

Quality of Frozen Squid and Cuttlefish of the Export Trade

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Commercial samples of frozen squid (*Loligo* sp.) and cuttlefish (*Sepia* sp.) were evaluated by organoleptic, microbiological and biochemical means. Volatile base nitrogen, trimethylamine nitrogen and indole were below the permitted levels in the samples. They were free from salmonella, *Listeria monocytogenes* and *Vibrio cholerae*. 8.3% of cuttlefish samples contained *V. cholerae* NON 01 type and 10% squid samples had *Vibrio parahaemolyticus*. The incidence of faecal streptococcus was 50% in squid and 58.3% in cuttlefish. Few squid samples had *Escherichia coli*. Coagulase positive staphylococcus was present in most of the samples. Cooked meat was hard to chew. Mercury and zinc in all samples were below the permitted levels. 16% of squid and 8.3% of cuttlefish had higher levels of cadmium. Except 10% cuttlefish, all samples had copper below the permitted level. 10% of squid and 20% of cuttlefish had higher levels of lead.

Key words: Quality, squid, cuttle fish, heavy metals

Export of frozen cephalopods from India was 75654 t worth Rs 5761.7 million in 1996-97 (Anon, 1998). Due to strict quality standards prescribed by the European Union and the introduction of safety oriented quality assurance systems there is an urgent need to ascertain the possible hazards associated with these products. Quality requirements for frozen squid and cuttlefish have been laid down (IS: 8076, 1976). The main problems in cephalopods are pink and yellow discolouration, bruised pieces, deterioration, high bacterial count, presence of pathogenic and indicator organisms and high levels of certain trace metals like cadmium. Presence of coliforms, *Escherichia coli*, faecal streptococci and coagulase positive staphylococci in frozen squid and cuttlefish has been established (Lakshmanan *et. al.*, 1993). Salmonella (Varma *et. al.*, 1985) and *Vibrio cholerae* non-01 (Iyer *et. al.*, 1988) have been reported in few samples of frozen squid and cuttle fish. Lakshmanan (1988) reported mercury and cadmium far below the limits in cleaned squid tubes and cuttlefish fillets. In another study Lakshmanan *et. al.* (1993) reported 90% of commercial samples of squid and cuttlefish as moderately good to excellent based on sensory evaluation and 85% as good based on biochemical indices. The present study aimed at evaluating the quality of squid and cuttlefish of the export trade.

Materials and Methods

Frozen samples of squid (whole, whole cleaned, tubes and rings) and cuttlefish (whole cleaned as block, whole cleaned IQF, fillet and roe) were collected at random

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from different processing factories in Cochin. Approximately 120 g was used for bacteriological analysis and the rest was sealed in plastic pouches and later thawed in running water and used for other studies. Sensory evaluation was made on samples cooked for 5 min in 2 % boiling brine by a panel of five trained members. Texture was measured using a Rheotest Rheometer SD 305 model.

Trimethylamine nitrogen (TMAN) and total volatile base nitrogen (TVBN) were determined by the method of Conway (1962). Indole and trace metals were determined by the AOAC (1975) methods. Total bacterial count, *E. coli*, coagulase positive staphylococcus, salmonella, *Vibrio cholerae*, *Vibrio parahaemolyticus* were determined as per FDA (1978) and *Listeria monocytogenes* by the method of Kenner *et. al.* (1960).

Results and Discussion

Microbiological characteristics of the samples are presented in Table 1. Total bacterial count was in the range 10^4 - 10^7 cfu/g. Nearly 20% of squid and 25% of cuttlefish samples had microbial loads above permissible limits. Cuttlefish fillet and whole cleaned squid were of poor quality in this respect. Among the pathogenic bacteria, salmonella and *L. monocytogenes* were absent in all samples. *V. cholera* NON 01 was present in 25% of whole cleaned cuttlefish, while *V. parahaemolyticus* was detected in two samples of whole cleaned squid. Among the indicator organisms, although *E. coli* was absent in most samples except a few whole and whole cleaned squid, faecal streptococcus was observed in many samples. Only block frozen whole cleaned cuttlefish was free from it. Faecal streptococcus is comparatively resistant to frozen storage (Iyer, 1985). Staphylococcus was present in all samples, squid samples showing higher loads.

Table 1. *Bacteriological characteristics of frozen cephalopods

Product	Total bacterial count/g	Coliforms/g	<i>E. coli</i> /g	Faecal streptococci/g	Staphylococci/g
CF	8.6×10^4 - 8.7×10^5	34 - 76			16 - 106
CI	2.4×10^4 - 3.6×10^5	-		0 - 76	22 - 116
CF	3.0×10^6 - 1.1×10^7	44 - 274		196 - 535	0 - 43
CR	9.0×10^3 - 1.2×10^5	0 - 32			16 - 19
SW	3.0×10^4 - 4.2×10^5	18 - 83	0 - 18	0 - 175	87 - 287
SWC	3.4×10^5 - 1.9×10^6	0 - 140	0 - 12	0 - 55	79 - 220
ST	8.0×10^4 - 2.3×10^5	0 - 40		0 - 10	9 - 163
SR	3.8×10^6 - 4.7×10^7	57 - 732		214 - 907	0 - 133

* See Table 5 for expansion of abbreviations

TVBN, TMAN and indole in the samples are presented in Table 2. Woyewada and Ke (1980) proposed the acceptance limits for these in squid as 30-60 mg TVBN and 3-10 mg TMAN per 100g. All samples contained TVBN, TMAN and indole within acceptable limits indicating no obvious decomposition. However, indole has been shown to be an unreliable indicator of spoilage in seafood (Francis *et. al.*, 1995).

