0.044±0.001	0.089±0.002	0.036±0.001	ND	ND
C22:0	Behenic acid	0.016±0.001	0.029±0.001	0.021±0.001	ND	ND
C23:0	Tricosanic acid	0.080±0.001	0.090±0.001	0.103±0.01	0.088±0.001	ND
∑ of SFA		**3.872**	**1.543**	**2.338**	**1.250**	**1.435**
C14: 1	Myristoleic acid	0.017±0.002	0.039±0.001	ND	0.026±0.001	ND
C15:1	cis-10-pentadecenoic acid	0.077±0.01	0.644±0.02	0.047±0.001	0.170±0.01	0.201±0.02
C16:1	Palmitoleic acid	0.020±0.001	0.073±0.001	ND	0.012±0.007	0.039±0.02
C17:1	cis-10-Heptadecanic acid	0.055±0.01	ND	0.028±0.001	ND	0.018±0.001
C18:1n9t	Elaidic acid	ND	0.083±0.001	0.484±0.03	0.169±0.01	0.060±0.001
C18:1n9c	Oleic acid	0.053±0.01	0.031±0.001	0.015±0.001	0.063±0.001	0.022±0.002
C20:1n9	cis-11-Eicosenoic acid	0.055±0.01	0.032±0.001	0.113±0.01	ND	0.062±0.002
C22:1n9	Erucic acid	0.069±0.01	ND	ND	ND	ND
C24:1n9	Nervonic acid	0.063±0.01	ND	ND	ND	0.058±0.001
∑ of MFAs		**0.409**	**0.902**	**0.687**	**0.440**	**0.460**
C18:2n6c	Linolelaidic acid	0.050±0.001	0.015±0.001	ND	0.042±0.002	0.016±0.002
C18:2n6t	Linoleic acid	0.027±0.002	0.477±0.04	0.201±0.02	0.014±0.001	0.098±0.007
C18:3n3	alpha-:Linolenic acid	0.029±0.001	0.022±0.001	0.029±0.001	ND	ND
C18:3n6	gamma-Linolenic acid	0.045±0.001	0.157±0.01	0.037±0.001	0.034±0.001	0.013±0.001
C20:2	cis-11,14-Eicosanoic acid	0.168±0.001	ND	0.095±0.001	0.043±0.001	ND
C20:3n3	cis-11,14,17-Eicosatrie acid	0.195±0.01	ND	0.105±0.01	ND	ND
C20:3n6	cis-8.11,14- Eiosatrienoic acid	0.044±0.001	0.067±0.001	0.037±0.002	0.040±0.001	0.022±0.003
C20:4n6	Arachidonic acid	0.018±0.002	ND	ND	ND	ND
C20:5n3	Cis-5,8,11,14,17-Eicosapentaen acid	0.100±0.001	0.034±0.001	0.041±0.001	0.093±0.001	0.019±0.002
C22:6n3	Cis-4,7,10,13,16,19-Docosahexaenoic acid	0.850±0.03	0.310±0.02	0.275±0.01	0.263±0.01	0.330±0.02
C22:2	Cis-13,16-Dosadienoic acid	ND	0.020±0.001	0.140±0.03	ND	0.036±0.002
∑ of PFAs		**1.526**	**0.483**	**1.236**	**0.266**	**0.238**

