J. mar. biol. Ass. India, 1975, 17 (1) : 213-222

EARLY LIFE HISTORY OF A STENOPODID SHRIMP *MICROPROSTHEMA SEMILAEVE* (DECAPODA : MACRURA)

P. C. RAJE AND M. R. RANADE

Marine Biological Research Station, Ratnagiri

ABSTRACT

Microprosthema semilaeve, one of the two species of stenopodid shrimps recorded from India, was hatched and reared to the sixth post larval stage in the laboratory. The only stenopodid larvae of known parentage previously described belong to two species of the genus *Stenopus*, in which there are nine or more zoeal stages. Larvae of *M. semilaeve* differ from these in having no dorsal spines and there are only four zoeal stages. These and the first post-larva are described in details and the later (juvenile) stages more briefly.

None of the previously described but unidentified larvae of the stenopodidae appears to belong to the genus *Microprosthema*.

INTRODUCTION

THE family Stenopodidae consists of a group of animals that show peculiar specialisations in habits, morphology and larval development. Some species are reptant, some are blind, possibly burrowing forms and some are symbionts in sponges. There are generic differentiations in the external morphology and, from what is known through published records, in the mode of the larval development also. Such differentiation within a single family makes it difficult to ascertain the position of the group in the taxonomic table. It would be a greater asset to the study of the affinities of the group if the larval morphologies of the majority of the species were known. Unfortunately only a few species have been hatched or reared in the laboratory and apparently all of them belong, or are very closely related, to the genus *Stenopus* (Gurney and Lebour, 1941; Gurney, 1939). The early life history of a genus other than *Stenopus* is presented here by hatching and rearing the larval and post larval stages of the species *Microprosthema semilaeve*.

The Authors are deeply indebted to Dr. D. I. Williamson for sending xerox copies of Miss. Lebour's paper and for critical suggestions on the manuscript.

MATERIAL AND METHOD

M. semilaeve leads a reptant life and is frequently encountered in a community of the polychaete *Eurithoe complanata*, alpheids and brittle stars in sandy and muddy beds underlying the rocks in the intertidal zone of Mirkarwada jetty of Ratnagiri city. The environment is typically marine and a rich variety of fauna and flora flourishes. Ovigerous females are found usually accompanied by the males. A pair was brought to the laboratory and kept in two litres of constantly aerated seawater of salinity 34.5 ‰ and temperature 27–28 °C. The eggs were deep green initially, turned dark brown with subsequent embryonic development and hatched in about nine days, always at night. The female could be seen to retain a great deal of deep green ovarine tissue dorsally and became ovigerous on two subsequent occasions following a moulting and probably mating, though the fecundity went on diminishing in the succeeding broods. The male only moulted once.

The larvae were pelagic, natatory and positively phototactic. They were transferred individually to finger bowls containing 150 ml of sea-water and an uncounted number of freshly hatched brine shrimp nauplii. The water was changed every day and brine shrimp nauplii were replenished every alternating day. The larvae were preserved with their corresponding moults in neutral 10% formalin to which an equal part of glycerin was added.

Total length mentioned in the following description is the length from the tip of the rostrum to the tip of the telson. Carapace length is measured from the tip of the rostrum to the posterior margin of carapace.

DESCRIPTION OF LIFE STAGES

Eggs

Eggs were spherical, yolky and were individually encased in a transparent membrane. The initial deep green colour changed to deep brown as eyes developed in the embryo. Eggs hatched usually after an incubation period of about nine days and always at night. The hatching was total and complete at the same time. In all 75 larvae were obtained.

First zoea (Fig. 1a)

Total length : 2.95 mm; Carapace length : 1.31 mm; Duration : 4-5 days.

The first zoea is transluscent and almost colourless. It swims vertically, upside down. The larva bears three pairs of maxillipedes and only one pereiopod plus two pairs of antennae, a mandible and two pairs of maxillae. The carapace shows a strong elongated and anteriorly pointed rostrum but is otherwise smooth. The eyes are immovably fixed in the carapace. No post orbital spine is present. The abdomen is six-segmented with the telson fused to the sixth segment. The abdominal somites are devoid of dorsal projections as are apparent in many species of Atlantic stenopids, but bear blunt projections ventrally; these are more pronounced on the first and second pleura whereas the fifth somite has a ventral median projection.

