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# ANTIOXIDANT EFFECTS OF GREEN TEA EXTRACT ON BIOCHEMICAL PARAMETERS OF *HETEROPNEUSTES FOSSILIS* POISONED BY CYPERMETHRIN

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**Abstract**

*The biochemical response in Heteropneustes fossilis to cypermethrin and mitigating effect of Green tea extract (GTE) was assessed during this study. The $LC_{50}$ of cypermethrin evaluated in previous study was found to be 0.00066 ml/l, 0.00044 ml/l, 0.00033 ml/l and 0.00022 ml/l after 24, 48, 72 and 96 h exposure. To assess the effect of GTE on some biochemical parameters fishes were randomly divided into 4 groups of 10 fishes each. $I^{st}$ group served as control, the fishes of $II^{nd}$ group were treated with 0.00066 ml/l of cypermethrin, $III^{rd}$ group received 0.5ml/l GTE whereas $IV^{th}$ group received cypermethrin (0.00066ml/l) +GTE (0.5ml/l). Same protocol was employed by taking $LC_{50}$ concentration of cypermethrin at 48, 72 & 96 h exposure periods and 0.5ml/l GTE was applied at all exposure periods. After completion of 24, 48, 72 & 96 h blood was collected to separate the serum and estimation of SGOT, SGPT, ALP, ACP, Total protein, Creatinine, Uric acid and Blood glucose, was carried out. The level of SGOT, SGPT, Creatinine, Uric acid and Blood glucose was elevated when treated with cypermethrin after 24, 48, 72 & 96 h, while decreased activity was observed in total protein, ALP and ACP after all exposure periods. After addition of GTE all the parameters became normalize showing the antioxidant effect of green tea.*

**Keywords**: *Cypermethrin, Green tea extract, Heteropneustes fossilis, biochemical parameters, Acute-toxicity.*

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## INTRODUCTION

Cypermethrin, a synthetic pyrethroid is widely used all over the world against pests in households, industries and agriculture fields to increase the production of food grains and other agricultural products [1]. Due to excessive use, cypermethrin enters into natural water bodies and affects several non-target aquatic organisms specially fishes. Fishes are unable to metabolize pyrethroids efficiently which disturbs fish metabolism and fish population. Cypermethrin produces many harmful effects on fishes and is also known to reduce the survival, growth and reproduction of fishes [2,3]. Olalekan, 2014 reported that pesticides accumulation in fish organs such as liver and muscle, cause organ dysfunction and death of fishes [4].

All the vital process in the body are indicated by the nature of blood and any changes in blood chemistry are useful to analyze the toxicity in fishes. Enzymes essential for metabolic functions are early indicators of toxic effects as activities of many enzymes are altered due to toxicity [5].The alterations in the activity of liver enzymes following cypermethrin exposure were shown by many bioresearches [6-8]. Several workers also reported the poor function of kidney during stressed condition [9,10]. Further cypermethrin insecticides exert their biological effect by inducing oxidative stress leading to the generation of free radicals such as ROS [11,12].

More attention has been paid towards the protective effects of natural antioxidants against drug induced toxicities [13]. Flavonoids are polyphenolic compounds present in natural food supplements which provide stress protection, acting as scavengers of free radicals such as reactive oxygen species (ROS) [14,15]. The highest contents of flavonoids are found in green tea among common food and beverage products and have different pharmacological properties due to the presence of catechins (epigallocatechingallate and epicatechin), theoflavin, tannin and caffeine [16-18]. It was reported earlier that green tea inhibits oxidative stress and prevent toxicity [19,20]. Although several studies have been carried out to investigate the effect of green tea on hepato and nephro toxicity induced by pesticides on rats but scarce data are available on fishes. Therefore we found it appealing to investigate the attenuating behaviour of GTE on acute-toxicity caused by cypermethrin in *Heteropneustes fossilis.*

## MATERIALS AND METHODS:

In toxicity studies Jackpot 25 (Cypermethrin 25% EC) insecticide manufactured by Crystal Crop Protection Private Limited, Delhi and Lipton green tea bags were used. Different concentrations obtained from $LC_{50}$ estimation were prepared from stock solution. The stock solution of Green tea extract (GTE) was also prepared and 0.5ml/l was used in all the experiments [19].

