

Full Length Research Paper

## Nutritional evaluation of the different body parts of cuttlefish *Sepia kobiensis* Hoyle, 1885

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The basic nutritional components such as protein, carbohydrate, lipids, vitamins and minerals are chemical compounds essential to the growth and health of a living being. Hence, in the present study, the nutritional quality of different body parts (head, arm, tentacle and mantle) from the cuttlefish *Sepia kobiensis* was evaluated. The total protein content ranged from  $26.55 \pm 0.45\%$  (tentacle) to  $43.95 \pm 0.62\%$  (head); and the carbohydrate content from  $9.18 \pm 0.29\%$  (tentacle) to  $11.85 \pm 0.20\%$  (arm). The lipid level was minimum in the mantle ( $1.19 \pm 0.18\%$ ) and maximum in the arm ( $2.46 \pm 0.20\%$ ). The moisture content was least in the mantle ( $81.50 \pm 0.56\%$ ) and maximum in the head ( $86.82 \pm 1.59\%$ ). The ash content was found fluctuating between  $5.79 \pm 0.13\%$  (mantle) and  $7.35 \pm 0.13\%$  (head), whereas the total cholesterol and High-density lipoprotein (HDL) cholesterol levels range from  $131.25 \pm 0.89$  mg/100 g (mantle) to  $359.36 \pm 1.94$  mg/100 g (arm), and  $43.83 \pm 0.81$  mg/100 g (head) to  $204.53 \pm 1.78$  mg/100 g (tentacle), respectively. Likewise, the triglyceride content was minimum in mantle ( $156.52 \pm 0.83$  mg/100 g) and maximum in arm ( $234.78 \pm 1.28$  mg/100 g). All the aforementioned biochemical components have been calculated on dry weight basis. Thus, the present study explains that the cephalopods are highly delicious seafood because of their nutritive value next to fin fishes.

**Key words:** Proximate composition, nutritional value, cuttlefish, body parts.

### INTRODUCTION

Class Cephalopoda, which includes the nautilus, cuttlefish, squid and octopods is the most advanced class of phylum: Mollusca, adapted to a swimming existence. There are about 80 species of cephalopods of commercial and scientific interest distributed in the Indian seas (Oommen, 1977). The world cephalopod catch increased from 0.58 million tons in 1950 to 3.51 million tons in 2003 while the all India cephalopod catch increased from 400 tons in 1957 to 89,353 tons in 2003 (Fishstat, 2004). Cephalopod catches have increased steadily in the last 40 years, from about 1 million metric tonnes in 1970 to more than 4 million metric tonnes in 2007 (FAO, 2009). The main reason for this increasing demand is that cephalopods are a good protein and lipid source (Zlatanov et al., 2006), thus a highly nutritious food that represents

an alternative to fish resources.

Due to their nutritional and market value, cephalopod aquaculture has also shown an increasing interest during the past few years (Lee, 1994). The value of cephalopods is increasing in the world market, due to their good nutritive value, and in India, it is earning a good foreign exchange through export. Most of squids and octopuses are valued not only as food but also as bait in many parts of the world. The major consumers of octopuses are Japan, Spain, Republic of Korea, Italy and Portugal (Shenoy, 1988).

Biochemical composition of the whole body indicates the quality of cephalopods. But, the proximate measurement of some proximate profiles such as protein, carbohydrate, lipid and moisture content is often necessary to ensure that they meet the requirements of food regulations and commercial specifications (Watermann, 2000). However, most of the previous studies concentrate on the proximate composition and nutritional

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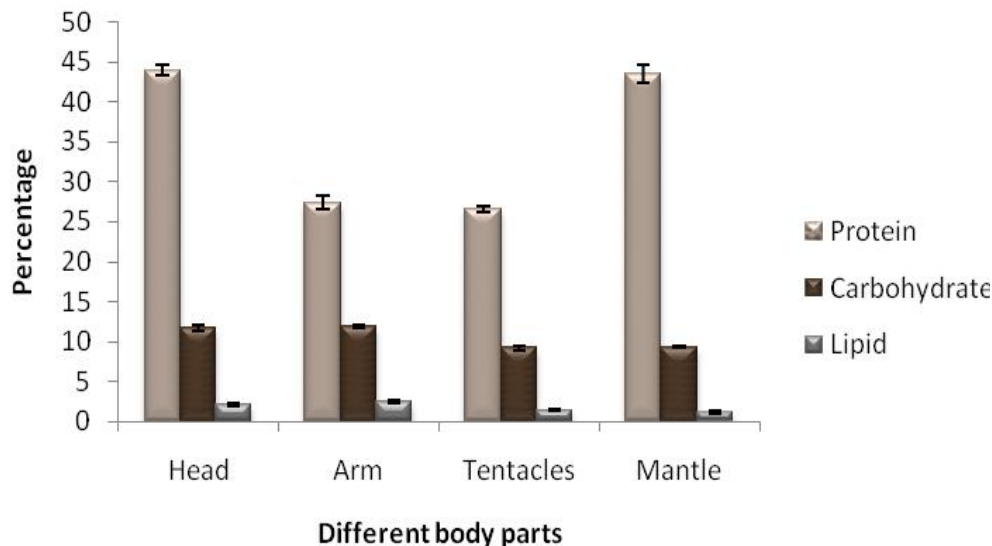


Figure 1. Proximate composition in different body parts of *S. kobiensis*.

evaluation of many commercially important fishes and few species of cephalopods. But at the same time there, no work has been carried out in the different body parts (head, arm, tentacles and mantle) of cephalopod *Sepia kobiensis*. Therefore, the present study was undertaken to evaluate the nutritional quality of cuttlefish *S. kobiensis*.