First antenna (Fig. 1 b) is three-segmented with a biramous distal segment; endopod of distal segment comprised of a long bulbous seta, while exopod is small, oval and bears four apical setae; second antenna (Fig. 1c) is two segmented with distal segment biramous; endopod is stumpy and bears two long, stout terminal setae; exopod is thin, blade-like and shows some segmentation terminally; it bears eight inner and one outer seta on its margin; mandible (Fig. 1d) is simple, large, without a palp and beset with several strong teeth; first maxilla (Fig. 1e) is devoid of any endopod or exopod; protopod bilobed with anterior lobe bearing seven setae and posterior, five; second maxilla (Fig. 1f) is more developed and shows an unsegmented endopod with three setae and an exopod with five setae; protopod is four lobed of which proximal bears six setae, the others two, four and three respectively; one short seta present at juncture of endopod and protopod; exopod well developed, oval and bears five setae.

First maxillipede (Fig. 1g) presents an unsegmented rod-shaped exopod with four seate apically and a three-segmented endopod set on anterior margin of protopod; endopod bears two, two and four setae on its segments (from proximal

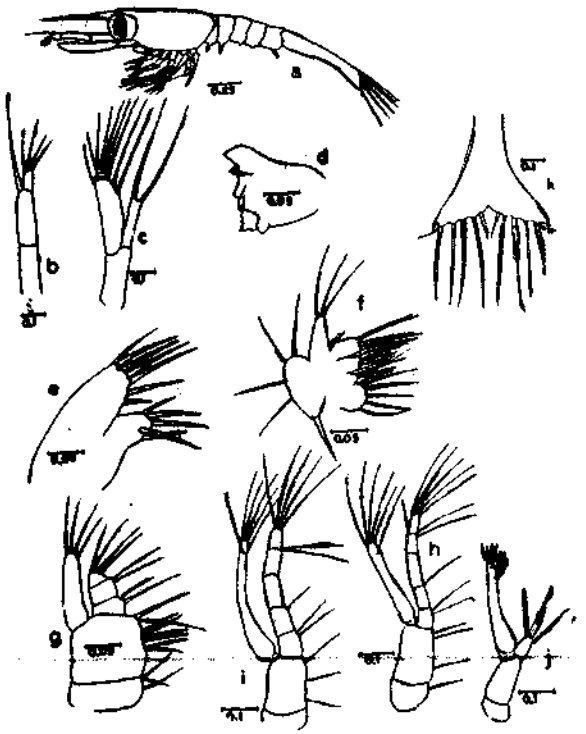

Fig. 1. First zoea : a. Entire larva; b. First antenna; c. Second antenna; d. Mandible; e. First maxilla; f. Second maxilla; g. First maxillipede; h. Second maxillipede; i. Third maxillipede; j. First pereiopod, and k. Telson (scales in mm).

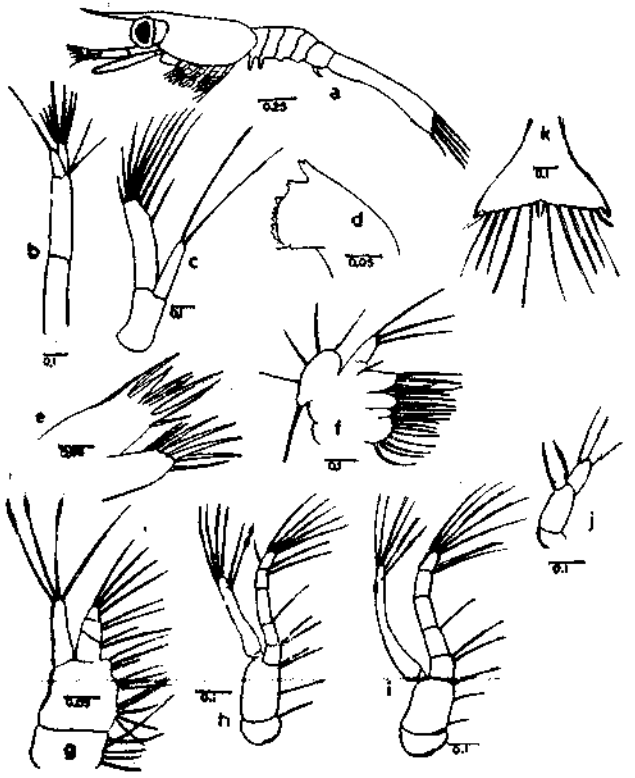

Fig. 2. Second zoea: For Explanation See Fig. 1.

