Environment & Ecology 29 (3A) : 1440—1443, 2011
 ISSN 0970-0420

Thermal Processing of Tuna in Curry Packed in Tin Free Steel Can

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Abstract

Tin-free-steel can is ideal alternative to tin container for thermal processing of little tuna (*Euthynnus affinis*) in curry. Effect of heat penetration on physical, biochemical and sensory characteristics of canned tuna was studied. The obtained F_0 value of tuna curry packed in tin free steel can was 10 minutes when retorted at 115 C for 70 minutes. The heating rate index (f_h) value of canned tuna curry was 15 minutes exhibited an inverse relationship with temperature of processing. The cook value was inversely proportional to f_h value, the biochemical characteristics of tuna in curry TVB-N, TMA-N and FFA was found to be increasing and TBA value was found to be decreasing during storage of 5 months in the product. Protein content of pre-cooked tuna was more than the fresh raw tuna due to relative decrease in concentration of moisture. The product was well accepted in sensory test conducted by trained panelists even after of 5 months of storage studies at room temperature.

Key words : Tin free steel can, Curry, Temperature, Storage.

Consumption of seafood has increased over the last decade because of its high nutrient content present in the seafood. Among the seafood, tuna is popularly known as marine beef. Tuna meat is rich in high quality and good biological value protein, richer than beef or chicken and also one of the best sources of essential amino acids. Tuna flesh contains substantial amount of vitamins namely B12, A and D (1). Thermal processed foods are ready to serve or ready to eat foods, which are normally packed in airtight containers. This offers one of the best solutions to the problems of long term preservation of foods. Hence, present day canned foods are gaining importance and acceptance among consumers in India.

One of the recent developments in rigid containers is TFS (tin-free-steel) cans, with chromium coating and is manufactured with easy open ends and is coated inside with polymer which does not react with product. Naresh et al. (2) have mentioned on the chromium coated steel plate as an alternative to tinplate for canning of seafood products. Polymer coated TFS cans is now available in India. Market for processed food in India has been growing at greater rate partly due to change in life style and food habits of the people. Attempts have been made to use of curry as filling media for canned fish.

In the present work an attempt was made to utilize the tuna fish with curry in a better way by processing it into more valuable canned products. In India tuna fish contributes about 4-5% of the total marine catch among this little tuna (*Euthynnus affinis*) has got a first place in tuna production. Value addition is still low in fishery product, this study is one of the possible approaches to raise the profitability of fish processing industry in India.

(The authors are grateful to the Central Institute of Fishery Technology, Cochin, India for giving the opportunity to carry out the heat penetration studies at their Institute).

Table 1. Standardized tuna curry recipe.

Ingredients	Quantity (g)
Dressed fish	1000
Onion	50
Garlic	15
Ginger	25
Coriander powder	30
Chilli powder	60
Turmeric powder	4
Mustard	2
Oil	50
Salt	20
Cumin	4
Pepper	4
Tomato	150
Water	1000 ml

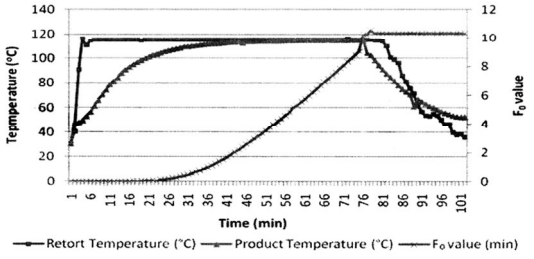

Figure 1. Heat penetration characteristics with respect to F_0 value of canned tuna in curry in TFS can.

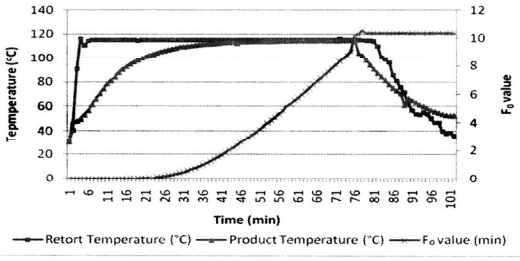

Figure 2. Heat penetration characteristics with respect to cook value of canned tuna in curry in TFS can.

Methods

Fresh little tuna (*Euthynus affinis*) procured from Mangalore fish landing center was used for canned product preparation. The proximate composition and freshness characteristics of raw tuna fish were analyzed. Round open top cylindrical internally quoted with sulfur resistant lacquer 8 oz (305 × 206) TFS cans manufactured and supplied by M/s Poysha Industries Ltd., Mysore, India. The time temperature measurement during sterilization process was carried out using an Ellab - CTF - 84 data recorder with printer. Standard thermocouple probes are Ellab SSA-120500-G-700-TS stainless steel electrode was used.

Methods of Chemical Analysis

Moisture, protein and ash content of the samples were determined by following the method of AOAC (3). The total lipid from the fish meat sample was extracted according to the procedure of Bligh and Dyer (4). The pH of the sample was measured by the method described by Suzuki (5). Estimation of TVB-N and TMA-N by the procedure of Beatty and Gibbons (6) using conway's microdiffusion technique. The free fatty acid (FFA) content in the lipid extract was determined by the improved titrimetric method of Ke et al. (7) and determination of TBA value by Tarladgis et al. (8).

