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SHORT COMMUNICATION

IODINE IN MARINE PRAWNS AND ITS FATE ON BOILING

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Abstract : The iodide content of four marine prawn species,namely, *Penaus indicus* (Indian white prawn), *Penaus monodon* (Giant tiger prawn), *Penaus semisulcatus* (Green tiger prawn), and *Metapenaus ensis* (Greasyback prawn) collected from Negombo on three different days was determined. The iodide content was highest in *P. indicus*. For all species under study, iodide was found to be largely concentrated in the exo-skeleton rather than in the edible flesh. Boiling of prawns leads to significant loss of iodide with relative loss being greater when boiled without the exo-skeleton. Moreover, boiling prawns with the exo-skeleton intact leads to an increase of the iodide content in the edible flesh. A relatively simple and sensitive method based on the Sandell and Kolthoff reaction was used to determine the iodide content.

Key words : Exo-skeleton, iodine, *Metapenaus ensis*, *Penaus indicus*, *Penaus monodon*, *Penaus semisulcatus*, prawns.

INTRODUCTION

Iodine is needed for the synthesis of thyroid hormones which are necessary for mental and physical health of both humans and animals. It cannot be synthesized in the human body and therefore should be provided in the daily diet. Daily requirement of iodine is around 150 μg for an adult and the average life time requirement of an individual would be barely a teaspoon of iodine. The non-availability of this amount regularly can lead to iodine deficiency disorders(IDD) of which the best known manifestation is endemic goitre.

Iodine deficiency is a problem for nearly all countries in the world and threaten more than 1.5 billion persons, mostly children. In the past several countries and international agencies have pledged the virtual elimination of IDD by year 2000. Among other methods, iodized salt has been the most practical and cost effective means of achieving this goal. Another approach to make Sri Lankans iodine sufficient and bring about control and prevention of IDD is to encourage intake from dietary sources other than iodized salt. The inclusion of iodine content of Sri Lankan foods in food composition tables[1] can make the public aware of the iodide levels in foods consumed in their daily diet.

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It is well documented that adequate amounts of micronutrient iodine is found in sea foods.[2] However, no reports are available on the iodide level of prawns (marine) commonly found in Sri Lanka. In our continuing effort[3-5] to determine the iodine content in raw foods, we report here the iodide levels of four common species of prawns namely *Penaus indicus* (Indian white prawn), *Penaus monodon*(Giant tiger prawn), *Penaus semisulcatus*(Green tiger prawn) and *Metapenaus ensis* (Greasyback prawn) and the fate of iodine during boiling.

METHODS AND MATERIALS

Sampling of prawns for analysis : All prawn species mentioned were collected from Negombo. Prawns samples of each species collected on three different days during the months of January - June 1996 were analysed. Fresh prawns were collected early in the morning when fishermen arrived with their catch. All specimens were sampled randomly for analysis at three different times during the aforementioned period. The samples used in the analysis were approximately of the same size and weight and these data are summarized in Table 1.

Table 1 : Characteristics of the prawn species analysed.

			Edible portion		
Species	Length (cm)	Weight (g)	Length (cm)	Weight (g)	Weight of flesh (g)
P. indicus	13-16	12-16	8-10	8-10	7-9.5
P. monodon	13-15	14.5-16.5	8-9	7.5-9.5	8-10
P. semisulcatus	13-15	11-15	7.5-9.5	7-10	6.5-9.5
Metapenaus ensis	11-13	6-10	5-7	5-7	4.5-6.5

Ashing of samples : Approximately 3g of accurately weighed edible portions were subjected to alkaline dry ashing.[6]

Effect of boiling : Approximately 3g of accurately weighed edible portions were boiled in 20 cm^3 of double distilled deionized water for 10 min maintaining a constant heating rate using a heating mantle. Thereafter, the samples were subjected to ashing.

In order to determine iodide in boiled edible flesh (after boiling with exo-skeleton intact), the following procedure was adopted prior to ashing: The exo-skeleton was carefully slit with a sterile blade and thereafter the flesh was removed and weighed accurately. The flesh was then kept intact with the exo-skeleton and was tied with a fine thread. This sample was then boiled as above, edible flesh separated, and subjected to ashing.

Determination of moisture[7] : Moisture content of the edible flesh (5g) of prawn species was determined using Dean and Stark apparatus with distilled water saturated toluene (125 cm^3) as solvent.

Determination of iodide in prawn samples : Each ashed sample was dissolved in double distilled water, centrifuged at 3000 rpm and made up to 100 cm^3 in a volumetric flask. The iodide levels were determined colorimetrically at 420nm based on the iodide catalysed reduction of Ce(IV) by As(III)[8] (Sandell and Kolthoff reaction) in acidic medium at 40±1°C using a Galenkamp single beam spectrophotometer. A modified procedure[9-11] to that reported by Mahesh *et al*[6] was used.

