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RESEARCH ARTICLE

Studies of Metabolites in relation to Gonadal cycle of two fishes, *Sillagosihama* and *Otolithus rubber* at the Gulf of Kuchchh, India

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Abstract

The investigation was carried out at the Southern coast of the Gulf of Kuchchh (22^o 41.6' N and 70^o 18.4; E). For the present study to fishes such as, *Sillagosihama* and *Otolithus rubber* were selected for detailed investigation. *Sillagosihama* and *Otolithusruber* were sacrificed in the field very quickly; the testes and ovaries of the fishes were dissected out separately from each of the two species for estimate the glycogen content. For samples of total lipid were brought to the laboratory and were oven dried at 48^oC for 3 to 5days and homogenized powders were made than dried samples were estimated by soxhlet apparatus using ethanol and petroleum ether mixture (3:1 ratio) as a solvent. The metabolites like Lipid in Ovary increase during the active process of gametogenesis in both the fish species. While the Glycogen level decreased in *Sillagosihama*, whereas in *Otolithusruber*, these metabolites showed an increased trend. This is due to as *Sillagosihama* laid eggs in batches, while *Otolithusruber* had a definite spawing time.

Introduction

It is known that the fish ovary undergoes several histological, anatomical, physiological, cytological, and biochemical changes during maturation. Spawning and post-spawning periods of fishes and possibly the main target for many fish physiologists. Fish ovary is under influence of pituitary (Ball., 1962; Belsare, 1965; Ahsan, 1966; Sunderraj and Nayyar, 1967; Yamazaki and Donaldson, 1968; Bannett et.al 1994). According to some authors the follicular epithelium of fishes is endocrine in nature (Barr, 1968; Hoar, 1969; Iwasaki, 1973). Evidence of steroid genesis has been reported in corpora luetes of Torpedo fish by Chieffi (1967). The unspawned ova are reabsorbed back in fish ovary (Smith, 2008). In his exhaustive work on ovaries of scomberscomber, Bara (1966) has furnished valuable information about various changes which occur during the maturation and shading of oocytes and on resorption of unspawned eggs. Ovaries of fishes of *Sillagosihama* and *Otolithusruber* are pale yellow organs which occupy which occupy a posteriodorsal position in the viscera situated underneath the kidney. The lobes lie together and are fused at the posterior end and opening to the cloacae. The testes are relatively small, white, and elongated organs. It becomes milky white on attaining sexual maturity. The ovaries of fish have shown rise in protein during maturation and the rises in lipid which bring about series of change in lipid metabolism.

Energy metabolism of developing oocytes differs considerably from that of embryo as the oocytes receive glucose from the female body and therefore the ooctye is site of continuous glycogen synthesis. In the beginning of vittellogenesis the oocytes showed very high activities of glycol sis. During this period the glycogen increases which leads to several metabolic changes (Yamazaki, 1961). In fish body the gonads store large quantity of lipids during maturation (Pandey, 1969). The mobility of a fat from other organs through gonads in the fish is also suggested by Vaidya, (1960).

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The seasonal changes in lipid of liver of *Pleuronectesplatessa* was studied by Dawwson and Grimm (1980); Donaldson, (1973). It is known that fish testes contain various amounts of lipids. After mating a rapid accumulation of cholesterol and lipids in somniferous tubules of teleost, the distributions of physiological characteristics of testicular lipids have been reviewed by Johnson (1970). The present study was undertaken to investigate the variations in Glycogen and Lipid level in ovaries and testes of fish, *Sillagosihama* and *Otolithus rubber*.

Material and Methods

The investigation was carried out at the Southern coast of the Gulf of Kuchchh (22^o 41.6' N and 70^o 18.4; E). Inshore fishing was carried out extensively at the study site. The fishermen use traditional sail boats for fishing purpose.

