*Fishery Technology*
1999, Vol. 36(1) pp : 19 - 23

# Products for Human Consumption from Antarctic Krill

**Jose Joseph, V. Muraleedharan, R. Thankamma and C.N. Ravishankar**
*Central Institute of Fisheries Technology, Cochin - 682 029, India*

Studies were conducted to formulate different products using frozen-stored whole krill/krill meat. Dried krill of good quality could be prepared by blanching krill in boiling 5% salt solution for 5 min and then sun drying. Incorporation of krill mince even at a level of 10% to *Catla catla* mince for production of mixed mince and fish paste adversely affected the quality. Though a prawn like flavour was imparted on mixing krill mince with *Catla catla* mince during preparation of fish cutlet and fish burger, it gave a bitter after taste at 10% level and bitter taste at 20% level or above. The swelling property of the fish wafers was affected by incorporation of krill mince.

**Keywords: Antarctic krill, fish mince, product development, mixed mince, quality changes**

Antarctic Krill, *Euphausia superba* is a largely unutilized source of protein. Though it has been exploited and used for human consumption in a small scale, there exist many problems for processing of krill into an acceptable food. One of the obstacles in utilising krill is the quick autolysis by strong protease present in it (Suzuki, 1981; Yanase, 1971; Bobrovskaya *et. al.*, 1981). Excessive loss of exudate during storage at non-freezing temperatures, blackening and development of unpleasant flavour are some other problems in the utilisation of krill (Suzuki, 1981). Another major problem is the high content of fluoride in the shell, which migrates to the meat (Bobrovskaya *et al.*, 1981; Christians *et al.*, 1981). Recent studies have shown that fluoride in the shell migrated into the meat during frozen storage to the extent of 44% in 3 months (Ravishankar & Asok Kumar, 1998). Hence further work is required in this direction to find out suitable handling and processing methods to utilise this large source of protein. The present work was carried out to find out suitable methods of utilisation of krill meat.

## Materials and Methods

Fresh krill were collected on board Sagar Sampada during first Indian Antarctic Krill Expedition. Immediately after the catch, krill were washed properly with fresh water packed in trays lined with polythene sheets and frozen at -35°C and the frozen product was stored at -30°C. Krill mince was prepared by separating the meat in a BAADAR 694-meat bone separator, frozen and stored as above. After 2 months of storage on board, the samples were stored at -20°C in the laboratory. These samples were used for further studies.

The whole krill was partially thawed and dipped in 0,1,2 and 5% boiling brine (1:1 ratio) for 5 min, drained and dried under sun. The head and shell were removed and the meat was packed in polythene cover and stored at ambient temperature. The samples were analysed for total nitrogen (TN), non-protein nitrogen (NPN), moisture, fat, ash, salt (AOAC, 1990) and total volatile basic nitrogen (TVN) (Conway, 1947).

Fresh *Catla catla* collected from a local farm were brought to the laboratory in iced

condition and filletted and minced in a meat bone separator. The meat was washed in chilled water and surimi was prepared as per the method described by Muraleedharan, *et al.* (1997). The mince from krill was mixed with washed *C. catla* mince at 10, 20, 30 & 40% (w/w) proportions in a Hobart mixer for 25 min at 15°C and the chemical, physical and organoleptic properties of the mixtures were studied.

Moisture, total nitrogen, fat and ash contents of these samples were determined by the AOAC (1990) method. Salt soluble nitrogen (SSN) was analysed by the method of Dyer *et al.* (1950) and colour & appearance was assessed by spreading 10 g of sample on a glass sheet at 2-mm thickness and observing visually. Texture was analysed using Rheotex rheometer and deformation and rupture force were calculated (Muraleedharan & Gopakumar, 1996).

Krill mince was incorporated at 10, 20 and 30% (w/w) level with *Catla catla* meat and made into a paste using a silent cutter. The sensory quality aspects and spreadability were studied as per the method described by Muraleedharan *et. al.* (1997).

Fresh *Nemipterus japonicus* was collected from Fisheries Harbour, Cochin, and the meat was separated using a meat bone separator. The separated meat was cooked in boiling water for 10 min. Fish products such as fish burger, fish cutlets (Joseph *et. al.*, 1984) and fish wafers (Shenoy *et. al.*, 1983) were prepared by incorporating cooked krill mince at 10, 20, 30 & 40 % with cooked *N. japonicus* meat. Sensory characteristics of the products were evaluated using a trained taste panel consisting of eight members.

