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DISSOLUTION AND REFORMATION OF CRYSTALLINE STYLEOF THE EDIBLEOYSTER*SACCOSTREACUCULLATA*FROM SINDHUDURGDISTRICT, MAHARASHTRA STATE

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ABSTRACT:

Two geographically separated estuarine localities at Deogad (16^0 23' N; 73^0 23' E) and Achra (16^0 15' N; 78^0 26' E) in Sindhudurg district of Maharashtra State,India were selected on the basis of the differences in habitat, topography,vegetation and local market value to study the dissolution and reformation of the crystalline style of the oyster *Saccostrea cucullata*. The maximum sizes observed by S. *cucullata* in the estuaries at Deogad and Achra were 44-45 mm shell length. Comparatively large sized oysters are found round the year in the estuary at Deogad than at Achra.

The environmental parameters such as pH, temperature, dissolved oxygen and salinity existing on the oyster beds in Deogad and Achra were recorded at the time of the experiment. The oyster beds in Deogad gets exposed to atmospheric air for comparatively a long time than those at Achra and with the commencement of high tide oyster bed at Achra gets reimmersed to the sea water earlier than the bed at Deogad. The time required for dissolution of crystalline style from the oysters of estuary at Achra is less than those from the estuary at Deogad. Further, time required for the reformation of style after immersion in sea water was less in the oysters from the estuary atAchra than at Deogad.

Key words:*S. cucullata*, Deogad, Achra, estuary,oyster, dissolution and reformation.

INTRODUCTION:

[15] Along the west coast of India the backwaters and estuaries are very extensive and play an important role for food production. These are widely scattered, have an area of 30.7 lakhs acres from which Maharashtra coast constitutes 3.0 lakhs acres combining together 2.0 lakh acres for brackish water and one lakhs acre for estuaries. [9] The backwater and estuaries are very productive along the coast and are being used for various purposes. They are the breeding grounds of various species of marine and estuarine fauna.

Two geographically separated localities at Deogad (16^0 23' N; 73^0 23' E) and Achra (16^0 15' N; 78^0 26' E) in Sindhudurg district of Maharashtra State were selected on the basis of the differences in habitat, topography, vegetation and local market value to study the dissolution and reformation of the crystalline style of the oyster

Saccostrea cucullata. The maximum sizes observed by *S. cucullata* in the estuaries at Deogad and Achra were 44-45 mm shell length. Comparatively large sized oysters are found round the year in the estuary at Deogad than at Achra. The estuary at Achra is comparatively deeper than at Deogad but the estuary at Deogad is wider than at Achra.

The topography of the oyster beds on the rocks in these two localities in mixed soil of mud and sand. In Deogad mangrove vegetation exits near the oyster bed and at Achra it is away from the oyster bed. The oyster beds in the intertidal zone in Deogad get exposed to atmospheric air from comparatively a longer period than those at Achra, where it is situated in the subtidal zone. The oyster bed in Achra gets exposed to atmospheric air during in neap tides. Both the estuaries are free from water pollution and no mechanical fishing operation occurs. The water is fairly clean on the oyster beds.

MATERIAL AND METHODS:

The environmental parameters such as pH, temperature, dissolved oxygen and salinity existing on the oyster beds at Deogad and Achra were recorded.The samples of sea water were drawn just before the collection of these oysters and analysed immediately. Samples were collected for determination of dissolved oxygen in 250 ml DO bottles and oxygen was fixed by adding alkali iodide for further analysis by Wrinkler's method, azide modification. The temperature of sea water was recorded with the help of standard centigrade thermometer ^{0}C. pH was recorded with the help of standard BDH pH paper strips. Salinity was measured according to the method given by Parson *et al*. [20]. The time requirement for the complete loss of the crystalline style of *S. cucullata* upon exposure to atmospheric air and for the reformation upon reimmersion to filtered water have been studiedat the study area.

RESULTS:

The environmental parameters like temperature, salinity, dissolved oxygen, pH and relative humidity were measured during the collection period are given in Table 1.

Table1: Environmental parameters examined during the collection period in the estuary at Deogad and Achra.

Environmental parameters	At Deogad	At Achra
Temperature °C	29.83 (±0.29)	29.67 (±0.29)
Salinity ‰	27.79 (±0.74)	29.37 (±0.59)
Dissolved oxygen ml/L	4.75 (±0.07)	4.13 (±0.08)
pH	6.93 (±0.57)	6.93 (±0.57)
Relative humidity %	85.33 (±0.58)	85.33 (±0.58)

(Figures in brackets show ± S.D.)

