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Thermoformed Containers for Packaging and Frozen Storage of Fish (*Scomberomorus guttatus*) Curry

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Seer fish (*Scomberomorus guttatus*) curry was dispensed in 150 to 174 g lots in thermoformed containers of 294 and 328 cm^3 volume made from Polystyrene (PS) and Polyvinyl chloride (PVC) respectively and top of the tray was heat sealed using plain Polyester film laminated with low density polythene. The trays were stored at -20±2°C and the properties of the curry packed in PS and PVC trays were compared. The curry remained in good condition for 26 weeks in these thermoformed containers. Overall migration residues in both the trays studied were within the limits specified by the Bureau of Indian Standards and the U.S. Food and Drug Administration.

Key words : **Fish curry, frozen storage, thermoformed containers, *Scomberomorus guttatus*.**

The fish processing industry in India is mainly export oriented and the major portion of the export is mainly contributed by the block frozen and individually quick frozen shrimp, lobsters, squid and cuttle fish. But in recent years attempts have been made for the diversification of products for export. One such product is fish curry which can be exported in frozen or canned form. But, canned fish curry is not generally relished because of the changes in flavour and texture caused by heat processing (Gopal *et al.*, 1988). Fish curry can be satisfactorily preserved by freezing, but the main problem in this case is the selection of suitable material for packaging (Gopal *et al.*, 1988). It is well known that the major changes that are taking place during frozen storage of the fish curry are desiccation, discolouration and development of rancidity. Conventional packaging materials like flexible plastic films individually are not suitable for these products as they provide little mechanical protection to the product and as a result the product gets damaged or broken during handling and transportation. Hence thermoformed containers which are more rigid can be used for this purpose. Therefore studies were carried out on the suitability of two different synthetic thermoformed containers available in the market and the results are reported in this paper.

Materials and Methods

Fresh seer fish (*Scomberomorus guttatus*) procured from the local market were dressed, cleaned, cut into small pieces (approximate size : 3 x 3 x 1 cm), washed, drained and used for the curry preparation. The ingredients used for the preparatin of curry are given in Table 1. Chopped onion was fried in oil. When half fried, chopped ginger, garlic and green chilli were added and frying was continued to get a slightly brown colour. A fine paste made of chilli powder, coriander and turmeric was added

Table 1. Ingredients for seer fish curry

Cut fish pieces (Seer), kg	2.5
Chilli powder, g	20
Coriander powder, g	20
Turmeric power, g	5
Green chilli, g	20
Ginger, g	20
Garlic, g	10
Onion, g	250
Tomato, g	250
Refined groundnut oil, ml	150
Malabar tamarind, g	40
Table salt	to taste
Water, ml	1000

and fried nearly for one minute. Then sliced tomato, washed tamarind pieces, about 100 ml water and table salt were added and boiled for 3 minutes. Then fish pieces and remaining water were added and boiled for 10 minutes. Salt was added according to taste and allowed to cool. Tamarind pieces were removed and the curry thus prepared was dispensed in 150-170 g lots in thermoformed containers of size 11.4 x 8.6 x 3 cm (294 cm^3) and 11.9 x 8.9 x 3.1 cm (328 cm^3) made from Polystyrene (PS) and Polyvinyl chloride (PVC), respectively (Manufacturers: M/s Package India, Madras, India). The top of the trays were sealed with plain polyester film laminated with polythene using Blister sealing machine for High Impact Polystyrene trays. The trays were kept in frozen storage, maintained at -20±2°C. The suitability of thermoformed containers for food contact application as indicated by heptane and water extractives were determined by the methods of BIS (1981) and FDA (1983). Frozen samples were thawed under running water. The proximate composition of fish curry and other analyses were done after mixing three packets of fish curry samples (both fish pieces and curry medium) to get a composite uniform sample. About 10 g fish pieces along with curry were made into a paste with 20 ml water by thoroughly grinding in a waring blender for determining the pH. The thawed curry was warmed to 42-45°C in a water bath and served to the taste panel. Organoleptic assessment was made by a trained laboratory taste panel consisting of 12 members. The overall acceptability was rated on a hedonic scale ranging from 9 to 1, the acceptability limit being taken as 4 (Amerine *et al.*, 1965). The peroxide value (PV) was determined by AOAC (1975) method after wiping off the adhering substances from the fish muscle with filter paper. Free fatty (FFA) acid estimation was done as per AOCS (1989). Total volatile nitrogen (TVN) was determined from the trichloroacetic acid (10%) extract of the fish muscle by the microdiffusion method (Conway, 1947). About 10 g of the frozen curry sample was aseptically scooped out from the surface and used for the determination of total bacterial count, faecal streptococci, *Escherichia coli* and staphylococci. Total bacterial count, faecal streptococci, *E. coli* and coagulase positive staphylococci were determined as per Indian Standards specification for frozen prawns (BIS 1985).

