

## Seasonal Variations in Cholesterol Content of Different Species of Prawn

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Seven species of prawns of different size caught during different seasons were analysed for fat, nonsaponifiable matter (NSM) and cholesterol for a period of 1 year. The cholesterol content was found to be not steady throughout the seasons with alternate ups and downs, the maximum being in August and November. Two way ANOVA showed that there was significant difference in cholesterol content between species as well as between seasons. A negative correlation of cholesterol content was observed between size and months of sampling from March to June.

**Keywords :** Cholesterol, shellfish, nutrition labelling, seasonal variation

The determination of sterol compounds particularly cholesterol is of growing importance to the food industry ever since the inception of Nutritional Labelling as a compulsory measure (Sehat & Niedwetzki 1998). It is well known that increased cholesterol content in the blood can lead to cardiovascular diseases and the dietary cholesterol can affect the serum cholesterol levels (Ammu *et al.*, 1996; Sanchez-Muniz, *et al.*, 1991). In recent years, the incidence of cardiovascular diseases has increased to such an extent that the consumers now prefer food with low cholesterol content and select processed food with nutritional labelling. In an extensive survey of cholesterol content of Indian fish and shellfish (Suseela *et al.*, 1999) it was found that shellfish especially prawns, squid and cuttle fish had higher levels of cholesterol compared to fish. It has been reported that fish fat and cholesterol content might vary with habitat and size of the fish (Kinsella, 1987). An attempt is made here to study the seasonal variations in the level of cholesterol, fat and NSM in different species of prawns from Indian coastal

waters, as no data in this regard are reported yet.

### Materials and Methods

Seven species of prawns (*Penaeus monodon*, *Metapenaeus dobsoni*, *Penaeus indicus*, *Metapenaeus monoceros*, *Metapenaeus affinis*, *Parapenaeopsis styliifera*) and the fresh water prawn (*Macrobrachium rosenbergii*) of different sizes were collected every month from local markets in and around Cochin, India, for a period of 1 year. The samples were brought to the laboratory in iced condition. The representative samples of peeled and undeveined meat (30g) in duplicates were taken from each species for analysis. The prawns were grouped into different size based on total length. Lipid content was estimated after extracting the mince with chloroform methanol following the method of Folch (1957). Nonsaponifiable matter (NSM) was determined by the method of AOAC (1990) and cholesterol by the ferric chloride method as described by Rudel and Morris (1973). Standard cholesterol was

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procured from Sigma chemicals and all other chemicals were of analytical grade. Statistical analysis was done by two way Analysis of Variance (ANOVA).

### Results and Discussion

Fat, NSM and cholesterol in the meat of seven species of prawns of different size grades for a period of one year is given in tables 1a, 1b and 1c. The results showed that cholesterol content was found to be maximum in *Penaeus indicus* with a total length (TL) of 8.0-10 cm. during the month of November and minimum in *Penaeus monodon* collected during May (18-20 cm. TL). The average cholesterol content of different species of prawns is shown in table 2 along with average fat and NSM contents. Compared to other species of prawns, cholesterol

content was found to be less in *Penaeus monodon* and *Macrobrachium rosenbergii*.

In general the cholesterol content of prawns was found to vary randomly throughout the seasons, the maximum being in August and November (Fig. 1). Two way ANOVA showed that there was significant difference in cholesterol content between species as well as months (Table 3). Correlation coefficient was determined to study the effect of size and season on the cholesterol content. The results showed that during March to June there was a negative correlation (Table 4). As the size of the prawn increased, cholesterol content decreased during this period. Idler and Tsuyuki (1958) reported a variation during different seasons in the cholesterol content of the muscle of fish, suggesting a relationship

