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DISTILLERY EFFLUENT INDUCED ALTERATIONS IN THE GLYCOGEN AND LIPID DURING OVARIAN CYCLE OF COLISA FASCIATUS (BL. & SCHN.) A TROPICAL FRESHWATER PERCH

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ABSTRACT

Present paper deals with the effect of distillery effluent if any, on the glycogen and lipid content during different phases of ovarian cycle of a freshwater perch Colisa fasciatus after long term exposure (30 days) at 5% and 10% concentration of the effluent. No appreciable declining in the glycogen and lipid content was noticed in 5% effluent concentration during any phase of ovarian cycle. However, 10% effluent concentration brought significant alteration (P<0.01-0.001) in selected biochemical parameters after long term exposure (30 days) in all the three principal phases (preparatory, spawning and post spawning) of ovarian cycle of Colisa fasciatus which reflects the toxic index of distillery effluent upon the reproductive physiology of the selected fish.

Key Words : Distillery effluent; *Colisa fasciatus;* Ovarian cycle; Total glycogen, Total lipid.

Introduction

India is the major producer of sugar in the world having about 579 sugar mills and 319 distilleries (Patil and Ghole, 2010). Apart from sugar and alcohol, these industries generate many by-products and waste materials(Krishna and Prakash, 2010). Industrial effluents in developing countries are indiscriminately discharged into aquatic ecosystem and even into nearby fields without any pretreatment (Srivastava *et.al.*, 2007; Shukla and Shukla, 2012a,b). Distillery effluent contains a variety of pollutants of different nature of organic and inorganic salts, which create serious problem to the non-target fauna, especially fishes (Ramakrishnan *et.al.*, 1999; Ramakritinan et.al.2005). Biochemical indices have varied sensitivities to different environmental factors and chemicals. In fish, alterations in biochemical parameters depend upon the concentration of pollutants and exposure duration (Venkatramreddy, 2009).

The major effective parameters in distillery effluent are dissolved solids, chlorides, sulphates, less amount of highly toxic sulphides and a high precentage of dissolved organic as well as inorganic matters (Joshi, 1999:Ramakritinan *et.al.*, 2005). In addition, high biological oxygen demand causes depletion of dissolved oxygen and proves deleterious to aquatic fauna. The distillery

effluent is a potent complex water pollutant in two ways, first, its highly colorful nature may block sunlight and hence becomes detrimental to aquatic life and second, it has a high pollution load that results in eutrophication of water (Joshi, 1999; Ramakritinan *et.al.,* 2005). Thus, the untreated effluents pose a toxic impact on fish and aquatic fauna (Krishna and Prakash, 2010; Shukla and Shukla 2012 a,b). Hence, it becomes essential to reduce the toxic level of various pollutants in the distillery effluent before discharging it into adjacent water course or land. Various studies have been carried out on the toxicity of industrial effluent on various biochemical parameters in the fishes. (Kumar et.al., 1995; Pant and Adholeya, 2007, Shukla and Shukla 2009). However, deleterious impact of various concentrations of distillery effluent particularly on glycogen and lipid content is very scarce. Hence, present study was undertaken to assess the impact of distillery effluent on glycogen and lipid content during different phases of ovarian cycle (preparatory, spawning and post spawning) under two concentrations of distillery effluent (5% and 10%) in *Colisa fasciatus* after a long term exposure (30 days).

Materials and Methods

Distillery effluent sample were collected from three sites. Sampling was done from the depth ranging from 20-25cm. Precautions were taken to avoid any disturbance by loose segments. As analytic technique, the procedures outlined by APHA (2005) was followed for analysis (Table 1). Adult specimens of *C. fasciatus* (weight 28.98 $\pm$ 2.36 gm) were procured from local lake for the study and were brought to the laboratory in an oxygen pack. They were acclimatized for 7 days under natural photoperiod in glass aquaria containing laboratory tap water having temperature 21.30 $\pm$ 1.64^{0}C; pH 7.28 $\pm$ 0.22 ; hardness as $CaCO_3$ 128.30$\pm$6.24 mg/l and electrical conductivity 1283.0µmhos/cm. They were fed with dried shrimp powder daily but feeding was allowed only after 5 days during the experimental period.

Colisa fasciatus is an annual breeder perch. Its reproductive cycle though has been divided into six phases as reported by Pandey and Mishra (1981). However, only three principal phases namely preparatory, spawning and post spawning has been chosen to observe alterations if any in lipid and glycogen content under 5% and 10% effluent stress when compared with control. In each phase 20 fishes were kept in control and experimental media. The total glycogen and lipid were estimated by adopting the standard methods outlined by Kemp and Kits (1954) and Pandey et.al.(1963) respectively. The values were tested for significance using students ‘t’ test (Bailey, 1959).