Table 2. Biochemical, microbiological and sensory characteristics of raw tuna.

Biochemical characteristics		Sensory characteristics	
Parameters	Fresh raw material	Sample characteristics	Score (out of 10)
TVBN (mg %)	6.10	Appearance	8.9
TMAN (mg %)	2.5	Colour	8.5
pH	6.02	Taste	8.65
Free fatty acid value (% of oleic acid)	3.5	Texture	8.25
TBA mg (melonaldehyde/kg)	0.10	Odour	8.75
Total plate count (cfu/g of meat)	4.45×10^4	Overall acceptability	8.50

Curry Preparation

Three different types of curry recipe were prepared and analyzed by a trained sensory panel of ten judges. As per the taste panel's opinion, one recipe was selected and the standardized recipe is given in the Table 1. For curry recipe preparation, chopped onion was fried in oil (175—185 C) till it became light brown in color. Curry powder and turmeric powder were gently warmed and blended with water for 1—2 minutes. The fried onion was added to the blended mixture and heating (100 C) continued for 2—3 minutes. At this stage chopped tomato was added and heated again for 10 minutes. Potable water was added and the total medium was boiled for 8—10 minutes to get the required consistency.

Final Product Preparation and Standardization of Thermal Processing

Fresh raw tuna was dressed, cleaned and pre-

Table 3. Proximate composition of raw and precooked tuna.

Parameters (%)	Raw tuna meat	Precooked tuna
Moisture	73.10	69.98
Protein	24.20	27.12
Fat	1.37	1.50
Ash	1.43	1.40

Table 4. Changes in proximate composition during storage of canned tuna in curry packed in TFS and tin can.

Parameter (%)	Months 0	1	2	3	4	5
Moisture	72.39	73.01	72.35	73.01	72.15	72.90
Protein	24.29	24.30	24.10	24.35	24.92	24.10
Fat	1.50	1.49	1.91	1.41	1.30	1.46
Ash	1.82	1.20	1.65	1.33	1.23	1.54

cooked at 115 C for 1 hour at 10 psi pressure. Precooked tuna kept in a refrigerated temperature overnight for dark meat separation. Light meat tuna loins cut into 2.5 cm long pieces for can fill and standardized curry is used as filling media with net weight of 170 grams packed in TFS can and closed by automatic exhausting and seaming operation. Exhausted cans were retorted at 115 C for 70 minutes at 10 psi pressure, after thermal process, cans were cooled in running water. During cooling center canned temperature reaches up to 50C then dried under fan and stored in dry place for 5 months of storage studies. The results of the heat penetration study such as retort temperature, product temperature, F_0 value and cook value were recorded at an interval of 1 minute. The heat penetration profile of these parameters are presented in the Figures A and B.

Results and Discussion

The freshness characteristics and proximate composition of fresh tuna meat infer that the selected raw material was within the prescribed limits and are given in the Table 2. The yield of precooked fish was 50.36% of whole fresh tuna. In precooked tuna, moisture content decreased to 69.98% and protein increases to 27.12%. Proximate composition of raw and precooked tuna are given in the Table 3.

Heat Penetration Characteristics of Canned Tuna

Effect of heat processing in canned food is scientifically evaluated. Conducting heat penetration tests by recording temperature reached at the cold spot during processing and thereby calculating the total sterilizing effect as F_0 value of the process. This is an essential step in the establishment of safety and

Table 5. Changes in the TVB-N, TMA-N, FFA, TBA and pH of canned tuna curry product.

Parameter	Months 0	1	2	3	4	5
TVB-N (%)	21.80	20.7	22.4	25.2	25.7	27.3
TMA-N (%)	7.26	8.4	9.0	10.2	11.6	12.3
FFA % as oleic acid	3.07	3.69	4.15	4.68	4.98	6.50
TBA mg of melonoldehyde/kg of sample	0.315	0.291	0.275	0.253	0.235	0.239
pH	5.98	5.65	5.63	5.54	5.37	5.38

sterility for canned products. The recommended F_0 value for fishery products ranged from 5—10 which is given by Frott and Lewis (9). In this study, received F_0 value of canned product was 10 minutes which is in close agreement with F_0 value of tuna in oil, packed in aluminum cans by Ali et al. (10). Heating rate index is one of the primary output of the heat penetration test. The fh value is used to compare the rate of heat penetration, higher the fh value slower is the heat penetration in canned tuna products was recorded. Cook value is the measure of heat treatment with respect to nutrient degradation and textural changes occur during processing. Cook value of canned tuna in curry was 145.5 minutes which is higher due to longer process time given to curry pack to inactivate the thermophilic bacteria present in the spices used as curry ingredients. The obtained fh value was 25 minutes which is similar to the fh value reported in squid masala in TFS can by Sreenath et al. (11).