Table 1 a. Variation in Cholesterol content of seven species of prawn with respect to size and season

| Species                              | Length (cm) | Nos./ 100g | Cholesterol content in muscle (mg/100g) |       |       |       |       |       |       |       |       |       |
|--------------------------------------|-------------|------------|-----------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                      |             |            | Jan                                     | Feb   | Mar   | April | May   | June  | July  | Aug   | Oct   | Nov   |
| 1. <i>Penaeus monodon</i>            | 18-20       | 1.6        | 132.9                                   | -     | 123.0 | 107.9 | 96.3  | 110.2 | 112.4 | 125.9 | 99.1  | 137.8 |
| 2. <i>Macrobrachium rosenbergii</i>  | 18-20       | 2.0        | 125.2                                   | -     | 119.0 | -     | -     | 101.7 | 106.2 | 144.1 | 138.1 | 148.1 |
| 3. <i>Penaeus indicus</i>            | 8-10        | 34         | 143.7                                   | 103.6 | 150.0 | 135.0 | 123.1 | 148.4 | 107.8 | 168.9 | 133.0 | 192.9 |
| 4. <i>Penaeus indicus</i>            | 10-12       | 20         | 134.7                                   | 133.1 | 154.0 | 121.4 | 146.5 | 129.4 | 125.2 | 141.4 | 142.3 | 162.5 |
| 5. <i>Penaeus indicus</i>            | 13-15       | 5.7        | 146.5                                   | 144.7 | 156.6 | 127.1 | 106.6 | 122.7 | 121.3 | 153.9 | 140.9 | 137.7 |
| 6. <i>Metapenaeus monoceros</i>      | 6.5-7.9     | 42         | 141.2                                   | 145.0 | 155.0 | 130.3 | 149.1 | 130.9 | 128.7 | 153.6 | 114.8 | 185.7 |
| 7. <i>Metapenaeus monoceros</i>      | 8.0-9.5     | 28         | 137.2                                   | 126.3 | 149.8 | 120.2 | 136.5 | 132.4 | 117.3 | 149.7 | 127.9 | 161.2 |
| 8. <i>Metapenaeus dobsóni</i>        | 5.0-6.5     | 107        | 114.0                                   | 124.1 | 139.6 | 127.9 | 128.2 | 127.3 | 113.9 | 157.6 | 131.6 | 146.4 |
| 9. <i>Metapenaeus dobsóni</i>        | 7.0-8.5     | 44         | 96.5                                    | -     | 157.5 | -     | 180.2 | 131.5 | -     | 144.8 | 137.1 | 148.6 |
| 10. <i>Metapenaeus affinis</i>       | 6.0-6.5     | 36         | 141.4                                   | -     | 151.6 | 115.1 | 167.3 | -     | -     | -     | -     | -     |
| 11. <i>Metapenaeus affinis</i>       | 7.0-8.5     | 20         | 138.2                                   | -     | 152.2 | 142.6 | -     | -     | -     | -     | -     | -     |
| 12. <i>Parapenaeopsis styliifera</i> | 6.0-7.0     | 70         | 135.1                                   | 134.1 | 161.0 | 140.2 | 125.6 | -     | -     | -     | -     | -     |
| 13. <i>Parapenaeopsis styliifera</i> | 9.0-12.0    | 16         | 146.3                                   | 133.2 | -     | -     | -     | -     | -     | -     | -     | -     |
| 14. <i>Parapenaeopsis styliifera</i> | 7.5-9.5     | 34         | -                                       | -     | 111.8 | -     | 121.8 | -     | -     | -     | -     | -     |

(- Specimens were not available)

Table 1 b. Variation in NSM content of seven species of prawn with respect to size and season