- **Collection and Maintenance of Fishes** - Healthy and live fishes (wt 80-90g) were collected from different water bodies in Jhansi district of Bundelkhand region U.P. India. Fishes were acclimatized for 6-10 days in laboratory conditions and fed with commercial diet. The fishes were checked against injury or infection by keeping in 0.2% of potassium permanganate solution for 2-4 minutes. Feeding was stopped 24 h before commencement of test experiments.
- **Experimental procedure-** According to Finney's probit analysis previously estimated $LC_{50}$ were 0.00066 ml/l, 0.00044 ml/l, 0.00033 ml/l and 0.00022 ml/l after 24, 48,72 and 96 h cypermethrin intoxication respectively [21] and 0.5 ml/l GTE from stock solution was found to be effective at which no mortality occurs [19]. To assess the effect of flavonoid on some biochemical parameters fishes were randomly divided into 4 groups of 10 fishes each, $I^{st}$ group served as control. The fishes of $II^{nd}$ group were treated with 0.00066 ml/l of cypermethrin, $III^{rd}$ group received 0.5ml/l GTE whereas $IV^{th}$ group received cypermethrin(0.00066ml/l) + GTE (0.5ml/l). Same protocol was employed by taking $LC_{50}$ concentration of cypermethrin at 48, 72 & 96 h exposure periods and 0.5 ml/l GTE was applied at all exposure periods. After completion of 24, 48, 72 & 96 h exposure periods blood samples from all the fishes were collected, centrifuged at 3000rpm for 20 min and serum was separated. Serum total protein, SGOT, SGPT, Alkaline phosphatase, Acid phosphatase, Creatinine, Uric acid and Blood glucose were analyzed using colorimetric diagnostic kit through biochemical auto-analyzer.
- **Statistical analysis-** Student's 't' test was employed to assess the statistical significance of various biochemical parameters. The results were expressed as mean ± standard deviation (SD). Differences with a P-value <0.05 were considered as statistically significant.

## RESULTS AND DISCUSSION:

In the present study biochemical alternations caused by cypermethrin and protective effect of green tea extract on fishes were carried out and results are given in Table 1 & 2. The significantly (<0.05) elevated levels of SGOT, SGPT, Uric acid and Blood glucose were observed in II[nd] group as compared to control group, while in IV[th] group a remarkable reduction was seen after all exposure periods. The level of SGOT, SGPT and Blood glucose in cypermethrin exposed group was increased gradually along with the exposure periods. The slight increase was observed in creatinine level when compared to untreated control group. A significant (<0.05) decrease was seen in total protein level in II[nd] group whereas in group III[rd] & IV[th] it was enhanced. The activity of both ALP and ACP was found to decrease slightly but insignificantly increased after treatment of GTE.

**Table-1.Effect of Green tea extract (GTE) on cypermethrin induced toxicity in *Heteropneustes fossilis***

| | | 24h Exposure period | | | | 48h Exposure period | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | C | T | GTE | T+GTE | C | T | GTE | T+GTE |
| 1 | S.G.O.T | 37.46 ± 3.65 | 91.76 [a] ± 1.77 | 40.01 [b] ± 2.21 | 75.90 [a b] ± 4.53 | 37.60 ± 1.70 | 96.23 [a] ± 1.30 | 39.88 [b] ± 1.34 | 70.46 [a b] ± 2.07 |
| 2 | S.G.P.T | 38.33 ± 5.15 | 63.83 [a] ± 5.15 | 42.7 [b] ± 1.26 | 54.33 [a b] ± 0.55 | 36.39 ± 3.10 | 65.16 [a] ± 5 | 40.56 [b] ± 4.59 | 49.63 [a b] ± 8.15 |
| 3 | T.PROTEIN | 6.94 ± 0.08 | 5.77 [a] ± 0.20 | 6.78 [b] ± 0.25 | 6.69 ± 0.63 | 6.95 ± 0.24 | 6.41 ± 0.87 | 6.85 ± 0.18 | 6.42 ± 0.46 |
| 4 | ALP | 474.97 ± 9.85 | 466.16 ± 9.50 | 473.26 ± 4.48 | 472.16 ± 7.72 | 485.26 ± 6.25 | 483.66 ± 2.44 | 484.16 ± 4.59 | 485.46 ± 5.05 |
| 5 | ACP | 3.92 ± 0.04 | 3.63 [a] ± 0.46 | 3.82 ± 0.10 | 3.77 ± 0.14 | 3.92 ± 0.31 | 3.63 ± 0.56 | 3.88 ± 0.08 | 3.86 ± 0.07 |
| 6 | CREATININE | 1.25 ± 0.13 | 1.38 ± 0.07 | 1.26 ± 0.41 | 1.07 ± 0.27 | 1.27 ± 0.12 | 1.53 ± 0.17 | 1.30 ± 0.18 | 1.32 ± 0.23 |
| 7 | URIC ACID | 5.92 ± 0.32 | 7.19 [a] ± 0.15 | 5.61 [b] ± 0.82 | 6.25 ± 1.51 | 6.09 ± 0.19 | 6.70 ± 3.88 | 5.71 ± 0.50 | 5.13 [a] ± 0.19 |
| 8 | BLOOD GLUCOSE | 88.66 ± 2.51 | 95.00 [a] ± 2.64 | 87.33 [b] ± 2.51 | 84.00 [b] ± 6.80 | 95.66 ± 3.05 | 103.33 [a] ± 2.51 | 93.66 [b] ± 3.21 | 92.66 [b] ± 4.16 |