Quality Characteristics of Canned Tuna After Processing and During Storage Period

Among the proximate composition of canned tuna, protein has slightly increases after thermal processing. This might be due various nitrogen compounds present in ingredients of curry. The proximate composition of canned tuna curry given in Table 4. The volatile base nitrogen (TVB-N) and Trimethylamine nitrogen (TMA-N) gradually increased in all products. The TVB-N and TMA-N content of canned

tuna were 21.8 mg% and 7.26 mg% respectively during initial stage which found to be increased to 27.3 mg% and 12.3 mg% respectively at the end of storage period. This increase could be due to the breakdown of proteins, amino acids and other nitrogenous compounds like trimethylamine oxide, nucleic acids and amines present in the foods which received thermal processing thid is reported by Chia et al. (12). Steady increase in FFA content was observed in the canned tuna during storage. This is mainly due to increased lipid hydrolysis at elevated temperature of processing. Several authors opine that heat processing in general increases FFA content on storage. These results are similar to those obtained by Medina et al. (13). TBA value an index of secondary lipid oxidation. TBA value of freshly prepared tuna product was found to be decreased at the end of storage period. Aubourg et al. (14) have suggested that decrease in TBA value of canned fish meat might be due to dilution of secondary oxidation product by the fill oils or their extraction from the meat to the fill oils. However in case of canned tuna product, decrease trend in TBA content might be due to the dilution of secondary oxidation product by curry recipe used as filling medium. In canned tuna product observed that pH decreased slightly from 5.91 to 5.74 at the end of storage period. This decrease trend could be due to acidic compounds present in tomato, tamarind and spices used as ingredients for recipe preparation. Biochemical characteristics of canned tuna are presented in Table 5.

Sensory Analysis

At each sampling during storage studies, the product was presented to panelists to evaluate the quality of canned tuna characteristics organoleptically. Even after 5 months of storage, oganoleptic characteristics of tuna curry product was acceptable by the panel of 10 judges and stability of the product was also good.

Conclusion

Based on heat penetration study, F_0 value 10 for canned tuna curry packed in TFS can was satisfactory. Sensory and biochemical parameters of tuna curry during storage studies were acceptable. With this, fish canning industry may look forward to use TFS cans for reviving canning industry in India. Also, it may increase the demand for ready to serve canned tuna in curry products with the developments of diversified can products for domestic market.

References

1. Dewberry E. B. 1969. Tuna canning in the United States. *Food Trade Rev.* 39 : 37—42.
2. Naresh R., M. Mahadeviah, R. V. Gowramma and B. A. Swamy. 1989. Chromium coated steel as an alternative to tin plate for canning food products. *J. Food Sci Technol.* 17 : 283—286.
3. AOAC. 2000. *Official methods of analysis of association of official analytical chemists*. Maryland, USA.
4. Bligh E. G. and W. J. Dyer. 1959. A rapid method of lipid extraction and purification, *Can. J. Biochem. Physiol.* 37 : 911—917.
5. Suzuki T. 1981. Kamaboko (fish cake). Pp. 62—112. *In Fish and krill protein processing technology*. Appl. Sci. Publ. Ltd., London, UK.
6. Beatty S. A. and N. E. Gibbons. 1937. The measurement of spoilage in fish. *J. Biol. Bd. Can.* 3 : 77—91.
7. Ke P. J., A. D. Woyewoda, L. W. Regir and R. G. Ackman. 1976. Env. Canada Fish Marine Serv. Tech Branch Malifare new series circular No. 61. 1—6 pp.
8. Tarladgis B. G., B. M. Watts and M. T. Youtham. 1960. A distillation method for the quantitative determination of melanaldhyde in rancid foods. *J. Am. Oil Chemists Soc.* 37 : 44.
9. Frott R. and A. S. Lewis. 1994. *Canning of meat and fish products*. Chapman Hall, UK. 202 pp.
10. Ali A. A., B. Sudhir and T. K. S. Gopal. 2005. Effect of heat processing on the texture profile of canned and retort pouch packed oil sardine (*Sardinella longiceps*) in oil medium. *J. Food Sci.* 70 : 350—351.
11. Sreenath P. G., Subhasis Sil, K. A. Martin Xavier, C. N. Ravishankar, J. Bindu and T. K. Srinivasa Gopal. 2005. *The 7th Indian Fisheries Forum proceedings*. AFSIB Mangalore, ICAR, UAS (B), KVAFSU (B) and FFT (B) India. 274—281 pp.
12. Chia S. S., R. C. Baker and J. H. Hotchikiss. 1983. Quality comparison of the thermoprocessed fishery products in cans and retortable pouches. *J. Food Sci.* 48 : 1521—1525, 1531.
13. Medina I., R. Sacchi and S. Aubourg. 1995. NMR study of lpid alterations during fish canning : effect of filling medium. *J. Sci. F. & Agric.* 69 : 445—450.
14. Aubourg S., I. Madiana and R. Perez- Martin. 1995. A comparison between conventional and fluorescence detection methods of cooking-induced damage to tuna fish lipids. *Zeitschrift fur Lebensmittel Unteruuchung und Forschung* 200 : 252—255.