Table 2. TMA, TVBN and indole in frozen cephalopods

Product	TVBN, mg/100g	TMAN, mg/100g	Indole, µg/ 100g
CF	17.43 - 20.19	1.45 - 5.39	0 - 0.1926
CI	6.56 - 14.62	1.15 - 7.14	0.45 - 1.24
CWC	15.55 - 22.03	2.50 - 6.28	0.08 - 2.21
CR	21.96 - 29.05	4.12 - 7.93	0.92 - 2.92
SWC	4.94 - 10.37	1.30 - 5.32	0.58 - 2.18
SW	7.23 - 11.90	2.67 - 5.29	0.16 - 2.06
ST	15.53 - 26.12	1.33 - 6.53	0.25 - 0.85
SR	18.35 - 29.00	3.50 - 9.80	0.58 - 0.90

Organoleptic characteristics of the samples are shown in Tables 3 and 4. Loss of weight on thawing was between 1 and 15%, which is normal for frozen cephalopods. Discolouration was quite common in squid with as much as 43% in whole squid. A fairly high proportion of the samples contained broken pieces and was generally flabby in texture (Table 3). Foreign matter was absent and odour was fair to very good.

Table 3. Physical characteristics of frozen samples

Product	Thaw loss, %	Appearance	Discolouration, %	Deterioration, %	Broken pieces, %	Texture	Odour
CF	10.5 - 14.0	Good - fair	0 - 40	Nil	Nil	Soft, firm	Good
CI	4.1 - 8.7	V. good	-	Nil	Nil	Soft, firm	V. good
CWC	10.1 - 11.3	Good	0 - 14	-	-	Soft, firm	Good
CR	10.0 - 11.2	Fair	8 - 44	Nil	Nil	Soft	Poor
SWC	0.6 - 7.5	Good - fair	0 - 19	0 - 14	0 - 25	Flabby	Good to fair
SW	11.1 - 14.4	Good - fair	17 - 43	0 - 14	0 - 17	Soft, firm	Good to fair
ST	10.4 - 14.2	Good - fair	4 - 14	Nil	0 - 31	Flabby	Fair
SR	5.0 - 7.5	Fair	32 - 44	Nil	8 - 19	Flabby	Fair

Table 4. Organoleptic characteristics of cooked samples

Product	Biting strength, g	Texture	Flavour	Colour
CWC	226 to 528	hard to very hard	Good to Fair	Good
CF	333 to 518	hard to very hard	Good to Fair	Good
CI	249 to 432	hard to very hard	Good to Fair	Good
CR	113 to 332	Soft to hard	Good	Poor
SWC	295 to 432	hard to very hard	Good to Fair	Good
SW	91 to 365	Soft to hard	Good to Fair	Good

Biting strength of cooked samples ranged from 91 to 528 indicating wide variation in quality. Most samples were hard for mastication.

Table 5. Heavy metals in frozen cephalopods (ppm)

Product	Mercury	Cadmium	Copper	Lead	Zinc
CF	0.08-0.13	0.15-0.45	0.348-0.76	0.89-6.2	5.12-11.72
CWC	0.015-0.07	0.45-17.33	0.98-2.64	0.69-5.95	12.85-21.48
CI	0.015-0.14	0.07-0.18	0.61-1.47	1.74-6.34	17.29-23.21
CR	0.019-0.06	0.38-0.88	7.06-14.08	1.12-2.71	1.32-11.62
SWC	0.021-0.07	0.33-0.51	0.59-0.89	0.77-1.24	7.34-10.08
SW	0.049-0.09	0.19-5.14	3.24-9.31	0.31-5.14	1.24- 13.94

CF - Cuttlefish fillet; CI- Cuttlefish, whole cleaned IQF; CWC- Whole cleaned cuttlefish block frozen; CR- Cuttlefish roe; SWC- Squid whole cleaned; SW- Squid whole; ST- Squid tube; SR- Squid rings

Trace metals in the samples are presented in Table 5. Mercury was below the permitted level of 0.5 ppm in all samples. Cadmium was above the permitted limit of 2 ppm in 25% of whole cleaned cuttle fish, whole squid and squid tube. As liver of cephalopods contains high concentration of cadmium, contact with broken liver or its incomplete removal during cleaning may be the cause for its high content in these samples. Lead was present in many samples except whole cleaned squid above the permitted level of 2 ppm. Copper and zinc were below the permitted levels in all samples.

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