Results and Discussion

Table 1:Physico-chemical characteristics of distillery effluent of GIDA, Gorakhpur (U.P.)

Parameters	Units	Raw distillery effluent
Temperature	(^{0}C)	32.5+2.2
pH	mgl^{-1}	4.0-5.2
Oxygen	mgl^{-1}	ND
COD	mgl^{-1}	8000-12000
BOD	mgl^{-1}	1500-1800
Total Solids	mgl^{-1}	3600-4200
Suspended solids	mgl^{-1}	1800-2200
Volatile solids	mgl^{-1}	6000-8000
Total hardness	mgl^{-1}	ND
Free CO2	mgl^{-1}	ND
Organic nitrogen	mgl^{-1}	ND
Total nitrogen	(%)	0.80-1.20
Total phosphours	(%)	0.034-1.02
Potassium as K_2O	mgl^{-1}	1.16-1.28
Sulphate as SO_4	mgl^{-1}	3200-3800
Ferrous	mgl^{-1}	260-340
Suphide	mgl^{-1}	160-240
Calcium as Ca^{++}	mgl^{-1}	180-260
Chloride as Cl^{-}	mgl^{-1}	500-680
Salinity	(ppt)	ND

ND= not determined; values are mean of eight replicates +SE

Table 2: 5% & 10% effluent impact on total glycogen and lipid content in (mg/gm) dry weight of ovary during its phases (n=6)

* P>0.05

**=P<0.01

***=P<0.001

Ovarian cycle phases	**Biochemical parameters (mg/gm.) dry weight of ovary**	**Control**	**5% distillery effluent**	**% change**	**10% distillery effluent**	**% change**
Preparatory phase	Glycogen	22.24±0.36	20.76±0.56*	6.65	17.32±0.36**	22.12
	Lipid	72.46±1.38.	69.88±1.28*	5.56	61.88±1.82**	14.60
Spawning phase	Glycogen	28.22±0.30	26.66±0.32*	5.52	20.68±0.52***	26.71
	Lipid	88.56±1.72.	85.52±1.82*	3.43	74.88±1.92**	15.44
Post Spawning Phase	Glycogen	12.22±0.24	11.12±0.26*	9.00	9.76±0.16***	20.13
	Lipid	36.24±1.28	34.54±1.36*	4.47	30.24±1.02***	16.55

The physciochemical properties of effluent of distillery contains mixture of pollutants and their magnitude has been shown in Table 1.

The total glycogen and lipid concentration in all the phases of ovarian cycle of *Colisa fasciatus* exposed to 5% effluent concentration for 30 days of exposure produced least significant alteration. However, significant decrease under 10% effluent concentration after 30 days of exposure, in glycogen and lipid content was observed during different phases of ovarian cycle (preparatory, spawning and post spawning) as shown in Table 2. The distillery effluent are proved to be toxic and deeply colored (Shukla and Shukla 2013) for aquatic biota. The color and toxicity of the effluent arises due to the presence of low and high molecular weight organic compounds generated during processing. The slow decomposition of released toxic compounds also pose deleterious effects. The effluent discharged from distillery, even after aerobic treatment may exert various adverse effects on aquatic ecosystem and their fauna in general and fishes in particular. In our observations, it becomes clear that there is an appreciable demission in the glycogen and lipid content in all phases of ovarian cycle of *Colisa fasciatus* exposed to 10% distillery effluent (Table 2). It is also clear from table 2 that level of glycogen and lipid of ovary in control spawning phase was maximum in comparison to preparatory and post spawning which clearly indicates towards the possibility of supply of carbohydrate and lipid content in the form of glucose and lipid derivatives for active maturation of female gametes (ova). The increasing order of decrease in glycogen content during preparatory and spawning phases of ovarian cycle of *Colisa fasciatus* may be due to its enhance utilization as immediate source to meet energy demands for

maturation of a ova under effluent stress. It could also be on account of the prevalence of hypoxic or anoxic condition of the effluent which generally enhances glycogen utilization in one way or other (Dezwaan and Zandee 1973; Geetha et.al.,1991; Ozretic and Krajnovicozretic, 1993, Shukla et.al.,2005;2012a). The decline in the lipid content under 10% distillery effluent stress during different phases of ovarian cycle of *Colisa fasciatus* might be partly due to its utilization in cell repair and tissue organization with the formation of lipoprotein which is salient constituent of cell membrane and cytoplasmic organales (Harper, 1983).

Our findings regarding distillery effluent toxicity may be well correlated with the observations made by Joshi,1999; Kumar et.al., 1995; Ramakritian et.al. 2005; Patil and Ghole, 2012; Shukla and Shukla 2011, 2012a,2013,2014) and confirms that long term exposure under distillery effluent may interfere and impair in the ovarian physiology of the fish

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