At the time of experiment, the samples from the estuary at Deogad showed tempereature 29.83 (± 0.29) °C, salinity 27.79 (± 0.74) ppt, dissolved oxygen 4.75 (± 0.07) m1/L, pH 6.93 (± 0.57) and relative humidity 85.33 (± 0.59) % On 15th November, the samples from the estuary at Achra showed temperature 29 67 (±0.29) °C, salinity 29.37 (± 0.59) ‰, dissolved oxygen 4.13 (± 0.08) m1/L and relative humidity 85.33 (± 0.58) %.

The time requirement for the complete loss of the crystalline style of *S. cucullata* upon exposure to atmospheric air and for the reformation upon reimmersion to filtered sea water, are presented in Table 2.

Table 2: Dissolution and reformation of crystalline style of *S. cucullata* after exposure to atmospheric air and immersion in sea water.

Location of oyster beds	Time required for style dissolution (Hours)	Time required for style reformation (Hours)
Deogad	5.30	2.15
Achra	5.00	2.00

Exposure to atmospheric air resulted in complete dissolution of crystalline style in oysters from both the localities. From Deogad, the dissolution of style was observed at 5.30 hours and style reformation upon reimmersion was at 2.15 hours. From Achra, the dissolution of style was observed at 5.00 hours of desiccation and style was reformed at 2.00 hours after reimmersion in the sea water. It can be seen that the time required for the dissolution of crystalline style from the oysters of estuary at Achra is less than those from the estuary at Deogad. Further, time required for the reformation of style after immersion in sea water was less in the oysters from the estuary at Achra than at Deogad. As mentioned before the oyster beds in Deogad gets exposed to atmospheric air for comparatively a long time than those at Achra and with the commencement of high tide oyster bed at Achra gets reimmersed to the sea water earlier than the bed at Deogad.

DISCUSSION:

[5]Bingze Xu qoated that in blue mussel, *M. edulis*,the digestive structures and the shape of the crystalline style The mouth is located at the anterior end of the visceral mass between a pair of labial palps and followed by a short oesophagus. The oesophagus leads into a larger stomach. On the side of the stomach is the greenish digestive gland. Ducts from the digestive gland open into the stomach. A concentrically laminated hyaline rod called the crystalline style, is synthesized in a part of the digestive gland called the style sac. The crystalline style grows and thus protrudes continuously into the stomach. Cilia on the walls of the style sac rotate the crystalline style. This rotation aids in pulling a food-laden mucous strand through the mouth into the stomach.

[3] [12][21]A crystalline style is present in the digestive system of most bivalves and is largely composed of mucoproteins, carbohydrates, inorganic solids and water. More than 90% of the dry matter of the style is protein and carbohydrate. [22] Irrespective of the species, the ratio between protein and carbohydrate is approximately 3:1. [12] The proteins in the crystalline style are said to be crystalline. Inside the stomach the crystalline style softens and dissolves slowly, releasing a variety of digestive enzymes into the stomach. The stomach wall and the other digestive glands may also release enzymes into the stomach. Crystalline styles break down spontaneously under a variety of physico-chemical conditions. At the same time the dissolution of the styles acidifies and lowers the viscosity of the mucoid contents of the stomach.

[1][6][16][11]When the crystalline style revolves in the stomach it performs a number of functions that are relevant to the digestive process, such as mixing and food digesting. As mentioned above, during this process, the crystalline style dissolves slowly, liberating into the stomach a number of enzymes such as α-amylase, cellulase, laminarinase, chitinase, α-glucosidases (maltase, sucrase, melizitase and trehalase), β-fructosidase, arbutinase, α-D-mannosidase amongst glycoside hydrolases, trypsin, leucine-aminopeptidase and aminotripeptidase amongst peptide hydrolases and arylesterase and lipase amongst carboxylic ester hydrolases. These enzymes initiate a preliminary phase of extracellular digestion in the stomach and are capable of liberating reducing sugars from phytoplanktons as well as from natural particulate detritus [13]. However, until this work, there has been no report published on the presence of a mannanase in the crystalline style of blue mussels. The carbohydrases of the crystalline style not only catalyze extracellular digestion in the stomach, but also participate in intracellular digestion in the digestive diverticula. When the particles are broken down sufficiently, they are carried on ciliary tracts in the stomach to the digestive diverticulum for intracellular digestion. Digestive cells in the diverticulum take up small food particles together with digestive enzymes into food vacuoles within the cells where nutrients can be used directly. The intestine carries both undigested particles and waste products to the rectum, where they are stored prior to evacuation from the anus through the exhalant siphon [7].