| Species                              | Length (cm) | Nos./100g | NSM content in muscle (g/100g) |       |       |       |       |       |       |       |       |       |
|--------------------------------------|-------------|-----------|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                      |             |           | Jan                            | Feb   | Mar   | April | May   | June  | July  | Aug   | Oct   | Nov   |
| 1. <i>Penaeus monodon</i>            | 18-20       | 1.6       | 0.199                          | -     | 0.177 | 0.171 | -     | 0.179 | 0.197 | 0.209 | 0.175 | 0.158 |
| 2. <i>Macrobrachium rosenbergii</i>  | 18-20       | 2.0       | 0.164                          | -     | 0.204 | -     | -     | 0.169 | 0.187 | 0.238 | 0.183 | 0.179 |
| 3. <i>Penaeus indicus</i>            | 8-10        | 34        | 0.214                          | 0.231 | 0.217 | 0.215 | 0.240 | 0.219 | 0.204 | 0.232 | 0.197 | 0.261 |
| 4. <i>Penaeus indicus</i>            | 10-12       | 20        | 0.190                          | 0.208 | 0.233 | 0.195 | 0.209 | 0.210 | 0.224 | 0.213 | 0.203 | 0.215 |
| 5. <i>Penaeus indicus</i>            | 13-15       | 5.7       | 0.197                          | -     | 0.232 | 0.217 | 0.201 | 0.209 | 0.202 | 0.228 | 0.216 | 0.191 |
| 6. <i>Metapenaeus monoceros</i>      | 6.5-7.9     | 42        | 0.204                          | 0.215 | 0.224 | 0.215 | 0.214 | 0.212 | 0.202 | 0.219 | 0.186 | 0.224 |
| 7. <i>Metapenaeus monoceros</i>      | 8.0-9.5     | 28        | 0.216                          | 0.221 | 0.223 | 0.205 | 0.192 | 0.197 | 0.188 | 0.232 | 0.179 | 0.200 |
| 8. <i>Metapenaeus dobsoni</i>        | 5.0-6.5     | 107       | 0.160                          | 0.206 | 0.237 | 0.195 | 0.190 | 0.202 | 0.196 | 0.230 | 0.203 | 0.207 |
| 9. <i>Metapenaeus dobsoni</i>        | 7.0-8.5     | 44        | 0.211                          | -     | 0.246 | -     | -     | 0.208 | -     | 0.219 | 0.190 | 0.180 |
| 10. <i>Metapenaeus affinis</i>       | 6.0-6.5     | 36        | 0.163                          | -     | 0.237 | 0.226 | 0.228 | -     | -     | -     | -     | -     |
| 11. <i>Metapenaeus affinis</i>       | 7.0-8.5     | 20        | 0.181                          | -     | 0.234 | 0.227 | 0.270 | -     | -     | -     | -     | -     |
| 12. <i>Parapenaeopsis styliifera</i> | 6.0-7.0     | 70        | 0.207                          | 0.210 | 0.248 | 0.205 | 0.213 | -     | -     | -     | -     | -     |
| 13. <i>Parapenaeopsis styliifera</i> | 9.0-12      | 16        | -                              | -     | 0.148 | -     | 0.204 | -     | -     | -     | -     | -     |
| 14. <i>Parapenaeopsis styliifera</i> | 7.5-9.5     | 34        | 0.189                          | 0.215 | -     | -     | -     | -     | -     | -     | -     | -     |

(- Specimens were not available)

between the metabolism and biosynthesis of these sterols. March to June is a period of pre spawning in most of the species of prawns in India and there will be gonadal development in bigger sized prawns (Kurien & Sebastian, 1982). Redistribution of cholesterol may occur, accumulating more of it in the gonads. This may be a reason for low cholesterol content in the meat of bigger prawns.

Fat content of fish is reported to vary with size and season (Smith *et al.*, 1980; Nair & Nair 1985). Fat content was found to be maximum in large specimens of *Metapenaeus affinis* during May and minimum in large *Penaeus indicus* during June. Average fat content for the prawns was estimated to be

1.024g%. Analysis of variance (based on values showed in Table-1c) showed that there was significant variation in the fat content between the different varieties of prawn, but no variation was observed between different months (Table 5). In the case of oil sardine seasonal variation was reported in the fat content (Nair & Nair, 1985), similar is the case with mackerel (Smith *et al.*, 1980). However in the present studies, in fat content no significant seasonal variation was observed in prawns.

