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Evaluation of calcium in some commercially important Molluscan shells of Bhavanapadu mangroves, North East coastal Andhra Pradesh

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Abstract

In most of the molluscs, the shell forms a huge proportion of body weight. Very less people consume molluscan meat even though it has high nutritive value. Local people are engaged in shell collection and lime preparation which fairly commands attractive income. It was therefore, considered important to estimate calcium in the shells of various species of molluscs. The dry weight and contents of calcium carbonate ($CaCO_3$) in the shells of gastropods and bivalves, more specifically in *Anadora granosa*, *Crassostrea madrasensis*, *Meretrix meretrix*, *Perna virdis*, *Telescopium telescopium*, *Cerethidea cingulata* and *Cerethidea obtusa* were estimated by well known method of Pinheiro and Amato (1955). All the obtained results were expressed in milligram (mg) of $CaCO_3$ per gram (g) of shell weight. The present work reveals that the higher calcium content from the available molluscs could be used effectively for the purpose of quick lime production.

Keywords: Molluscs, gastropods, bivalves and calcium carbonate

Introduction

Molluscs play a significant role both in accumulation and circulation of Calcium especially in habitats where they are numerous and their biomass is high (Jurkiewicz-Karnkowska, 1986). Calcium is a metal that plays a vital role in the biology of the molluscs which constitutes an important limiting factor that determine the distribution and survival of the adult molluscs, oviposition rate, survival and development of eggs and the embryos (Thomas *et al*., 1974; Nduku and Harrison, 1976; Appleton, 1978; Dawies and Erasmus, 1984). The calcium ion helps in many enzymatic reactions required for metabolic processes related to the haemolymph (Sminia et al. 1977; De With and Sminia, 1980). Several physiological changes influence the calcium reserve in the shell and in the haemolymph of molluscs (Souza et al. 2000; Lira et al. 2000; Pinheiro, 1996). Calcium carbonate ($CaCo_3$) is one of the most important building materials in natural hard tissues such as bones and teeth. The composite materials created by biological organisms from calcium salts and proteins are architecturally complex and functionally diverse (Addadi and Weiner, 1997; Kamat et al. 2000).The molluscan shell is an organo-mineral compound in which the dominant mineral aragonite, or calcite, or vaterite is

closely associated to an organic matrix, which accounts only for 0.1-5% of the shell weight (Marin et al. 2008).The greater part of the calcareous material of the shell in marine molluscs is absorbed directly from sea water as Ca and bicarbonate ions (Robertson, 1941; Orton, 1925; Galtsoff, 1934; Fox and Coe, 1943).Mollusc shells consist mainly of $CaCO_3$, so that calcium demand of these animals is high to produce lime (calcium oxide). The lime produced from the shell of molluscs is termed as quick lime (Anima Panda and Misra, 2007). In the present study an attempt has been made to asses to the dry weight and calcium content of molluscan shells which are highly economic for lime production.

Materials and methods

Study Areas: The present work deals with the calcium estimation of different molluscs of Bhavanapadu backwaters adjoining the Bay of Bengal on the Northeast Coast of Andhra Pradesh. A total of 19 species of molluscs were already been reported from Bhavanapadu mangroves (Ranjan and Babu, 2014).The study area is viable for salt and aquaculture production. Many marine fisherman habitations and a sparse distribution of mangroves have been located in the vicinity of Bhavanapadu area.

Collection of Samples: Seven molluscan shells from both gastropod and bivalvia group namely *Anadora granosa*, *Crassostrea madrasensis*, *Meretrix meretrix*, *Perna virdis,Telescopium telescopium*, *Cerethidea cingulata* and *Cerethidea obtusa* were selected for the estimation of calcium content. Species were selected on the basis of abundance and economic importance. Shells of each species were collected in zip pouches and were carried to the laboratory for further analysis.