**Table -2.Effect of Green tea extract (GTE) on cypermethrin induced toxicity in *Heteropneustes fossilis***

| | | 72h Exposure period | | | | 96h Exposure period | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | C | T | GTE | T+GTE | C | T | GTE | T+GTE |
| 1 | S.G.O.T | 34.63 ± 5.37 | 99.3 [a] ± 1.9 | 37.4 [b] ± 3.88 | 68.6 [a b] ± 2.35 | 37.73 ± 2.25 | 101.76 [a] ± 3.45 | 39.05 [b] ± 5.52 | 67.26 [a b] ± 7.55 |
| 2 | S.G.P.T | 34 ± 7.53 | 68.26 [a] ± 5.47 | 39.12 [b] ±5.45 | 58.13 [a b] ± 1.70 | 36.63 ± 5.22 | 69.86 [a] ± 6.43 | 41.2 [b] ± 4.16 | 53.7 [a b] ± 6.1 |
| 3 | T.PROTEIN | 7.17 ± 0.07 | 5.10 [a] ± 0.01 | 6.54 [a b] ±0.23 | 6.01 [a b] ± 0.19 | 7.16 ± 0.62 | 6.52 [a] ± 1.32 | 7.04 ± 0.37 | 6.79 ± 0.57 |
| 4 | ALP | 502.06 ± 6.80 | 496.06 ± 7.0 | 501.36 ± 7.25 | 500.86 ± 1.46 | 509.5 ± 5.15 | 504.3 ± 7.39 | 505.06 ± 6.10 | 508.7 ± 6.33 |
| 5 | ACP | 3.96 ± 1.04 | 3.69 ± 0.54 | 3.95 ±0.15 | 3.79 ± 0.93 | 4.11 u ± 0.75 | 3.69 ± 0.90 | 4.05 ± 0.37 | 3.80 ± 0.73 |
| 6 | CREATININE | 1.24 ± 0.22 | 1.36 ± 0.17 | 1.18 ± 0.09 | 1.13 ± 0.18 | 1.23 ± 0.28 | 1.37 ± 0.15 | 1.26 ± 0.04 | 1.19 ± 0.11 |
| 7 | URIC ACID | 6.43 ± 0.04 | 6.85 [a] ± 0.01 | 5.61 [a b] ± 0.14 | 6.63 [b] ± 0.02 | 6.42 ± 0.40 | 7.55 ± 0.61 | 6.47 ± 0.64 | 6.15 [b] ± 0.12 |
| 8 | BLOOD GLUCOSE | 100 ± 5.29 | 107 ± 2.64 | 105.66 ± 2.08 | 102 ± 7.93 | 92 .67 ± 4.50 | 110.33 [a] ± 1.52 | 88.33 [b] ±2.51 | 105 [a] ± 7.81 |

([a]): Significant when compared to control group (p <0.05).

([b]): Significant when compared to cypermethrin treated group (p <0.05).