to distal) and all setae are projecting ventrally; protopod is two segmented with distal segment having eight setae and proximal three on its ventral margin; second maxillepede (Fig. 1h) is longer than first and has an unsegmented exopod with six setae and a five segmented endopod; setation of endopod is on distal segment with five terminal and one dorsal, second with two ventral, third none, fourth with one ventral and proximal with two ventral setae; distal segment of protopod bears three and proximal one inner setae; third maxillepede (Fig. 1 i) larger, but is identical to second except that distal segment bears only five terminal setae and segments of protopod lack one seta each; exopod of leg (Fig. 1j) has eight setae running along its anterolateral margin; endopod small, knob like, and bears three apical setae.

The telson (Fig 1 k) is markedly forked, triangular and shows seven plus seven setae of which first and seventh are small, while second is reduced to a hair, as in anomuran larvae.

Second zoea (Fig. 2 a)

Total length : 3.00 mm; Carapace length: 1.33 mm; Duration 4days.

A noticeable change at this stage is that the eyes become stalked and are accordingly movable. The telson is still fused with sixth abdominal segment.

Endopod of first antenna (Fig. 2b) becomes smaller than exopod but bears only one very long seta; exopod bears in all seven setae; second segment exhibits a pair of one more inner seta; mandibles (Fig. 2d) show sharp incisors and molar processes; first maxilla (Fig. 2e) bears seven setae on each lobe of protopod; protopod of second mixilla (Fig. 2f) shows additional setae on its lobes which now reveal eight, three, four and four setae respectively; protopod of first maxillipede (Fig 2g) shows eleven setae on distal segment and five on proximal; two remaining maxillipedes (Fig. 2 h, i) are unchanged and so also is leg (Fig. 2j); telson (Fig. 2k) becomes broader and its setae, with exception of first, second and seventh become longer.

Third zoea (Fig. 3a)

Total length : 3.40 mm; Carapace length : 1.60 mm; Duration : 3 days.

The telson becomes a distinct segment at this stage and rudiments of pleopods appear as small elevations on ventral side of abdomen.

First antenna (Fig. 3b) bears one more segment; endopod is as long as exopod; there is one long seta in between endopod and exopod and near its base two pairs of long hairs arise; four setae run along ventro-lateral margin of next three segments; in addition four are present at junction of second and third and two at junction of third and fourth segments; endopod of second antenna (Fig. 3c) is two-segmented, distal segment being longer than basal; exopod looses segmentation and bears twelve inner and one outer setae; mandibles are unchanged; two maxillae (Fig. 3d,e) remain unchanged except for posterior lobe of protopod of second maxilla where one more seta is located; an additional seta present on basal segment of endopod of first maxillipede (Fig. 3f); no remarkable change in the next two maxillipedes; endopod of leg becomes slightly chelate (Fig. 3g); telson (Fig. 3h) is a distinct segment and bears biramous uropods of which only the outer is setose.

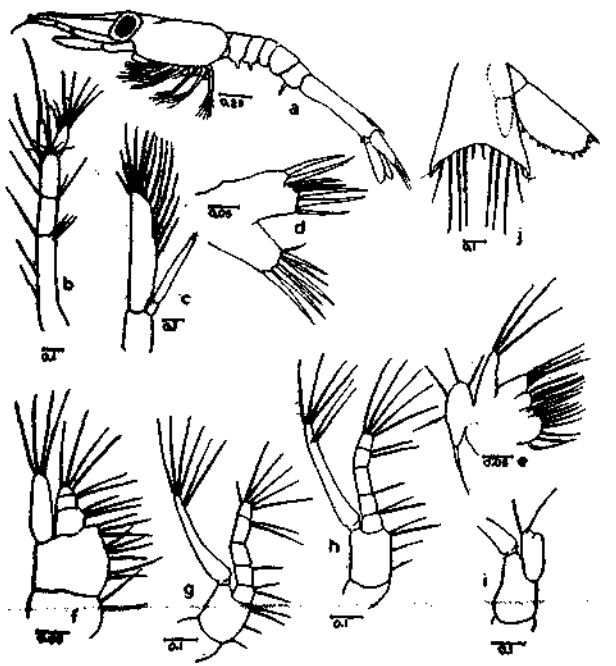

Fig. 3. Third zoea: a to c as in Fig. 1; d. First maxilla; e. Second maxilla; f. First maxillipedeg. Second maxillipede; h. Third maxillipede; i. First pereiopod, and j. Telson.

