intercellular spaces filled with a PAS positive substance.

Both non-specific esterases and acid-phosphatases have been localized on the stigmatic surface. As reported for other taxa[9, 10] esterases are present in the form of a layer, corresponding to the pellicle (figure 5). In young stigmas (4 or 5 days before anthesis), the pellicle is very thin but becomes thick in mature stigmas. The esterase test gives valuable information regarding receptivity of the stigmas because the reaction product is seen only at functional sites[8]. Acid phosphatases were negligible in stigmas 4 or 5 days before anthesis. Low activity could be seen in stigmas 2–3 days before anthesis which increased at maturity (figure 6). Acid phosphatases have also been reported in *Petunia*[11], *Linum*[7] and in a few legumes[12]. The specific role of acid phosphatases, however, is not yet clearly understood.

The style is green and solid. A hollow style in Cruciferae has been reported in only one variety of *Brassica campestris*[13]. The stylar epidermis bears stomata and trichomes, and is covered by a cuticle. The cortex occupies the largest area of the style and is clearly divided into an outer zone and an inner zone. The cells of the outer zone are round and loosely arranged and contain abundant starch grains, whereas those of the inner zone are polygonal and compact with very few starch grains. The two vascular bundles, traversing the inner zone of the cortex, are highly branched and extend up to the stigma (figure 2). The stylar cortex encloses a single narrow, compact strand of transmitting tissue of thick-walled, densely cytoplasmic cells with small intercellular spaces filled with PAS positive substance (figures 2 and 4). It is through this substance that the pollen tubes traverse and probably derive their nutrition.

Dark green coloration, presence of stomata on the epidermis and resemblance of the outer zone of cortex with spongy parenchyma of a leaf indicate that the style is a highly photosynthetic structure. The style persists even in the fruit.

Sporophytic self-incompatibility is widespread among Cruciferae and understandably this aspect has been studied more extensively than the basic aspects such as those reported here. Fundamental studies provide a better understanding of pollen-pistil interaction and incompatibility mechanism. With this work a beginning has been made and it is hoped that similar investigations will be carried out in other taxa.

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OXYGEN UTILIZATION BY DEVELOPMENTAL STAGES OF CARP EGGS

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INVESTIGATIONS on the respiratory metabolism of the eggs of freshwater fishes have mostly been reported from the temperate region[1–3]. However, studies on this aspect of fish eggs from the Indian subcontinent are rather limited. Oxygen consumption of different developmental stages of eggs and hatchlings has been studied in *Hilsa ilisha*[4]. In

Salmon, the oxygen uptake of eggs is known to increase with age and development[2]. While incubating eggs in hatcheries, one of the main criteria in determining the flow rate of water is the oxygen supply such that the development and hatching of eggs are not affected. In the case of carp eggs, information on the energy utilization was lacking and hence the present investigation was taken up.

Eggs for the above experiments were obtained by injecting a 450 g *Labeo fimbriatus* female at 12 mg pituitary gland (PG) extract per kg body weight and two 500 g males at 4 mg PG extract per kg body weight. Spawning occurred 4 hr after the final doze. Twenty of the good, water-hardened eggs were collected and introduced into a 20 ml syringe with 14 ml of fresh water filtered through 42 Whatman filter paper. The temperature was maintained at 25 ± 0.5°C by keeping the apparatus in a water bath. The initial and final water samples were collected through a latex tube fitted to the syringe and were estimated by Winkler's micro method. Eggs of three stages, morula to pre-yolk plug stage, pea shape stage and twitching stage were studied and in each case 4 replicate readings were taken. The pH was 7.4 and did not vary significantly during the experiment. The data collected were treated statistically and presented in table 1.

A scrutiny of the data shows that the oxygen consumption of eggs increases with the developmental stages from 0.2556 μg/egg/hr to 0.9534 μg/egg/hr. The increase in the oxygen consumption of carp eggs may be due to the high rate of energy utilization involved in the rapid cell multiplication during the initial stages of egg development and the active metabolism due to the high degree of activity during the twitching stage (table 1). It was found that immediately after hatching, the oxygen uptake increased to 1.7516 μg/hatchling/hr in the same species (Mohan, unpublished). In Salmon (*Salmo salar*) eggs, the oxygen uptake rate was 0.2 μl/egg/hr at fertilization and 3.4 μl/egg/hr during hatching[2]. The incubation temperature of salmon egg is very low, but the incubation period is prolonged and the egg size is bigger compared to carp eggs. The oxygen consumption values of 0.2500 μg/egg/hr, 0.9400 μg/hatchling of 1st day/hr and 1.5600 μg/hatchling of 2nd day/hr, reported for *Hilsa ilisha* are comparable to the present observation.

Table 1 *Statistical analysis of the data on the oxygen consumption of carp eggs at* 25 ± 0.5°C

Stage	Mean QO_2 (μg/egg/hr)	Standard deviation
Morula to preyolk plug stage	0.2556	0.0233
Pea shape stage	0.4548	0.0198
Twitching stage	0.9534	0.0075

The number of experiments conducted at all stages was 4.

Based on the above information, the flow rate required for a known number of eggs in an incubation system can be computed. Oxygen consumption in an open system can be expressed by the following equation.

$$QO_2 = dw/dt \times (C_1 - C_2)$$

where QO_2 is oxygen consumption by eggs in mg/hr, dw/dt is the rate of flow of water in l/hr and C_1 and C_2 are the initial and final concentrations of oxygen (mg/l) in water, respectively. The above equation enables the calculation of flow rate required for a definite number of eggs such that C_2 values will not fall to a critically low level due to the oxygen consumption of the developmental stages of eggs. For illustration, in a standard glass jar hatchery (6.35 l) supplied with water of 90% saturation (7.3 mg/l) at 25°C and with C_2 values fixed at a safe level of 70% of saturation (5.9 mg/l), the flow rate required for 50,000 eggs at the two extreme rates of oxygen consumption of 0.2556 μg/egg/hr and 0.9534 μg/egg/hr are 152 ml/min and 567 ml/min, respectively. Considering the various factors like the flow rate required to keep the eggs in suspension, removal of hatchlings from the jar to the spawnery, nullifying pollution effects due to low percentage of fertilization, etc a flow rate not less than 600 ml/min is recommended in standard glass jar hatcheries incubating 50,000 eggs of Indian Major carps, catla, rohu and mrigal[5].

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