Pesticide exposure causes several alterations in enzyme activities in blood of fishes indicating major pathological disorders. The liver faces the threat of maximum exposure to pesticides and its metabolites as detoxication process occurs mainly in liver. Several parameters viz. SGOT, SGPT, ALP, ACP, Creatinine, Total protein,Uric acid and Blood glucose are mainly used for liver and renal dysfunction [22-24].

Oxidative damage during stressed condition primarily occurs through production of ROS which initiate lipid peroxidation altering phospholipid membrane leading to cellular damage [25,26]. Previous reports showed that free radicals (ROS) are generated after cypermethrin poisoning [11,27]. The use of natural antioxidants having free radical scavenging ability is the common protecting strategies during stressed condition caused by exposure of pesticides. Several studies showed the protective effects of natural substances having antioxidant activity [28,29]. Green tea contains polyphenols which increase the removal of detoxified metabolites. Its administration improves the oxidative injuries and acts as scavengers of free radicals [30]. Catechins found in green tea reduced the formation of peroxides more effectively. Shimizu *et al.,* (2015) reported the anti-oxidative and anti-inflammatory activities of green tea catechins [31].

In the present study SGOT and SGPT levels were increased significantly after cypermethrin exposure. These enzymes are considered as sensitive indicators of stress, elevated levels may indicate hepatic damage as shown by several researchers [6,23]. In order to cope with the energy demand during stressed condition amino acids input in kreb's cycle occurs which increases the activities of transaminases [3]. Further the present work demonstrated significant decrease in SGOT and SGPT levels after treating with GTE highlighting the mechanism that green tea being an antioxidant have hepato-protective effect. Such findings are concomitant with the findings of others work [32,33].

Treatment of cypermethrin in the present observation reduced the level of total protein content in the serum of fishes. The reduced level suggests the impaired incorporation of amino acids in protein synthesis in liver due to hepatocyte damage [34]. A significant decrease in protein content was also observed in liver and muscles tissues by several other workers [4,35]. Bhanu and Deepak (2015) reported increased production of protease enzyme which cause decrease in protein content in fish tissue [9]. In group treated with cypermethrin + GTE, there was a significant increase in protein content. It may be due to the effect of green tea flavonoids which might protect liver toxicity by inhibition of oxidative damage of hepatocytes.

The alterations in the activities of Alkaline phosphatase and Acid phosphatase are the biomarkers of hepatic injury. In our experiment the ACP and ALP levels were reduced by cypermethrin exposure. Tiwari *et al.,* 2012, mentioned the reduced activity of ACP and ALP in fingerlings of *Labeo rohita* [34].These two enzymes act to modulate the activities of proteins in a cell in response to external stimuli, the low level of protein may cause the reduction in these enzymes. Co-administration of GTE along with cypermethrin normalized at least partially the level of ALP and ACP.

The rise in uric acid and serum creatinine levels are indicators of renal dysfunctions, as they are not properly excreted by the kidneys. The uric acid and creatinine were elevated in the blood of fishes under the impact of cypermethrin in present investigation. These findings are also supported by other workers [5,9]. Table 1 & 2 showed the gradual increase of blood glucose level in serum of fishes following cypermethrin exposure. Stress is an energy demanding process and the animal mobilizes energy substrates to cope with stress metabolically [36]. Hyperglycaemic response is an evidence of stress due to cypermethrin exposure [37]. The increase in blood glucose by pesticide treatment might indicate disrupted carbohydrate metabolism due to enhanced breakdown of liver glycogen [9]. Addition of GTE restored the damage caused by cypermethrin.

## CONCLUSION:

Acute toxicity effects of cypermethrin to fishes showed changes in some biochemical parameters. The administration of green tea extract exerted a protective role against pesticide toxicity.

## REFERENCES:

1 Usmani KA, Knowles CO. Toxicity of pyrethroids and effect of synergists to larval and adult *Helicoverpa zea*, *Spondoptera frugiperda* and *Agrotic ipsilon* (Lepidotera: Noctuidae.), J. Econ. Entomol, 2001; 94: 868-73.

2 Rahman O, Sadhu DN. Effects of pesticides on aquatic and aerial oxygen consumption in an air-breathing murrel fish, *Channa gachua*. Nat. Env. Poll. Tech, 2009; 8(3): 603-608.