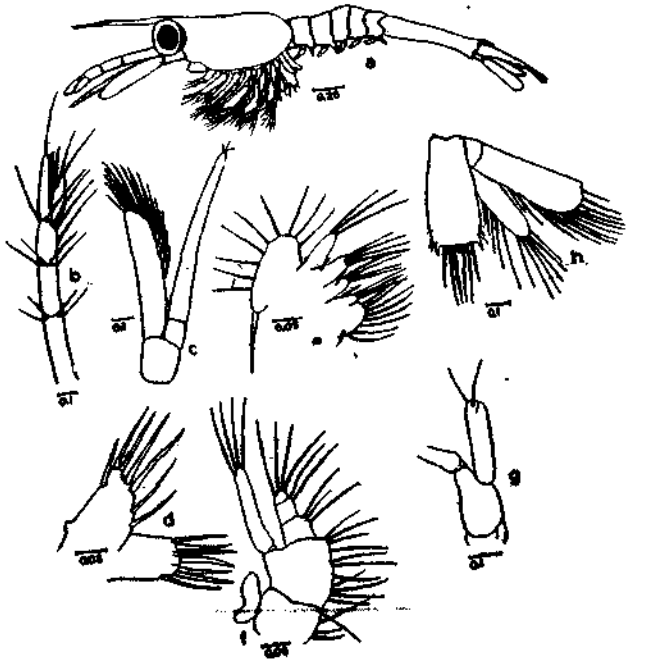

Fig. 4. Fourth zoea: a to f as in Fig. 3; g. First pereiopod, and h. Telson.

Fourth zoea (Fig. 4a)

Total length : 3.88 mm; Carapace length : 1.80 mm; Duration : 3 days.

Buds of pleopods appear in this stage and also five pairs of legs, although last two are present only as buds.

Exopod of first antenna (Fig. 4b) becomes shorter than endopod and looses three setae; distal segment of endopod of second antenna (Fig. 4c) becomes very long; exopod now bears in all fourteen setae on its inner margin; mandibles (Fig. 4d) show a small bud as rudimentary palp; first maxilla remains unchanged in armature but develops a rudimentary endopod; second maxilla shows further addition of setae on exopod, which now reveals ten setae and also on protopod where second and third lobe attain one more seta each (Fig. 4e, f); three maxillipedes remain virtually unchanged; rudimentary gills appear at their bases; all five legs appear now, although last two are present only as buds; endopods of first three legs are unsegmented, but are larger than previous stage, third being longest (Fig. 4g); telson (Fig. 4h) becomes square and posterior margin is no longer forked; first and third setae are present as small spines on lateral margin while second and seventh appear as small hairs; uropods are greatly developed with both rami bearing twelve setae each.

Post larva (Fig. 5a)

Total length : 2.85 mm; Carapace length : 1.20 mm; Duration : 5 days.

The larva undergoes some drastic changes to become the post larva; rostrum becomes very much shorter, extending slightly beyond tip of the eyes, thus reducing total length; both antennae develop long, slender multisegmented flagella; legs become five-segmented and functional; pleopods become biramous and sestose with exopod bearing eight and endopod having six seate; pleural projections on abdmoinal somites are no longer prominent; larva becomes pale brown with numerous red chromatophores interspaced on body; exopod of first antenna (Fig. 5b) shows numerous segments while endopod has three clear segments; a small blunt spine originates on anterolateral margin of third segment and a well developed statocyst is present at base; second antenna (Fig. 5c) shows endopod as a multisegmented flagellum which is longer than total length of post larva; exopod bears eighteen setae on its inner margin and three small hairs along outer margin; mandible (Fig. 5d) is quite large and palp shows two segments which are not setose; first maxilla (Fig. 5e) is of interest in so far as it now reveals a rudimentary palp resembling endopod; second maxilla (Fig. 5f) shows degeneration of several setae of endopod and protopod but exopod is very well developed and bears twenty three setae; first maxillipede (Fig. 5g) has a very long exopod with four setae while endopod has only one seta on its distal segment; protopod gains a number of additional setae; anterior segment having nineteen and posterior thirteen setae; second maxillipede (Fig. 5 h) becomes thickened and recurved and is beset with numerous small sharp spines; third maxillipede (Fig. 5i) is slender but also bears several additional setae; basal segment of its endopod shows a row of six spines running along ventral margin; a rudimentary exopod is present; first three legs have their dactyls remarkably developed and retain vestigial exopods; third leg (Fig. 5j) is stoutest and its chela bear fine teeth along inner margin of moving and fixed fingers; last two legs are minutely chelated but are longer than first three; fifth leg (Fig. 5k) is longer than fourth; telson is very peculiar; it is broadly triangular and laterally notched at about