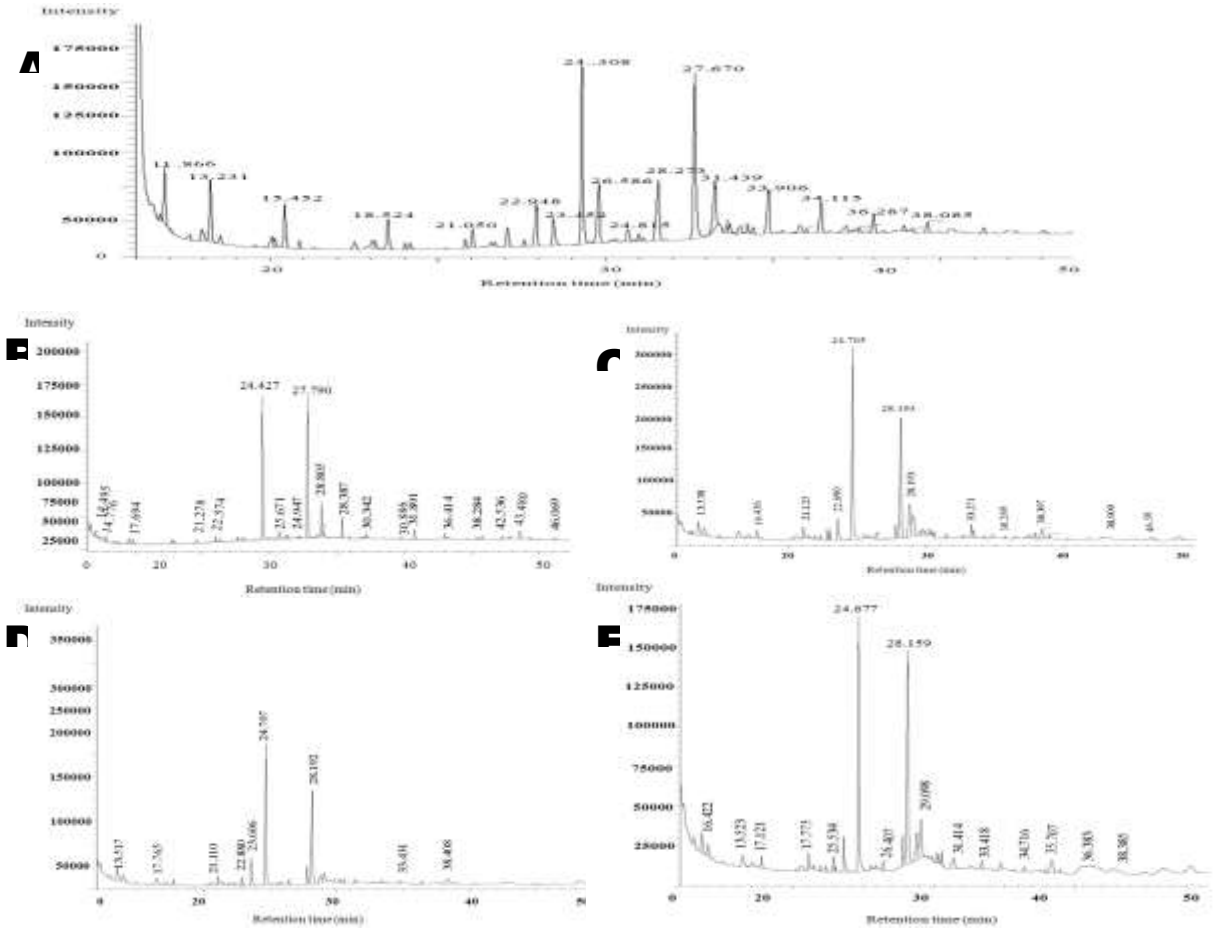
Values are given as mean±SE. Not detected (ND)

Table 6:-Free fatty acids profile in liver tissue of *C. striatus*exposed to sub-lethal concentration of propargite

Treatment	Liver		
	∑SFA	∑MUFA	∑PUFA
Control	3.872±0.04[a]	0.409±0.02[e]	1.526±0.08 [a]
1ppm 15 days	1.543±0.02[c]	0.902±0.03 [a]	0.483±0.04 [c]
1ppm 30 days	2.338±0.03[b]	0.687±0.01[b]	1.236±0.02[b]
2ppm 15 days	1.254±0.01[e]	0.440±0.02[d]	0.226±0.01[e]
2ppm 30 days	1.435±0.88[d]	0.460±0.01[c]	0.238±0.02 [d]

