A STUDY OF TOTAL PROTEIN, FAT, AND ASH CONTENTS OF SEA URCHINS: DIADEMA SETOSUM (LESKE) STOMOPNEUSTES VARIOLARIUS (LAMARK) AND ECHINOMETRA MATHAEI (DE BLAINVILLE)

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Sea urchins which are echinoderms have radially symmetrical bodies made of calcareous plates (Arnold, 1968 and Clark and Rowe, 1971). They are exclusively found both on hard and soft bottom of the sea (George and Jennifer, 1979).

Some studies by Binyon (1972) revealed that total protein content in sea urchin species Echinus and Spatangus were 8.4 and 9.1 per cent per gramme dry weight of tissues respectively while total fat content of Asteria rubens was recorded to be 12.9 and Spatangus 1.6 per cent per gramme dry weight of tissues. About 83.2 per cent total ash content of Echinus was reported to be between 90 and 95 per cent per gramme dry weight of tissues in sea urchin skeleton.

Eggs of some species of sea urchins, Heliocidaris erythrogramma, Tripneustes gratilla and Pneustes ventricosus are used as human food in some parts of the world such as Japan, Australia, Korea, and Barbados, (Jones and Endean, 1976). Sea urchin skeletons are used as animal feed and fertilizers, the globiferous pedicellariae muscles and spine stalks being processed into animal feeds and fertilizer (Binyon, 1972). However, in Kenya, there is no report of any sea urchin species that has been exploited as human food, feed for animals, or fertilizer.

The aim of this study was to investigate the sea urchins of the Kenya coast with a view to ascertaining the total protein content of eggs and determining their potential as a human food.

MATERIALS AND METHODS

Species used in this study were D. setosum, S. variolaris, and E. mathaei. Mature sea urchins of the same age were collected using long handled forceps from a 1-m deep and 4-m wide pool of water where they have been growing at English Point, Mkomani, at the Mombasa North coast, Kenya. They were put in large glass beakers full of sea water and stored at -15°C in the laboratory for preservation until they were dissected.

The frozen samples were thawed at room temperature and dissected using a handsaw blade. Eggs, globiferous pedicellariae muscles and spine stalks were removed using forceps and sprinkled with 3 g NACl per 5 g wet weight of tissues to stop the autolytic and bacteriological processes in tissues (Borgstrom, 1985 and FAO; 1983); they were sun-dried for 7 days to reduce moisture contents. Experiments for determination of total protein, fat, and ash contents were performed using a series of 6 animals of each species. The total protein, fat, and ash contents were estimated as a percentage of 1g of the total dry weight of the tissues.

Total protein

One gramme dry weight of tissue was measured for nitrogen content using the Kjeldahl digestions method as described by Maynard (1970). Nitrogen content was then converted to total protein using the relationship: total protein = percent NX6.25.

Total fat and ash contents.

Total fat and ash contents were each determined from 5 g dry weight of tissue, using Soxhlet method for fat and incineration in a muffle furnace in a closed system in the presence of oxygen for ash as described by Maynard (1970). The data were statistically tested by means of the student t-test (Bailey, 1976).

RESULTS AND DISCUSSION

Total protein, fat, and ash contents in the three parts of the three species of sea urchins, D. setosum, S. variolaris and E. mathaei are presented in the histograms (Figures 1, 2, and 3). Percent total protein content was highest in the eggs followed by globiferous pedicellariae muscles and least in spine stalks in all the three species of the sea urchins (Fig. 1). Highest protein content of 21.19 ± 1.67 per cent was recorded in S. variolaris and least percentage of 1.60± 1.15 in spine stalks of E. mathaei. Percent total fat content was higher in the eggs than in both
Fig. 2—Percentage mean fat values of three species of sea urchins: *D. setosum, S. variolaris*, and *E. mathaei*. 
Fig. 3—Percentage mean total ash values of the three species of sea urchins *D. setosum*, *S. variolaris*, and *E. mathaei*
Sea urchins

globiferous pedicellariae muscles and spine stalks in all the three species (Fig. 2). The highest fat content of 13.8±2.24 per cent was recorded in *D. setosum* in eggs while spine stalks of the same species had the least percentage of 0.56±0.44. Spine stalks and globiferous pedicellariae muscles had high total ash contents per gramme dry weight tissues and least percentage was recorded in eggs (Fig. 3). Spine stalks of *E. mathaei* had 87.03±3.53 percent total ash content per gramme dry weight while eggs of the same species had the least percentage of 5.62±.51.

The total protein and fat contents in the eggs show high values in contrast to the spine stalks. These results are in agreement with those of Giudice (1973) who found that 97 per cent of protein is synthesized in sea urchin eggs. *Asteria rubens* contain 12.9 per cent fat (Binyon, 1972). This lends support to the view that protein and fat contents in the eggs represent the principal site of embryonic development (Giudice, 1973 and Stearn, 1974). Active protein and fat biosynthesis takes place in the eggs (Stearn, 1974). The results obtained in this investigation showed no significant (P>0.05) differences between *D. setosum* and *S. variolaris* in protein content in eggs.

Inter-species differences in fat content were significantly (P≤0.05) high in eggs between *D. setosum* and the other two species. The differences in fat content in globiferous pedicellariae muscles and spine stalks respectively were not significant (P>0.05) in all three species of sea urchins. Eggs of sea urchins also contain phospholipids as the fundamental source of energy (Stearn, 1974). Binyon (1972) found that sea urchin skeletons contain 90-95 per cent calcium carbonate as calcite and magnesium carbonate. He found that *Echinus* contain 83.2 per cent and *Spatangus*, 78.5 per cent of total ash. His findings are in agreement with the results obtained in this investigation that sea urchin spine stalks have a higher ash content than other parts. The differences of ash content in globiferous pedicellariae muscles and spine stalks respectively were not significant (P>0.05) in all three species of sea urchins.

The information obtained from this study was useful in as much as it gave some insight into unknown aspects of the total protein, fat, and ash contents of three species of sea urchins. However, further investigations would be necessary to determine the changing levels of amino acids. Such findings would explain the role of tissue protein and fats in various metabolic processes. The total ash content would show the components of the sea urchin skeleton.

**SUMMARY**

A study was carried out to investigate the total protein, fat, and ash contents from eggs, globiferous pedicellariae muscles, and spine stalks of three species of sea urchins, *D. setosum*, *S. variolaris*, and *E. mathaei*. Percent mean total protein and fat contents were high in the eggs and in globiferous pedicellariae muscles per gramme dry weight of tissues. Spine stalks had a high percentage mean total ash content of 87.03±3.53 per cent per gramme dry weight tissues.

The result showed no significant difference (P<0.05) between *D. setosum* and *S. variolaris* in protein content in eggs. The difference of fat and ash content in globiferous pedicellariae muscles and spine stalks respectively were not significant (P>0.005) in all three species of sea urchins.

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