Results and Discussion

The proximate composition of seer fish muscle and seer fish curry are presented in Table 2. The organoleptic and chemical changes during storage are presented in Table 3. It is evident from the sensory score that the samples packed in PS and PVC thermoformed containers had almost the same sensory characteristics. Even after 26 weeks storage the frozen curry samples were in acceptable condition and no rancid odour was noticed. There was a slight decrease in pH after 4 weeks of storage in the containers. But the pH remained more or less same even after 26 weeks storage. These slight changes in pH did not affect the quality of the product. The increase of free

Table 2. Proximate composition of seer fish muscle (raw) & fish curry

	Raw fish muscle	Fish curry including curry medium
Moisture, %	75.11	77.22
Protein, %	21.56	15.38
Fat, %	2.24	2.80
Ash, %	1.40	2.39

fatty acids was more or less same in PS and PVC containers after 26 weeks storage (2.04 and 2.01%, respectively). The peroxide values after 26 weeks storage were only 8.6 and 7.75 meq kg^{-1} of fat in PS and PVC containers, respectively. The panel did not find any difference among the products packed in PS and PVC. No rancidity was reported in any of the samples. This may be attributed to the spices used in the curry which are reported to possess anti-oxidant properties (Harper *et al.*, 1969; Hudson & Lewis, 1983 and Joseph *et al.*, 1992). The TVN values remained almost steady with only a slight increase during 26 weeks of storage in both the containers.

The average water extractives of PS and PVC containers were found to be 0.65 and 0.25 mg l^{-1} respectively, when water extraction experiments were carried out at 40°C for 24 h. The average heptane extractives of PVC container was 5.95 mg l^{-1} at 25°C for 30 min. In case of PS there was a penetration of heptane solvent into the material and consequent swelling of polystyrene indicating the need for specific migration experiments. However, the thermoformed containers with water extraction studies revealed the extraction limits to be below the specified limit prescribed by BIS (1981) and FDA (1983) for food contact application.

The bacteriological characteristics of fish curry during frozen storage are presented in Table 4. There was a reduction in the total bacterial count during frozen storage. This is attributed to the destruction of bacteria at low temperature (Calcott, 1978; Ingram & Mackey, 1986). *E. coli* and coagulase positive staphylococci were not detected in curry samples. Faecal streptococci presnt in small numbers initially were fully eliminated after 14 weeks frozen storage.

The results indicate that the thermoformed containers made of PVC and PS are suitable for packing frozen fish curry for a minimum period of 26 weeks at -20±2°C.

Table 3. Organoleptic and chemical changes of seer fish curry on storage

Storage period, weeks	Sensory score		pH		FFA, % oleic acid		PV, meq kg^{-1} of fat		TVN, mg%	
	PS	PVC	PS	PVC	PS	PVC	PS	PVC	PS	PVC
Initial	8.0	8.0	5.52	5.52	0.33	0.33	Nil	Nil	12.95	12.95
4	7.0	7.0	5.13	5.40	0.43	0.35	1.44	2.31	13.54	14.26
10	7.0	7.0	5.05	5.24	0/51	0.85	6.04	13.64	14.65	14.25
14	5.5	6.0	5.62	5.32	1.23	1.32	3.63	4.35	16.17	14.89
18	5.5	5.5	5.48	5.48	0.90	0.49	8.17	5.03	16.84	17.48
20	5.5	5.0	5.36	5.47	2.04	1.86	7.37	7.70	16.94	17.25
26	5.5	5.5	5.58	5.51	2.40	2.07	8.60	7.75	16.25	17.89

PS - Polystyrene; PVC - Polyvinyl chloride

Table 4. Bacteriological characteristics of fish curry during frozen storage

Storage period, weeks	Total bacterial count g^{-1}		Faecal streptococci g^{-1}	
	PS	PVC	PS	PVC
Initial	13000	13000	158	158
4	1200	3100	50	ND
14	48	34	ND	ND
18	20	24	ND	ND
20	20	15	ND	ND
26	20	10	ND	ND

PS - Polystyrene; PVC - Polyvinyl chloride;
ND - Not detected

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