Calcium estimation: The shells were dried at room temperature and weighed. Later following the improved technique described by Pinheiro and Amato (1995) the shells were individually heated in hot air oven at 180ºC for three days. This made easy to powder the shells. Each species specific shell powder was weighed to a test sample of 1 gram. After that, each test sample powder was diluted in 10 ml of HNO_3 for six hours of digestion. Adding 2 ml of hydrogen peroxide (H_2O_2) brings the clarification of the resulting solution. The samples were then diluted to 100 ml with double distilled water and out of which ten aliquots of 10ml each were taken for calcium evaluation using EDTA according McCornick (1973). The calcium carbonate mass was calculated using the volume of EDTA rundown in the titration process and expressed as mg of $CaCO_3$ per gram of dry shell weight.

Statistical analysis: The results of the present *invitro* study were given as mean ± standard deviation (SD) obtained from ten independent experiments and analyzed with Student's 't'-test for paired data and 'P' values less than 0.05 was considered as significant difference in the analysis.

Results and discussion

The cram study area geographically located at Long: 18° 33' 52" to 18° 32' 11" N; Lat: 84° 21' 26" E to 84° 18' 22" E. Specific area maps were displayed in figures 1 and 2. The local fishing communities collect marine molluscs as a part of livelihood and deposit into heaps on the platforms of nearby fishing harbour (figures 3 and 4). The highly economic valued species congregated were *Anadora granosa*, *Crassostrea madrasensis*, *Meretrix meretrix, Perna virdis, Telescopium telescopium, Cerethidea cingulata* very rare *Cerethidea obtusa* and other snails. The heaps of these molluscs were then dried and transported to shell lime production industries located in Berhampur area of Orissa state. A mini kiln was also established by the nearby village to produce quick lime for domestic and commercial

uses like white washing, lime putty, preparation of pan (betel leaf, lime and other ingredients), Gudakhu (a paste of tobacco leaf and lime). As well it is used in aquaculture akin to increase alkalinity (Anima Panda and Misra, 2007), resembling water purifier in dug wells, on behalf of sanitizing the sewage sludge's and in preparation of cement and bleaching (Herbst, 2000).

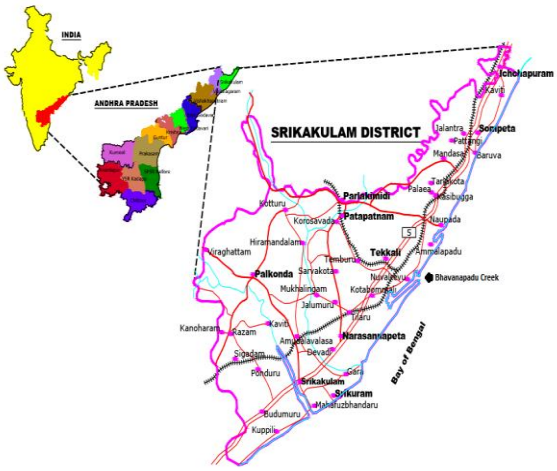

Fig. 1: Study area contour map.

Fig. 2: Satellite map.

Fig. 3: Heaps of different molluscs.

Fig. 4: Packing and transport.

In the current study the screened dry weight and calcium carbonate contents evaluated in the shells of Gastropoda and Bivalvia were *Anadora granosa* with 50.63±1.21gm and 920±42.4mg$CaCO_3$/gm, *Crassostrea madrasensis* by 72.48±2.31gm and 896±33.4 mg$CaCO_3$/gm, *Meretrix meretrix* through 51.03±1.65gm and 909±45.3 mg$CaCO_3$/gm, *Perna virdis* with 22.47±1.10gm and 758±36.9 mg$CaCO_3$/gm, *Telescopium telescopium* by means of 35.96±2.03gm and 589±26.3 mg$CaCO_3$/gm, *Cerethidea cingulata* shells by way of 1.12±0.023gm and 420±26.8 mg$CaCO_3$/gm,

Cerethidea obtusa through 4.86±0.36gm and 655±15.9 mg$CaCO_3$/gm. Each value represents the mean ± SD of ten replicates. Basing on the calculated 'P' values, all the results were considered as significant, where P<0.05. The above results clearly indicate that *Cerethidea cingulta* had the lowest dry weight and calcium carbonate content whereas *Crassostrea madrasensis* shells had the highest dry weight and *Anadora granosa* had highest calcium carbonate content. The results were put on show in figures 5 and 6.