## Results and Discussion

The yield of dried krill meat varied from 6 to 10%, the lowest being for the product cooked in water and highest for the product cooked in 5% brine (Table 1). The dried product prepared by cooking in water became powdery after two months of storage while the product cooked in salt solution did not show any change in their shape and physical characteristics. The dried products prepared after cooking in 1 and 2% salt solution had a pinkish dark appearance while that cooked in 5% brine had a pinkish white appearance The chemical characteristics of fresh krill meat and dried products are given in Table 1. The product cooked in water and dried had high total nitrogen and 45% of the TN was NPN. The TVN value was also very high. The TVN contents of the other three samples were below 100mg/100g. All the other products had a non-protein nitrogen content of 1400mg/100g, which might

Table 1. Chemical characteristics of fresh and dried krill meat

| Samples | Yield % | Moisture % | TN % | TVN mg % | NPN mg % | Ash % | Fat % | Salt % |
|---|---|---|---|---|---|---|---|---|
| Fresh krill meat | – | 80.56 | 2.49 | 11.20 | 1540 | 1.56 | 1.66 | – |
| Cooked in water and sun dried | 6.4 | 13.42 | 14.52 | 207.00 | 6766 | 10.80 | 4.17 | 0.29 |
| Cooked in 1% brine and sun dried | 7.1 | 11.45 | 10.56 | 84.00 | 1400 | 12.15 | 6.09 | 2.90 |
| Cooked in 2% brine and sun dried | 7.8 | 12.42 | 10.21 | 84.00 | 1400 | 13.05 | 6.73 | 5.85 |
| Cooked in 5% brine and sun dried | 9.7 | 10.21 | 9.10 | 70.00 | 1400 | 29.55 | 4.50 | 13.16 |

Table 2. Changes in chemical, physical and sensory characteristics of catla mince on incorporation of krill mince

| Characteristics | Catla 100% Krill 0% | 90% 10% | 80% 20% | 70% 30% | 60% 40% | 50% 50% | 0% 100% |
|---|---|---|---|---|---|---|---|
| Moisture | 76.65 | 80.42 | 82.28 | 80.22 | 79.63 | 76.91 | 74.71 |
| TN (%) | 3.20 | 2.50 | 2.36 | 2.51 | 2.65 | 2.61 | 2.44 |
| SSN (%) | 2.52 | 2.10 | 1.96 | 1.96 | 2.10 | 2.12 | 2.10 |
| Fat (%) | 0.79 | 1.23 | 1.22 | 1.36 | 1.54 | 2.06 | 1.31 |
| Ash % | 0.96 | 0.90 | 0.75 | 0.80 | 0.89 | 1.28 | 1.65 |
| Deformation, mm | 19.10 | 16.10 | 17.10 | 16.80 | 14.80 | 11.90 | – |
| Rupture force, g | 119.10 | 98.20 | 87.40 | 82.10 | 80.30 | 69.10 | – |
| Colour | Off white | pink | pink+ | pink+ | pink++ | pink++ | red |
| Odour | Slight fish odour | prawn smell | prawn smell | prawn smell | prawn smell | prawn smell | strong unpleasant smell |
| Texture | Soft & firm | pasty | pasty | pasty | pasty coarse | pasty coarse | watery |

+ Indicates increasing intensity of pink colour

have originally formed in the raw material due to high autolytic action. The salt content of the dried product showed a proportional increase depending on the salt content of the brine used for cooking.

Table 2 shows the changes in the quality of *C. catla* mince on incorporation of krill mince. There was a gradual deepening of colour from pink to red with the increase in the proportion of krill meat.

Table 3. Sensory characteristics of products prepared by incorporating krill mince to fish meat

| Products | Ratio of fish meat:krill mince in the product | | | | |
|---|---|---|---|---|---|
| | 100:0 | 90:10 | 80:20 | 70:30 | 60:40 |
| Fish paste | Smooth, fine & spread spreadable | Slightly bitter, smoothness considerably reduced, spreadablity lost | Bitter, not spreadable | Bitter, not spreadable | |
| Fish wafer | Good puffing property | Puffing property considerably reduced, slightly sweet | Puffing property lost, bitter taste | Puffing property lost, bitter | Bitter, puffing property lost |
| Fish cutlet | Very good, characteristic taste and flavour | Slightly sweet reduction in cohesiveness | Slightly bitter, cohesiveness lost, breaking on frying | Bitter, not cohesive, breaking on frying | Bitter not cohesive |
| Fish berger | Very good, characteristic taste and flavour | Slightly sweet bitter after taste, cohesiveness reduced | Bitter, cohesiveness lost | Bitter, not cohesive lost | Bitter, not cohesive |