3 Singh SK, Singh SK, Yadav RP. Toxicological and biochemical alterations of cypermethrin (Synthetic pyrethroids) against fresh water teleost fish, *Colisa fasciatus* at different season.

World J of Zoo, 2010;5 (1): 25-32.
4 Olalekan A. Biochemical response of *Clarias gariepinus* to Cypermethrin. J Environ Anal Toxicol, 2014;5(1):10.4172/2161-0525.1000250.
5 Ahmad SK, Gautam RK. Effect of Organophosphate Pesticide, Nuvan on Serum Biochemical Parameters of Fresh water Catfish *Heteropneustes fossilis* (Bloch.). Int. Res. J. Environ Sci, 2014; 3(10):1-6.
6 Prashanth MS, Neelagund SE. Impact of cypermethrin on enzyme activities in the fresh water fish *Cirrhinus mrigala* (Hamilton). Caspian. J.Env.Sci, 2008; 6:91-95.
7 Ghanim-AL KA. Effect of Cypermethrin toxicity on enzyme activities in the freshwater fish *Cyprinus carpio.* African J of Biotechnol, 2014;13 (10): 1169-1173.
8 Velisek J, Svobodova Z, Machova J. Effects of bifenthrin on some haematological, biochemical and histopathological parameters of common carp (Cyprinus carpio L.),Fish Physio and Biochem, 2009;35 (4):583-90.
9 Bhanu AP, Deepak M. Impact of Cypermethrin on biochemical aspects of clinical importance in the blood of freshwater fish *Cyprinus carpio*. J of Entomol and Zoo Studies, 2015; 3(1): 126-128.
10 Attia KA, El-Badawai AA. Effect of short or long term exposure of dithiopyr on certain blood, growth and tissue biochemical parameters in cat fish (*Clarius garipinus*). Int J Appl Sci Biotechnol, 2015;3(2): 314-321.
11 Uner N, Oruc EO, Canil M, Sevgler Y. Effects of Cypermethrin on antioxidant enzymes activities and lipid peroxidation in liver and kidney of the freshwater fish, *Oreochromis niloticus*. Bull Environ Contamination and Toxicol, 2001;67(5):657-664.
12 Richterova Z, Machova J, Stara A, Tumova J, Velisek J, Sevcikova N, Svobodova Z. Effects of a Cypermethrin based pesticides on early life stages of common carp (*Cyprinus carpio* L.) Veterinarni Medicina, 2015;60(8):423-431.
13 Gupta M, Mazumder U, Kumar T, Gomathi P, Kumar R. Antioxidant and Hepatoprotective effects of Buhinia Racemosa against Paracetamol and Carbon Tetrachloride induced liver damage in rats. Iranian J.Pharma. Therapeutica, 2004;3:12-20.
14 Anjaneyulu M, Chopra K. Quercetin an antioxidant bio-flavonoid attenuates diabetic nephropathy in rats. Clinical and Exp Pharmacol & Physiol, 2004;31: 244-248.
15 Hilger DK, Wohlenberg MF, Schaffer TK, Machado FS, Goncalves LK, Bortolato G, Dani G, Rodrigues A, Funchal C, Dani C. Purple Grape Juice, an Important Flavonoids Source, Influence in Biochemical Parameters in Offspring of Wistar Rats. Food and Nutr Sci, 2015;6(7): 683–91.
16 Frei B, Higdon J. Antioxidant activity of tea polyphenols in vivo: evidence from animal studies. J. Nutr., 2003;133: 3275-3284.
17 Scalbert A, Williamson G. Dietary intake & bio availability of polyphenols. J Nutr, 2000; 130: 2073S- 2085S.
18 Babu PV, Liu D. Green tea catechins and cardiovascular health: an update. Curr Med Chem. 2008; 15(18):1840-50.
19 Zahra K, Yadav S, Tanya, Jyoti, Deeksha, Sandeep *et al*. Assessment of acute toxicity of cypermethrin and its mitigation by green tea extract in fresh water fishes, *Channa punctatus.* Indo Amer J Pharma Sci. 2016; 3(4):374-378.
20 Heikal TM, Ghanem HZ, Soliman MS. Protective effect of green tea extracts against dimethoate induced DNA damage and oxidant/antioxidant stauts in male rats. Biohealth Sci Bull, 2011; 3(1):1-11.
21 Singh A, Zahra K. $LC_{50}$ assessment of cypermethrin in *Heteropneustes fossilis*: Probit analysis. Int J Fish Aq studies. 2017; 5(5): 126-130.
22 Banaee M, Sureda A, Zohiery F, Hagi BN, Garanzini DS. Alterations in biochemical parameters of the freshwater fish, *Alburnus mossulensis*,exposed to sub-lethal concentrations of Fenpropathrin. Inter J of Aq Bio, 2014;2(2): 58-68.
23 Das BK, Mukherjee SC. Toxicity of cypermethrin in *Labeo rohita* fingerlings: biochemical, enzymatic and haematological consequences. J. Comp. Biochem. Physiol., 2003; 134(C) : 109–121.
24 Banaee M, Ahmadi K. Sub-lethal toxicity impacts of endosulfan on some biochemical parameters of the freshwater crayfish (Astacus leptodactylus). Res J of Environ Sci, 2011;5(11):827-35.
25 Chen XY, Shao JZ, Xiang LX, Liu XM. Involvement of apoptosis in malathion-induced cytotoxicity in a grass carp (*Ctenopharyngodon idellus*) cell line. Comparative Biochem and Physio Part C: Toxicol & Pharmacol 2006;142(1):36-45.
26 Possamai F, Fortunato J, Feier G, Agostinho F, Quevedo J, Wilhelm Filho D, *et al*. Oxidative stress after acute and sub-chronic malathion intoxication in Wistar rats. Environ Toxicol and Pharmacol. 2007;23(2):198- 204.
27 Giray B,Gurbay A, Hincal F.Cypermethrin induced oxidative stress in rat brain and liver is