Nonsaponifiable matter was found to be maximum in *Penaeus indicus* (8.0-10cm. length) during November and minimum in *Parapenaeopsis styliifera* (9.0-12.0cm. length) during March. The average NSM for prawn



Table 1 c. Variation in fat content of seven species of prawn with respect to size and season

| Species                              | Length (cm) | Nos./100g | Jan   | Feb   | Mar   | Fat content in muscle (g/100g) |       |      |      |      |       |       |
|--------------------------------------|-------------|-----------|-------|-------|-------|--------------------------------|-------|------|------|------|-------|-------|
|                                      |             |           |       |       |       | April                          | May   | June | July | Aug  | Oct   | Nov   |
| 1. <i>Penaeus monodon</i>            | 18-20       | 1.6       | 0.932 | -     | 0.901 | 0.92                           | -     | 0.88 | 0.92 | 1.27 | 1.004 | 0.93  |
| 2. <i>Macrobrachium rosenbergii</i>  | 18-20       | 2.0       | 0.906 | -     | 0.845 | -                              | -     | 0.89 | 1.16 | 1.28 | 1.273 | 0.87  |
| 3. <i>Penaeus indicus</i>            | 8-10        | 34        | 1.036 | 1.059 | 1.09  | 1.034                          | 0.974 | 1.07 | 0.97 | 1.05 | 1.025 | 1.15  |
| 4. <i>Penaeus indicus</i>            | 10-12       | 20        | 1.046 | 1.105 | 1.15  | 1.042                          | 1.104 | 1.07 | 1.07 | 1.21 | 1.118 | 1.18  |
| 5. <i>Penaeus indicus</i>            | 13-15       | 5.7       | 1.074 | -     | 1.05  | 1.081                          | 1.07  | 0.83 | 1.09 | 1.12 | 1.155 | 1.05  |
| 6. <i>Metapenaeus monoceros</i>      | 6.5-7.9     | 42        | 1.027 | 1.006 | 1.04  | 0.97                           | 1.018 | 1.08 | 0.93 | 0.95 | 0.92  | 0.974 |
| 7. <i>Metapenaeus monoceros</i>      | 8.0-9.5     | 28        | 0.978 | 0.949 | 1.01  | 1.012                          | 1.019 | 1.07 | 0.93 | 0.98 | 0.96  | 0.999 |
| 8. <i>Metapenaeus dobsoni</i>        | 5.0-6.5     | 107       | 1.026 | 1.074 | 1.13  | 1.055                          | 1.105 | 0.97 | 1.00 | 1.07 | 1.02  | 1.17  |
| 9. <i>Metapenaeus dobsoni</i>        | 7.0-8.5     | 44        | 0.908 | -     | 1.06  | -                              | -     | 1.03 | -    | 1.08 | 1.02  | 1.22  |
| 10. <i>Metapenaeus affinis</i>       | 6.0-6.5     | 36        | 1.148 | -     | 0.935 | 0.867                          | 1.057 | -    | -    | -    | -     | -     |
| 11. <i>Metapenaeus affinis</i>       | 7.0-8.5     | 20        | 1.063 | -     | 0.965 | 1.087                          | 1.291 | -    | -    | -    | -     | -     |
| 12. <i>Parapenaeopsis styliifera</i> | 6.0-7.0     | 70        | 0.863 | 1.023 | 0.849 | 0.864                          | 0.909 | -    | -    | -    | -     | -     |
| 13. <i>Parapenaeopsis styliifera</i> | 9.0-12      | 16        | -     | -     | 0.874 | -                              | 0.939 | -    | -    | -    | -     | -     |
| 14. <i>Parapenaeopsis styliifera</i> | 7.5-9.5     | 34        | 0.929 | 0.950 | -     | -                              | -     | -    | -    | -    | -     | -     |

(- Specimens were not available)

samples was found to be 0.21g%. Average values showed that between different sizes of prawn, in each species, there was not much difference. Similar to cholesterol content, NSM content also was low in *Penaeus monodon* and *Macrobrachium rosenbergii*.