The odour also changed to an unacceptable level with the increase of krill meat in the product. The soft and firm texture of surimi from *C. catla* deteriorated to fibrous coarse texture by incorporation of 40 % of krill mince. The deformation of the heat set gel on application of external force decreased with corresponding drop in the rupture force, indicating appreciable decrease of gel strength. Heat set salt stabilised krill mince was found to be a very weak. Hence, krill mince alone could not be subjected to gel strength measurement. This clearly shows that the myofibrillar proteins in the krill meat have undergone significant hydrolysis during three months of storage, making it unsuitable for surimi preparations. The studies indicated that incorporation of krill meat in *C. catla* mince resulted in significant reduction of quality of the mince. The sensory characteristics of different products prepared by incorporating krill mince to fish meat are given in Table 3. The acceptability reduced as a result of incorporation of krill meat.

It is not possible to make definite conclusion on the suitability of krill meat for incorporating into various products. The product used in the present study was stored for 2 months at -30°C and for one month at -20°C. This could have caused significant autolytic changes in proteins and other macromolecules (Bykov, 1975; Budzinski *et al.*, 1985; Bidenco *et al.*, 1981), which could be responsible for the poor results upon incorporation of krill meat.

Authors wish to thank the Director, Central Institute of Fisheries Technology, Cochin, for granting permission to publish this paper.

## References

AOAC (1990) *Official Methods of Analysis* 15th edn, (Helrich, K., Ed.) Association of Official Analytical Chemists, Arlington, USA

Bidenco, M.S., Rasulova, T.A & Odinitisov, A.B. (1981) In: *Research in Technological Characterisation and Processing of Antarctic Krill* (Bidenco, M. S & Kalininggard, A., Eds) p. 15, VNIRO, Moscow

Bobrovskaya, N.D., Kardashev, A.V. & Vaitman, G.A. (1981) In: *Krill Processing Technology,* (Bykov, V.P., Ed.) p. 16, VNIRO, Moscow

Budzinski, E., Bykowski, P. & Dutkiewitz, D. (1985) *Possibilities of Processing and Marketing of Products Made from Antarctic Krill.* P.46, FAO Fish Technical Paper, 268, Food and Agriculture Organisation of the United Nations, Rome, Italy

Bykov, V.P. (1975) *Biological Value of Antarctic Krill and Possibility of their Utilisation for Human Consumption.,* Proceedings of Oceanology International, p. 361, BPS Exhibitions Ltd

Christians, O., Leinamann, M. & Manthey, M. (1981). *Inf. Fischwirtsch.,* **28**, 70

Conway, E.J. (1947) *Microdiffusion Analysis,* Revised Edition, Van Nostrad Co. Inc., NewYork

Dyer, W. J., French, H.V. & Snow, J.M. (1950) *J. Fish. Res. Bd Can.,* **13**, 129

Joseph, J., Perigreen, P.A. & Thampuran, N. (1984) *Fish. Technol.,* **21**, 70

Muraleedharan, V., Antony, K.P. & Perigreen, P.A. (1997) *Tropical Science,* **3**, 73

Muraleedharan, V. & Gopakumar, K. (1996). FAO Fisheries report No. 563, FIIV/R 563, APFC. Summary report and paper presented at the Tenth session of the Working party on Fish Technology and Marketing, Colombo

Ravishankar, C.N. & Asok Kumar, K. (1998). Studies on Antarctic Krill *Euphasia*

*superba* - Biochemical and Processing Aspects. Paper presented at the Working Group on Ecosystem Monitoring and Management at Cochin, India, 10-20 August 1998, by Commission for the Conservation of Antarctic Marine Living Resources, Australia

Shenoy, A.V., Madhavan, P., Thankamma, R., Prabhu, P.V. & Gopakumar, K. (1983) *Feasibility Report on Production of Fish Wafers,* Central Institute of Fisheries Technology, Cochin

Suzuki, T. (1981) In: *Fish and Krill Protein: Processing Technology,* p. 260, Applied Science Publishers Ltd., London

Yanase, M. (1971) *Bull. Tokai Reg. Fish. Res. Lab.,* **65**, 59