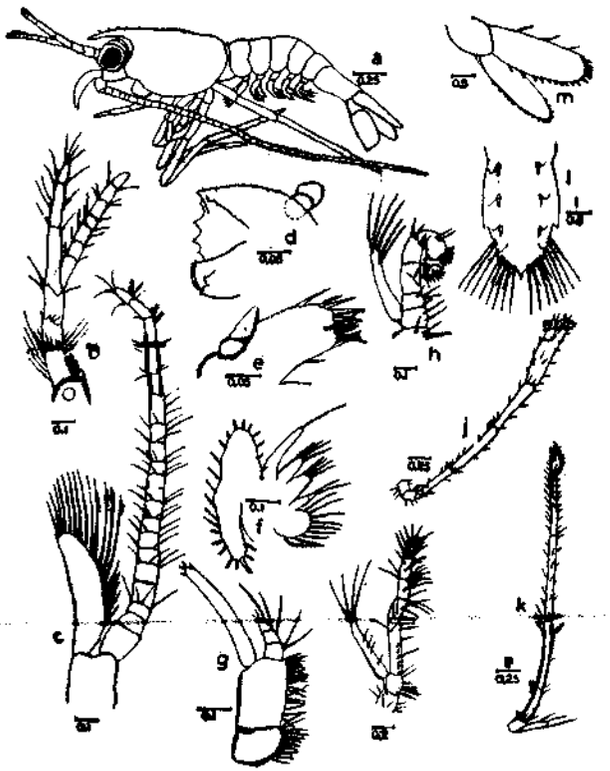

Fig. 5. Post larva-I: a to j as in Fig. 1; k. Fifth pereiopod; l. Telson, and m. Uropods.

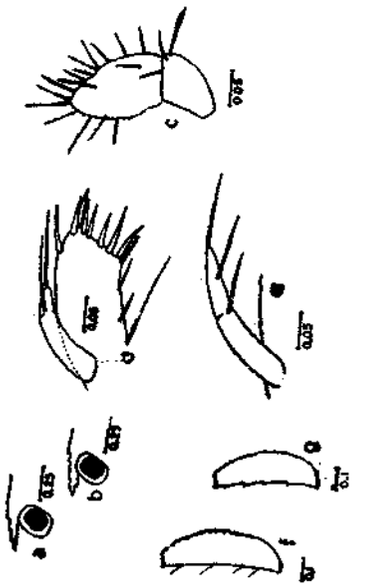

Fig. 6. Subsequent post larvae: a. Rostrum of Post larva-II; b. Rostrum of Post larva-III; c. Mandibular palp of Post larva IV; d. Endopod of Firstmaxilla of Post larva-II; e. Endopod of First maxilla of Post larva-V; f. Scaphocerite of Post larva-II, and g. Scaphocerite of Post larva-IV.

half its length; it bears five spines along its posterior margin and six setae (Fig. 5 l); in addition to this, sixteen setae arise posteroventrally as 8+8 on either side of posteromedian spine; three pairs of small spines arise on dorsal surface of telson and from base of each a small hair sprouts.