The process of feeding and digestion in the bivalvia have attracted attention largely because of the universal presence within the stomacc of the crystalline style..Such a structure, only occasionally in some herbivorous gastropods, is encountered nowhere else in the animal kingdom. The crystalline style attributed with a diversity of functions [19] must, however, be primarily considered as an organ of extracellular digestion. It has been reported that the styles of unionidae, Mytilus and Ostrea are soft and gelatinous, whereas the styles of Cardium, Solen, Donax and Pholax are much firmer [16]. Such differences in the hardness of the style could be due to the nature of the structural protein. The difference in the protein composition of the styles of different bivalves is evidenced by the difference in their amino acid composition [4]. In *S. cucullata* the style is 15 to 34 mm in adults of 45 mm shell length and it is a soft and gelatinous. [19] has stated that the style dissolves when the bivalve is kept out of water, under anaerobic conditions, or when the shell valves are clumped together, such conditions are encountered in littoral bivalves at the time of low tide. [16] In *C. gigas*reported that there occur differences in digestive tubule function in winter and summer, in winter the phases of absorption was long, whereas that of breakdown and resting stage was short In summer, the converse was true. Similarly, [16] explained that the process of breakdown extended over a longer period of time possibly indicating why the crystalline style was dissolved for a longer period of time in summer In the present study it has been observed that the crystalline style of *S. cucullata* was dissolved for longer time in oysters from Deogad when compared to those from Achra. This may help to probably state that in oysters from Deogad the process of breakdown extends over a longer period of time than those in oysters from Achra, however, the study on the tidal rhythmicity in digestive tubules was done on oysters from the estuary at Deogad Starvation and removal from water, i.e desiccation of *S. cucullata* in a complete loss of crystalline style in oysters from the estuarines at Deogad and Achra.

[10] Hameed quoted that the style loss was observed tobe quicker in desiccation (0.5 to 72.0 h) than in starvation (130 to 168 h). Probably, the stress load was relatively heavier in desiccation in which the bivalves had to withstand lack of food, lack of water and lack of dissolved oxygen while in starvation lack of food was the only stress Disappearance of styles on exposure was observed at different rate in different species This differential rate of style dissolution could be accounted by the variation in the organic content of the style [10] The author further added that under normal condition, the style undergoes a continuous dissolution but it is maintained through the addition of newly secreted style matrix from style sac. Exposure to atmosheric air in *S. cucullata* resulted in com-plete dissolution of crystalline style at the estuaries of Deogad and Achra from Deogad, the dissolution of style was observed at 5.30 hours and style reformation upon reimmersion was at 2.15 hours. From Achra, the dissolution of style was observed at 5.00 hours of desiccation and style was reformed at 2.00 hours after reimmersion in the sea water It can be seen that the time required for the dissolution of crystalline style from the oysters of estuary at Achra is less than those from the estuary at Deogad. Further, time required for the reformation of style after immersion in sea water was less in the oysters from the estuary at Achra than at Deogad. As mentioned before the oyster beds in Deogad gets exposed to atmospheric air for comparatively along time then those at Achra and with the commencement of high tide oyster bed at Achra gets reimmersed to the sea water earlier than the bed at Deogad.

The evidences from the present study strongly suggested that under favourable conditions, the complete loss of style was brought out by the continuous dissolution followed by cessational of style secretion. Therefore, it may be concluded that style dissolution is a physical and continuous process while style secretion is a physiological process which is energy consuming and operative only under favourable conditions, as evidenced by the style reformation experiments. Hence, the loss of style during adverse conditions could also be considered as a energy conservation process The results of the style reformation experiments indicated that oysters bivalves are endowed with the ability to reform a functional new style within a short time (2.00 to 2.15 hrs). This capacity appeared to be an adaptive feature which enabled oysters under adverse conditions to initiate the feeding and digestion whenever normal environmental conditions were restored, the earliest view of style dissolution on starvation was that of Hazay and Haseloff (as quoted by Yonge) [23] It is considered the style as a reserved food, assumed to be utilised on starvation. Dakins [8] and Allen [2] were of the opinion that the availability of food was the prime factor controlling style permanance but this view had been disproved by the work of Orton [18], and Yonge [24] who showed that bivalves retain the style after a long period of starvation. Yonge [24] reported that when the bivalves were under adverse conditions, they could not carry out normal metabolic processes like style secretion.

CONCLUSION:

A study on the time requirement for the complete loss of the crystalline style of oysters upon exposure to atmospheric air and for the reformation upon reimmersion to filtered sea water showed that exposure to atmospheric air resulted in complete dissolution of crystalline style in oysters from both the localities From Deogad, the dissolution of style was observed in 5 30 hours and style reformation upon reimmersion was within 2 15 hours From Achra, the dissolution of style was observed in 5 00 hours of desiccation and style was reformed within 2.00 hours after reimmersion in the sea water The time required for the dissolution of crystalline style in oysters from the estuary at Achra was less than those from the estuary at Deogad Further the time required for reformation of style after reimmersion in sea water was less in oysters from the estuary at Achra than at Deogad As mentioned before the oyster beds in Deogad gets exposed to atmospheric air for comparatively a long time than those in Achra and with the commencement of high tide oyster bed at Achra gets reimmersed to the sea water earlier than the bed at Deogad.

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