## MATERIALS AND METHODS

### Collection of samples

The specimen of *S. kobiensis* were collected from Cuddalore (Lat. 10° 42' N; Long. 79° 46' E) landing centre (fish market), southeast coast of India. After collection, the animals were thoroughly washed with tap water and subsequently with distilled water. The different body parts such as arm, mantle, head and tentacles were dissected out and dried at a constant temperature of 60°C for 24 h in a hot air oven. The dried material was powdered using pestle and mortar and used for further analysis.

### Biochemical determinations

The difference in weight between wet and dried tissue represented the weight of water in the different body tissue, which is expressed as percentage. The modified method of Lowry et al. (1951) was employed to determine the total protein. For the estimation of total carbohydrate content (1 mg/ml), the procedure of Dubois et al. (1956), using phenol-sulphuric acid was followed. The chloroform-methanol extraction procedure of Folch et al. (1957) was used to determine total lipid from the various body parts.

### Estimation of total cholesterol and high-density lipoprotein (HDL) cholesterol

Total cholesterol and HDL cholesterol was estimated by the method of Zlatkis et al. (1953), using cholesterol as standard. Values are expressed as mg/100 g dry tissue. Triglycerides were determined

by following the method of Forster and Dunn (1973) using triolein as standard and the values are expressed as mg/100 g of dry tissue. Ash content was estimated by incinerating the pre-weighed samples (1 g dry weight in a muffle furnace, at 550°C, for a period of 5 h). The residue was weighed and the percentage was calculated. All the above biochemical analyses were done in triplicate.

### Statistical analysis

Data on the nutritional evaluation of different body parts was analyzed by one-way analysis of variance (ANOVA) using SPSS-16 version software followed by Duncan's multiple range test (DMRT).  $P \leq 0.05$  were considered as significant.

## RESULTS

The values of total protein, carbohydrate, lipid, cholesterol and triglyceride contents in the various body parts such as arm, head, mantle and tentacle of *S. kobiensis* are presented in Figure 1 and Table 1. The total protein content was ranging from 26.55 (tentacle) to 43.95% (head). The total carbohydrate content was found to be varying between 9.18 and 11.85% in tentacle and arm, respectively. The total lipid content was ranging from 1.19% (mantle) to 2.46% (arm). At the same time, the mantle recorded a minimum cholesterol content of  $131.25 \pm 0.89$  mg/100 g dry tissue and the arm recorded a maximum of  $359.36 \pm 1.94$  mg/100 g dry tissue. The HDL cholesterol content was minimum in head ( $43.83 \pm 0.81$  mg/100 g) and maximum in tentacle ( $204.53 \pm 1.78$  mg/100 g); whereas, the triglyceride content was recorded to be from  $156.52 \pm 0.83$  mg/100 g dry tissue (in mantle) and  $234.78 \pm 1.28$  mg/100 g dry tissue (in arm). Apart from this, high moisture and ash content were recorded in head,  $86.82 \pm 1.59$  and  $7.345 \pm 0.13\%$ , and low in mantle  $81.50 \pm 0.56$  and  $5.790 \pm 0.13\%$ , respec-

**Table 1.** Biochemical composition in different body parts of *S. kobiensis* (values expressed in % on dry weight basis except moisture).

Body part	Moisture (%)	Ash (%)	Cholesterol (mg/100 g)	HDL Cholesterol (mg/100 g)	Triglycerides (mg/100 g)
Head	86.82 ± 1.59	7.345 ± 0.13	168.75 ± 1.20	43.83 ± 0.81	197.10 ± 0.93
Arm	85.44 ± 1.25	6.378 ± 0.18	359.36 ± 1.94	59.30 ± 0.55	234.78 ± 1.28
Tentacle	84.04 ± 0.45	6.798 ± 0.16	256.25 ± 1.25	204.53 ± 1.78	176.81 ± 0.76
Mantle	81.50 ± 0.56	5.790 ± 0.13	131.25 ± 0.89	135.78 ± 0.89	156.52 ± 0.83

\*The statistical significance: P values ≤ 0.05 (DMRT).

tively.