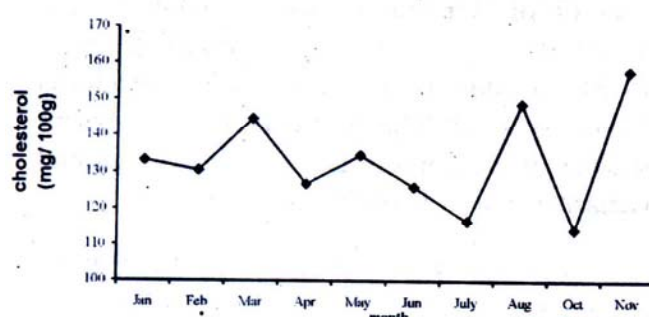


Fig. 1. \*Average cholesterol content in prawn during different months

\* Average values of all species and size of prawns.

Table 2. Average value of fat, NSM and cholesterol of different species of prawns irrespective of size and season

| No. | Species                          | Fat (g%) | NSM (g%) | Cholesterol (mg%) |
|-----|----------------------------------|----------|----------|-------------------|
| 1.  | <i>Penaeus monodon</i>           | 0.969    | 0.183    | 116.17            |
| 2.  | <i>Macrobrachium rosenbergii</i> | 1.032    | 0.189    | 126.08            |
| 3.  | <i>Penaeus indicus</i>           | 1.036    | 0.214    | 138.54            |
| 4.  | <i>Metapenaeus monoceros</i>     | 0.991    | 0.208    | 139.65            |
| 5.  | <i>Metapenaeus dobsoni</i>       | 1.049    | 0.206    | 143.97            |
| 6.  | <i>Parapenaeopsis styliifera</i> | 0.916    | 0.202    | 139.48            |
| 7.  | <i>Metapenaeus affinis</i>       | 1.052    | 0.221    | 144.09            |

Table 3. ANOVA (Two-way) – Cholesterol content

| Source of variation | Sum of squares | DF | MSS    | F     |
|---------------------|----------------|----|--------|-------|
| Between species     | 5922.7         | 8  | 740.3  | 3.8** |
| Between months      | 12862.1        | 9  | 1429.1 | 7.4** |
| Error               | 13976.3        | 72 | 194.1  |       |
| Total               | 32761.1        | 89 |        |       |

\*\* Significant at 1% level

Table 4. Correlation between size and seasons in cholesterol content in prawn

|          |        |
|----------|--------|
| January  | 0.1334 |
| February | 0.0024 |
| March    | 0.7172 |
| April    | 0.5860 |
| May      | 0.7577 |
| June     | 0.7271 |
| July     | 0.1318 |
| August   | 0.4218 |
| October  | 0.1813 |
| November | 0.3467 |
| Size –   | 1.000  |

\*\*Sig at 1% level

Table 5. ANOVA (two way) – fat content

| Source of variation | Source of squares | DF | MSS     | F      |
|---------------------|-------------------|----|---------|--------|
| Between species     | 0.1050            | 6  | 0.0175  | 6.53** |
| Between months      | 0.0024            | 2  | 0.0012  | 0.45   |
| Error               | 0.0321            | 12 | 0.00268 |        |
| Total               | 0.13953           | 20 |         |        |

### Conclusion

The data on variations in cholesterol content of prawn during different months of the year can add to the information on the cholesterol content of food. The content of cholesterol in prawn was found to be high irrespective of month or size at the time of catch. Big sized prawns like tiger prawn (*Penaeus monodon*) and giant fresh water prawn (*Macrobrachium rosenbergii*) showed comparatively lower levels of cholesterol. Seasonal and species variation was observed in cholesterol content of prawn. Seafood are

known to be hypocholesterolemic. Both fish protein and the polyunsaturated fatty acids (PUFA) of fat have cholesterol lowering effect on blood serum. However in prawn the high content of cholesterol also should be taken into consideration when we emphasize on the effects of PUFA and fish protein on lowering the serum cholesterol.

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