For the present study to fishes such as, *Sillagosihama* and *Otolithus rubber* were selected for detailed investigation. Ten to fifteen live *Sillagosihama* and *Otolithusruber* of total length 10 to 25 cm and 10 to 35 cm, respectively in size were sacrificed in the field very quickly, the testes and ovaries of the fishes were dissected out separately from each of the two species. The testes and ovaries were then separately immersed in 30% KOH to estimate glycogen content in testes and ovaries respectively, for which Hassid and Abraham (1957) method was followed. Total lipids were estimated quantitatively. The samples for total lipid were brought to the laboratory and were oven dried at 48^oC for 3 to 5days and homogenized powders were made. Total lipids of the dried samples were estimated by soxhlet apparatus using ethanol and petroleum ether mixture (3:1 ratio) as a solvent. The values recorded are in milligrams per gram.

Result and Discussion

Glycogen

The results of glycogen content in selected fishes are shown in table 1 and 2. The glycogen content showed a decrease level during pre-spawning time and an increases level were observed during August and September, again it decreases during the middle of the spawning time and it showed the lowest level during the last period of the spawning time in the ovaries of *Sillagosihama*. An increases trend is observed during March and May, i.e., during post spawning time. A rise in glycogen during pre-spawning (June) and during begging of the spawning time (August and September) was observed. It can be explained that fish might be accumulating glycogen in ovary during pre-spawning time (June) and beginning of the spawning time (August and September). A fall in glycogen level during October, November, December and February (6.34, 4.47, 5.72, 2.54 mg/gm respectively), may be explained due to depletion. In post-spawning time normally increase level is observed, which can be attributed to storage of glycogen during resting time. Regarding the ovaries of the *Otolithusruber* glycogen level increase during pre-spawning time March and June (16.54, 19.59 mg/gm, respectively) and during spawning time (August and September) and decrease level is observed during the beginning of the spawning time (July) and during the last month of the spawning time, i.e., during October. It may be attributed to release of mature eggs during spawning time. As fish spawns after an interval of time and due to accumulation of mature eggs during middle of the spawns time an increase trend in glycogen content of ovaries of Otolithusruber is observed. The fish breeds in gulf of kuchchh, and after spawning, it might be returning back to open sea, after taking rest for some time and might be accumulating glycogen for the next successive process of game to genesis, an increases trend in glycogen is observed during post-spawning time (November,

December, January). It is reported that ovary in fish accumulates glycogen during maturation and this glycogen is stored in the eggs. The fish eggs are the storehouse of metabolites and it is obvious that during depletion on release of ova, decrease in ovarian glycogen is recorded in ovary of *Onchorhynchusnerka* (Chang et al., 1960). In *clarieslazera* (Yamazaki, 1962) alsoaccumolation of glycogen and glucose have been reported during maturation and which declines after spawning. Glycogen content in testes of *Sillagosihama* increases at the beginning of the spawning time during August and level decreases during October, November and December again rises in January (31.19 mg/gm) i.e. during late period of spawning time, and again rises in March (43.38 mg/gm) i.e. beginning of post-spawning time. In case of *Otolithusruber* the glycogen level increases during pre-spawning time and decrease trend is observed in July, September and October (6.82, 14.00, 5.45 mg/gm, respectively) i.e. during spawning time. A sudden rise in glycogen content in testis is observed during the middle period of spawning time i.e. during August (74.2mg/gm). A decrease and increase level in glycogen content in testis is observed during November (9.83mg/gm) and December (90.1mg/gm) respectively. A rise in glycogen level during pre-spawning time and beginning of spawning time indicate the mobilization of glycogen from liver to testis for active process of spermatogenesis and spermeogenesis.

Table 1. Result showing the Glycogen content in Gonad of *Sillagosihama*.

Month	Glycogen content in Gonads of *Sillagosihama* (mg/gm)	
	Testies	**Overy**
January	31.18 ± 1.86	24.57 ± 0.72
February	03.69 ± 0.14	02.54 ± 0.29
March	43.38 ± 2.61	20.64 ± 0.31
April	06.00 ± 0.15	08.48 ± 0.12
May	10.81 ± 0.16	15.13 ± 0.86
June	19.79 ± 0.34	40.84 ± 1.24
July	05.69 ± 0.18	05.16 ± 0.07
August	54.25 ± 1.47	14.91 ± 0.08
September	14.58 ± 0.34	14.26 ± 0.17
October	16.08 ± 0.08	06.34 ± 0.11
November	15.02 ± 0.16	04.47 ± 0.04
December	13.07 ± 0.17	05.52 ± 0.24

Table 2. Result showing the Glycogen content in Gonad of *Otolithusruber*.