In this modified method [As(III)] / [Ce(IV)] ratio is kept high (~12) and log [absorbance Ce(IV)] is plotted against time(~5 min) for known iodide concentrations. The gradients of these plots are then plotted against known iodide concentration to obtain the calibration plot (r = 0.9988, mean co-efficient of variation = 0.05%). This calibration plot was used to determine iodide levels of unknown samples.

In a typical experiment to obtain the calibration plot, order of adding reagents involved mixing 0.12M As(III) solution and working standard solution of iodide (7 ng per cm^3) followed by the addition of 0.02M Ce(IV) at 40°C. The total volume of the reaction mixture was kept at 25.00 cm^3. This volume consists of 6.00 cm^3 As(III), 3.00 cm^3 of Ce(IV) and balance comprising of water and iodide solution. The volume of water and iodide was varied to alter the concentration of the iodide in the reaction mixture. Timing was started when half the Ce(IV) volume has drained to the solution containing As(III), iodide and water.

Precision, detection limit and accuracy : Analysis was repeated four times for each ashed sample. The co-efficient of variation was calculated to be less than 5% for all determinations. The detection limit of this method was found to be 4 ng per cm^3 in the working iodide solution. To evaluate the accuracy of the method iodide solutions of known strength were analysed both at high and low levels of iodide. The accuracy was found to be satisfactory for all the standard solutions.

Statistical analysis of results : The comparison of means of the samples (ANOVA) at p=0.05 collected at three different times were performed using Minitab statistical software version 7.

Reagents : All reagents used in this study were of analytical grade or better and used as received.

Table 2 : Iodide and moisture contents of raw and boiled prawns.

Species	Raw flesh with shell	Raw flesh without shell	Boiled flesh with shell	Boiled flesh without shell	Boiled flesh without shell after boiling with shell intact	Moisture content (%)[a] raw edible flesh
P. indicus	121±6(23)	20±3(27)	85±2(11)	8±2(10)	47±4(11)	73.8±0.4(3)
			89±5(9)	11±2(10)	49±5(10)	
			81±5(9)	10±2(9)	44±2(9)	
P. monodon	101±6(26)	14±3(24)	56±4(25)	5±1(9)	37±2(9)	77.2±0.6(3)
				7±1(9)	40±2(10)	
				6±1(10)	38±3(11)	
P. semisulcatus	58±4(29)	19±3(29)	43±2(9)	14±2(10)	25±2(9)	77.6±0.5(3)
			44±2(9)	12±1(10)	26±2(9)	
			46±2(11)	11±2(10)	28±1(9)	
Metapenaus ensis	86±5(28)	17±2(30)	57±4(9)	7±2(10)	37±2(9)	76.2±0.4(3)
			50±1(10)	8±1(10)	41±3(10)	
			51±2(9)	10±2(10)	39±3(9)	

Total number of prawn samples analysed are given in parenthesis. A single value for each determination indicates that the three means are not significant ($p>0.05$); when the means are significant ($p<0.05$ they are expressed separately. Values are mean ± s.d. in µg/ 100g wet weight.

[a] Average of three determinations collected on three different days.

RESULTS AND DISCUSSION

The iodide levels in the edible portions of the prawn species under investigation and its fate during boiling are summarized in Table 2.

Results in column 1 indicate that prawns are a good source of iodide with highest iodide level found in *P. indicus*. However, comparison with column 2 shows that a large fraction of iodide in prawns is concentrated in the exo-skeleton which is not consumed . This may prompt one to categorize prawns as nutritionally poor source of iodine. Interestingly, comparison of columns 4 and 5 indicate that boiling of prawns with exo-skeleton intact leads to an increase in the iodide content of the flesh making prawns a more significant source of iodine. This increase is as a result of the migration of iodine from the exo-skeleton to the edible flesh during boiling. Similar behaviour is known in the case of parboiled rice. Here the migration of vitamins from the bran of the rice grain to the interior is a well known phenomenon. The higher the iodide content in the exo-skeleton greater the migration to the edible portion is also evident by comparison of columns 1,2,4 and 5. Another noteworthy observation in this investigation is that the mean iodide levels of raw prawn species (both with and without exo-skeleton), collected on the three different days are not significant ($p>0.05$) whereas mean iodide levels among the five raw prawn species are significantly different ($p<0.05$). The iodide content in raw flesh given in column 2 compares well with those reported in India[6] and Britain[12]. A significant loss of iodide is observed during the boiling of raw prawns with relative loss being greater when boiling without the exo-skeleton. It can be concluded that preparation of a iodine nutritious meal of prawns involves cooking over a minimum period of time with exo-skeleton intact.

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