SUBSEQUENT POST LARVAE

The post larvae moulted further generally after a duration of five to eight days in each instar. The more remarkable developments in the post larval growth are as follows:

Rostrum develops teeth where only setae were present in first post larva; from their instar onwards, rostrum bears five dorsal and one ventral spines (Fig. 6 a, b); flagella of two antennae become longer and spine at base of second antennae becomes extremely prominent and well curved like that of adult; scaphocerite becomes indented on inner margin usually bearing four to five spines; mandibular palp develops setae which go on increasing in number in subsequent instars; in fourth instar, distal segment bears fourteen, and basal three setae (Fig. 6 c); endopod of first maxilla shows progressive development; it becomes setose at second instar (Fig. 6 d) and shows faint segmentation at fifth instar (Fig. 6e); second maxilla continues to develop its exopod which in third instar has thirty six setae, forty-three in fourth and fortysix in sixth instar; endopod regenerates most of its setae by sixth instar and is three segmented; first maxillipede has its protopod greatly developed and bears numerous spines; second and third maxillipedes do not show any remarkable change, though exopods can no longer be located; third maxillipede, however, develops greatly in size; apart from corresponding growth with each moult and attaining more spines legs remain as before; third leg still does not have a bulbose chela in sixth instar; abdomen begins to flatten dorsoventrally from third instar and resembles that of an adult from fourth instar onwards; pleopods at sixth instar have twelve setae on outer ramus and eight on inner; telson thickens dorsoventrally and goes on adding to number of setae are present ventrally; in third instar they are 9+9 number in fourth 11+11, in fifth 12+12 and in sixth 16+16; no additional spines evident; outer margin of outer ramus of uropod shows additional setae in subsequent instars and in sixth instar bears 8 spines, from base of each of which arises one small hair.

DISCUSSION

Although a number of stenopid larval forms have been recorded, only two species *viz.*, *Stenopus spinosus* (Cano, 1892) and *Stenopus hispidus* (Gurney and Lebour, 1941) are known with all the larval forms leading to the post larva. Ortmann (1893) described the larvae of another genus *Embryocaris* but this is apparently the same species as *S. spinosus*. In another genus *Spongicola koehleri* newly hatched youngs are far advanced juveniles as also is the case with some species of the genus *Richardina* (Kemp, 1910 a, b). Lebour had also obtained a post larva succeeding several larval stages of two other larval forms from plankton (Gurney and Lebour, 1941). As these were not hatched in the laboratory from the eggs their identity could not be ascertained. However, Lebour felt that both of these forms belong to a genus other than *Stenopus*.

The larvae of *M. semilaeve* described in the present paper are not identical with any of the stenopid larval forms described hitherto. The larva of *M. semilaeve* comes close to Lebour's A and B in that it lacks dorsal projections on the abdomen

but A differs in lacking the abdominal ventral projections and notably in having a very primitive first maxilla; B develops a prominent supraorbital spine in later stages but its post larva is reminescent of *M. semilaeve* although there are certain major differences. B thus appears more closer to *Microprosthema* than any other species described.

The development of B requires at least 9 larval stages and the mandibles and first maxillae remain without palps till the last stage; in the post larva these appendages have not been referred to *M. semilaeve* develops vestigeal palps of the mandible and first maxilla in the last larval stage and these go on developing in subsequent post larval instars. The species also has a much shorter larval period than most of the species known. The rostrum of B is serrated in the first post larval form whereas in *M. semilaeve* only hairs are present and the full armature is discerned only in the late instars. Devlopment of *M. semilaeve* thus supports Lebour's claim that her B does not belong to the genus *Stenopus* but neither does it belong to the genus *Microprosthema;* it probably belongs to an allied genus.

It is of interest to note that *Microprosthema semilaeve* is synonymous with *Setnopus robustus* Borradaile. Holthuis (1947) separated the genus as *Microprosthema* and recognised four species *viz., validum, semilaeve, plumicorne* and *scabricaudatum*. Gravely (1927) recorded *M. validum* as *S. robustus* from Krusadi Islands. Mahadevan *et al.* (1962) have recorded *M. semilaeve* from Palk bay, while on the west coast the same species has been recorded by Ranade (in press) from the same locality described in the present paper.

The two species *M. validum* and *M. semilaeve* are very much alike and are separated only by the characteristics of the scaphocerite, spines on the telson and spines on the carapace. The post larval characteristics described in the present paper are in accordance with the adult characteristics of *M. semilaeve*. Mahadevan *et al.* (1962) have suggested that the two species might be synonymous. It should, therefore, be of interest two know the larval and the post larval characters of *M. validum* before coming to such a conclusion.

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