prevented by Vitamin E or allopuriol.Toxicol Lett, 2001;118:139-146.

28 Hussein RH, Khalifa FK. The Protective Role of Ellagitannins Flavonoids Pretreatment against N-Nitrosodiethylamine Induced-Hepatocellular Carcinoma. Saudi J of Bio Sci, 2014;21(6): 589–96.

29 Banaee M, Sureda A, Shahaf S, Fazilat N. Protective effects of Silymarin extract on Malathion - induced Zebra Cichlid (*Cichlasoma nigrofasciatum*) Hepatotoxicity. Iranian J Toxicol, 2015; 9(28):1239-1246.

30 Elzoghby RR, Hamoda AF, Fatah AA, Farouk M. Protective role of vitamin C and green tea extract on malathion induced hepatotoxicity and nephrotoxicity in rats. Am J of Pharmacol and Toxicol. 2014; 9(3):177-188.

31 Shimizu M, Shirakami Y, Sakai H, Kubota M, Kochi T, *et al*. Chemopreventive potential of green tea catechins in hepatocellular carcinoma. Int J Mol Sci 2015 16: 6124-6139.

32 Adel AG, Tarek AS, Sabah FE, Mohamed EE, Amira UE. Protective role of Green tea on Carbontetrachloride- Induced Acute Hepatotoxicity. Sci J Fac Sci Minufia Univ, 2009; XXIII: 55-67.

33 Al-Ngada RS, Abdelwahab AM, El-Bahr SM. Effect of dietary supplementation of Green tea (Camellia Sinesis) on growth, body composition and serum biochemistry of the Asian Seabass, Lates calcarifer fingerlings. J Aquac Res Dev. 2017,8 (11): DOI:10.4172/ 2155-9546.1000518.

34 Tiwari S, Tiwari R, Singh A. Impact of Cypermethrin on Fingerlings of Common Edible Carp (*Labeo rohita*). The Scientific World J. 2012; 7.

35 Tantarpale SA. Cypermethrin Impact on Total Protein in Muscle and Liver of the Freshwater Fish *Channa Striatus*. Sci Res Reporter, 2011; 1(3): 155–58.

36 Hog H. Effects of sublethal concentration of Zinc II sulphate heptahydrate (Zn $SO_4.7H_2O$) on blood glucose level of fresh water fish Heteropneustes fossilis. Int J of Sci Tech Res. 2014;3(5):128-131.

37 Deka C, Dutta K. Effect of cypermethrin on blood glucose and urea levels of *Heteropneustes fossilis* (Bloch). Biolife, 2015. 3(3): 717–721.