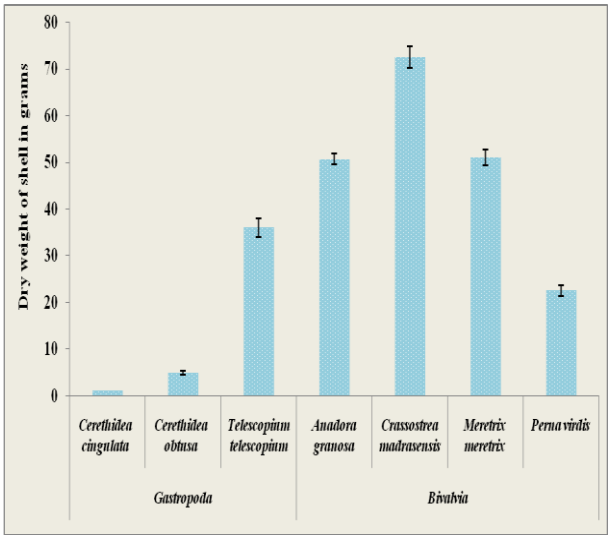

Fig. 5: Dry weight content of Gastropoda and Bivalvia shells.

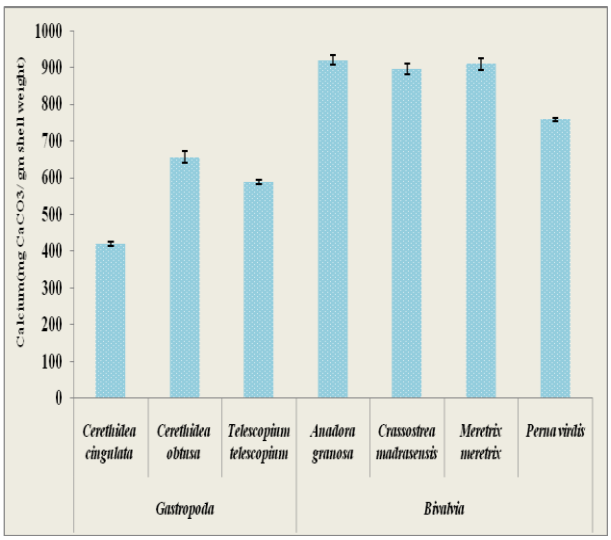

Fig. 6: Calcium contents of Gastropoda and Bivalvia shells.

Our outcomes were in row with Rao et al. (1986) next to Sarvaiya (1989) and Gokhale (1960), who worked on few marine molluscs out of which *Telescopium telescopium* and *Crassostrea* species of Saurashtra Coast, correlates positively with our outcomes. In elaboration to the above findings, similar fallouts were also reported in terrestrial and fresh water molluscs by several workers (Soido et al. 2009; Jurkiewicz-Karnkowska, 2005; Baby et al. 2010, Ugoeze Kenneth Chinesu et al. 2015). According to Anima Panda and Misra (2007) mollusc shells such as *Anadora granosa*, *Meretrix meretrix*, *Meretrix casta* and *Cerethidea cingulata* were mainly used for lime production. Investigations of Effiong et al. (2009) reveals that the shells of *Achatinaa chatina*, *Turritella* sp., *Cardium edule*, *Ampullela* sp., and *Spondylus spinosus* are found to contain high percentage of $CaCo_3$ which are active agents for liming materials.

Conclusion

In the present study area over harvesting of above mentioned species are interrupting species assemblage and also disappearing at a faster rate from the ecosystem. The findings of the study may help to select the appropriate species forgross harvesting in order to conserve the biodiversity.

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