Month	Glycogen content in Gonads of *Otolithusruber*(mg/gm)	
	Testies	**Overy**
January	19.82 ± 0.54	19.65 ± 0.69
February	08.38 ± 0.08	02.68 ± 0.46
March	30.03 ± 0.21	16.54 ± 0.36
April	12.61 ± 0.17	03.00 ± 0.19
May	18.82 ± 1.82	06.04 ± 0.23
June	55.34 ± 1.09	19.58 ± 0.61
July	06.81 ± 0.09	05.65 ± 0.24
August	74.20 ± 2.01	11.26 ± 0.12
September	14.00 ± 0.96	13.42 ± 0.52
October	05.44 ± 0.77	4.92 ± 0.09
November	09.82 ± 0.26	47.09 ± 1.15
December	90.10 ± 5.18	28.83 ±0.61

Table 3. Result showing the total lipid content in Gonad of *Sillagosihama*.

Month	Total Lipid content in Gonads of *Sillagosihama* (mg/gm)	
	Testies	Overy
January	356 ± 4.08	214 ± 3.04
February	328 ± 3.65	316 ± 4.08
March	200 ± 3.00	177 ± 2.79
April	282 ± 2.11	330 ± 4.66
May	208 ± 0.00	213 ± 2.70
June	243 ± 3.03	268 ± 3.61
July	270 ± 3.65	308 ± 2.97
August	324 ± 4.65	282 ± 1.17
September	223 ± 3.33	248 ± 2.68
October	210 ± 3.37	274 ± 4.04
November	214 ± 2.18	266 ± 3.67
December	388 ± 4.11	394 ± 4.67

Table 4. Result showing the total lipid content in Gonad of *Otolithusruber*.

Month	Total Lipid content in Gonads of *Otolithusruber*(mg/gm)	
	Testies	Overy
January	258 ± 3.11	288 ± 3.45
February	304 ± 4.44	300 ± 0.69
March	306 ± 4.91	328 ± 4.21
April	280 ± 3.76	298 ± 3.98
May	122 ± 2.16	117 ± 2.48
June	070 ± 2.05	088 ± 2.16
July	110 ± 1.74	180 ± 1.08
August	114 ± 2.21	128 ± 3.05
September	177 ± 2.49	194 ± 2.46
October	164 ± 2.00	280 ± 2.86
November	284 ± 4.14	216 ± 3.11
December	242 ± 3.08	298 ± 3.37

Total Lipids

Lipid content in selected fishes shown in table 3 and 4, it can be stated the total lipid content shows an increase trend during pre-spawning (July) and beginning of the spawning time (August) in testes and ovary of *Sillagosihama*. A slight decrease level is observed in October and November in testes and September, November and January in Ovary. The level declined just after spawning time (March). An increase level in total lipids of ovary is recorded during post-spawning time (April) which may be attributed to resorption of mature ova after spawning time. In case of Otolithusruber an increase trend in total lipid in testes and ovary is observed during enhancement of active gonadial activity of fish which might be accumulating total lipids prespawning time. The total lipids level in testes and ovary, fall down during spawning time, may be attributed to depletion. An increase trend in total lipids level is recorded after the spawning time which may be due to resorption of mature gonads. Increase in ovarian fat in relation to sexual maturity has been reported by some workers (Jennings, et al., 2001).

It is also suggested that ovarian fat depletes during late period of pre-spawning (September, November and January in *SillagoSihama* and during June, July, August, and September in *Otolithusruber*). The testicular lipid increases during the period of gametogenesis in Sillagosihama (June, July) and in *Otolithusruber* (March, Aprial). Fall in testicular lipids in post-spawning period has been recorded in *Pampusargenteus* and *Parastromateusniger* by Devadoss, (1969).

Conclusion

The metabolites like Lipid in Ovary increase during the active process of gametogenesis in both the fish species. While the Glycogen level decreased in *Sillagosihama*, whereas in *Otolithusruber*, these metabolites showed an increased trend. This is due to as *Sillagosihama* laid eggs in batches, while *Otolithusruber* had a definite spawing time.

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