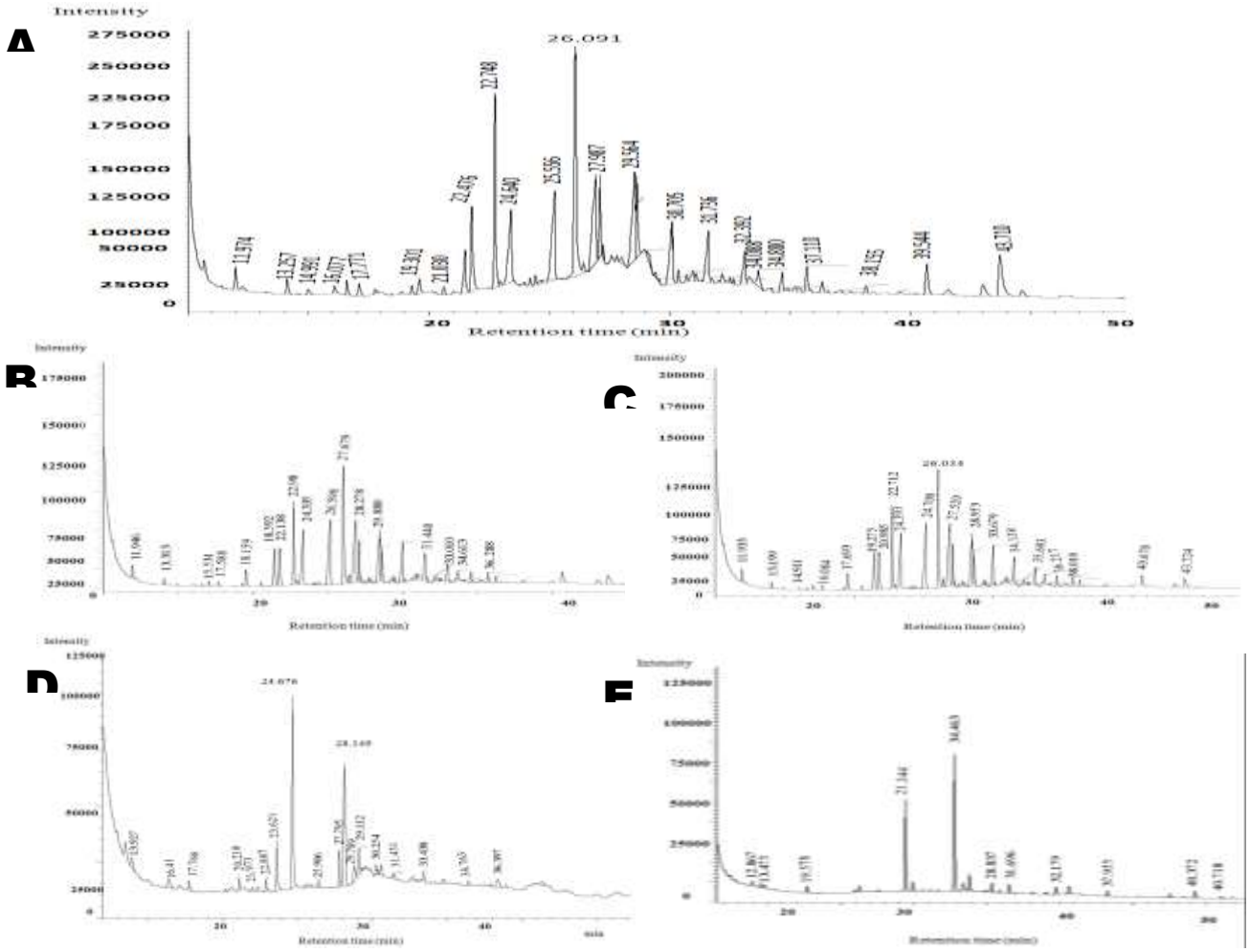
Values are given as mean±SE. Values not sharing a common marking ([a, b, c, d, e]) different alphabets in columns differ significant at p< 0.05 (Duncan's Multiple Range Test).

Fig 1: Muscle fatty acids profiles in *Channastriatus exposed* to propargite treatment in gas chromatograph



A- Control, B- Propargite 1ppm 15 days, C- Propargite 1ppm 30 days, D- Propargite 2ppm 15 days and E- Propargite 2ppm 30 days in muscle tissue fatty acid profile

Fig 2:-Liver fatty acids profiles in *C.striatus exposed* to propargite treatment in gas chromatograph



A- Control, B- Propargite 1ppm 15 days, C- Propargite 1ppm 30 days, D- Propargite 2ppm 15 days and E- Propargite 2ppm 30 daysin liver tissue fatty acid profile.

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