## DISCUSSION

Biochemical composition of organisms are known to vary with season, size of animal, stages of maturity and availability of food, temperature etc. When compared to fish, cephalopods have 20% more protein, 80% less ash, 50 to 100% less lipid and 50 to 100% less carbohydrate. Also, according to this author, cephalopod mantle does not store lipid or its storage is below 1 g of its wet weight. This is due to the poor absorption of lipids (Odor et al., 1984) and consequent poor utilization by the animal's metabolism (Ballantyne et al., 1981). Vairamani (2010) reported that the protein content of the various body parts of *Sepiella inermis* such as head, mantle, tentacle and arm was found to be 35.10, 36.36, 42.84 and 45.35%, respectively. In the present investigation, the total protein content was ranging from 26.55 to 43.95%. The protein was maximum in the head (43.95 ± 0.62%) and minimum in the tentacle (26.55 ± 0.45%). These higher amounts of protein content indicate that the cephalopods are one of the good nutritive food items.

Vairamani (2010) reported that the carbohydrate content of *S. inermis* was found to be varying between 3.31 and 5.63% in the tentacle and mantle, respectively. In the present study, the carbohydrate content in head, arm, tentacle and mantle was found to be 11.70 ± 0.37, 11.85 ± 0.20, 9.18 ± 0.29 and 9.33 ± 0.13%, respectively. Sambasivam et al. (2005) reported that carbohydrate content varied from 0.91 to 1.54% in *Oreolalax rugosus* and the carbohydrate content of molluscs is mainly composed of glycogen, and the change in the carbohydrate level may be due to the accumulation of glycogen at different stages of gametogenesis and spawning (Ansari et al., 1981).

Lipids are considered very important during gametogenesis for gonad maturation, especially in females to provide energy for subsequent embryo development (Pollero et al., 1983). The lowest lipid content was observed in *Eledone moschata* (0.60 to 0.68%); whereas *Lysimachia vulgaris* reported the highest level of lipid (1.34 to 1.92%) (Ozogul et al., 2008). Similar results were also observed in several other cephalopod molluscs such as cuttlefish, octopus and squid (Zlatanov et al., 2006).

Vairamani (2010) reported the total lipid content as ranging from 6.88% (head) to 11.50% (mantle) of *S. inermis*. But in the present study, the lipid content of head, arm, mantle and tentacles of *S. kobiensis* are found to be 2.11 ± 0.16, 2.46 ± 0.20, 1.44 ± 0.13 and 1.19 ± 0.18%, respectively. This difference in the lipid content may be due to species, gender, geographical origin and season (Rasoarahona et al., 2005) apart from the abundance of food (Rosa et al., 2002).

In the present study, the ash content in their different body parts studied in *S. kobiensis* was estimated as 7.35 ± 0.13% (head), 6.38 ± 0.18% (arm), 6.80 ± 0.16% (tentacle) and 5.79 ± 0.13% (mantle). Ozogul et al. (2008) reported the ash content of *Sepia officinalis* as 2.11 ± 0.64%, *L. vulgaris* as 1.95 ± 0.44%, *Eledone moschata* as 1.85 ± 0.33% and *Octopus vulgaris* as 2.06 ± 0.11%. The moisture content of *S. kobiensis* was found fluctuating from 81.50 ± 0.56% (mantle) to 86.82 ± 1.59% (head). Similar results were also observed in other species of cephalopod like *S. officinalis*, *L. vulgaris*, *E. moschata* and *O. vulgaris* (Ozogul et al., 2008).

Cholesterol is viewed as the most important sterol in aquatic molluscs because it is required for the synthesis of membranes and for use in the production of other steroids necessary for reproductive development. For the most part, bivalve molluscs have limited ability to synthesize sterols (Holden and Patterson, 1991). Vairamani (2010) reported the minimum cholesterol content of 133.34 mg/100 g dry tissue in arm and the maximum of 441.48 mg/100 g in mantle dry tissue of cuttlefish *S. inermis*. But in the present investigation, on the contrary, the cholesterol level was reported lowest (131.25 ± 0.89 mg/100 g) in mantle and highest in arm (359.36 ± 1.25 mg/100 g). The HDL cholesterol level was found lowest in head (43.83 ± 0.81 mg/100 g) and highest in tentacle (204.53 ± 1.78 mg/100 g dry weight basis). Thanonkaew et al. (2006) reported the triglyceride content in head as 0.44 ± 0.10 and in mantle as 0.90 ± 0.02 of cuttlefish *Sephia pharaonis*. Vairamani (2010) reported the triglyceride content as 173.34 mg/100 g dry tissue in head and 219.25 mg/100 g dry tissue in mantle of *S. inermis*. In the present study, the triglyceride content of head, arm, tentacle and mantle was found to be 197.10 ± 0.93, 234.78 ± 1.28, 176.81 ± 0.76 and 156.52 ± 0.83 mg/100 g, respectively. From the results of the present study, it is clear that unlike that of fish, squid lipid tends to be low in

triglycerides (Okuzumi and Fujii, 2000).

## Conclusions

Fish is a major source of animal protein. Fish is widely consumed in many parts of the world by humans because of its high protein content. Likewise cuttlefish also has more protein and less lipids and hence the cuttlefishes could also be consumed in higher amounts like other fin and shellfishes.

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