

Quality changes in smoked *Colisa fasciata* from the markets of Manipur during storage

M. Karthikeyan*, B. Dhar, B. Kakati, A. Hassan and S. Das

Department of Fish Nutrition and Food Technology, College of Fisheries
Central Agricultural University, Lembucherra, Tripura, India - 799 210

The traditional smoking process adopted in the state of Manipur, is different from the smoking process adopted else where in the world. Fishes are not salted during the entire smoking process. Smoked fish *Colisa fasciata* obtained from the market were packed in low density polyethylene pouches (200 gauge thick) and evaluated for its quality during storage. The product had a moisture content of 9.77 %, which showed an increase ($p < 0.05$) during storage whereas the crude protein and fat decreased ($p < 0.01$) during storage. The total volatile base nitrogen and alpha amino nitrogen showed an increase ($p < 0.01$) during storage indicating protein changes which is further confirmed by an increase in non protein nitrogen ($p < 0.05$) and decrease in salt soluble nitrogen ($p < 0.05$). The peroxide value and free fatty acid value increased during the storage period confirming fat degradation. The yeast and mould counts were minimal during storage but the visible fungal colonies increased during later periods of storage. The fresh smoked fish had a crispy texture, golden yellow colour and high smoky odour and the sensory quality showed a decline during storage. The product kept well up to 120 days under ambient storage conditions ($30 \pm 2^\circ\text{C}$).

Key words : fresh water fish, *Colisa fasciata*, smoke curing, proximate composition, quality, shelf life

Smoke curing is an age old practise of preserving foods. Smoking of fish is practised in many parts of the world for long term storage. Smoking of fish not only preserve it, but also to impart a pleasant mild smoky flavour. Today, the former is common in less developed countries (Gopakumar, 2002). The preservative effect is due to deposition of formaldehyde, phenol and other substances on fish evolved from wood smoke during smoking (Stansby, 1963). According to Horner (1992) the shelf life extension of smoked fish can be from the combination of lowered water activity and the uptake by the product of bactericidal and antioxidant components of wood smoke. The

effects of treatment with salt and other preservatives (vinegar, BHT, BHA, citric acid, potassium sorbate etc.), smoking and the use of packaging on the quality of smoked fish were reported by Eyabi & Eyabi (1988).

Small sized trash fishes are not readily acceptable to consumers because of low meat yield, bony nature and poor taste. However smoked fresh water carps, minnows, barbs etc., are very popular and widely consumed in Manipur (Lilabati & Vishwanath, 2001). The fish thus processed is consumed after frying or roasting or as an ingredient in vegetable curry preparation in order to add flavour and taste

*Corresponding author: Dr. M. Karthikeyan, Assistant Professor College of Fisheries Lembucherra, Tripura - 799 210; E-mail: karthim@rediffmail.com

(Singh *et. al.*, 1990). Though there are reports on smoke curing from India as well as from abroad (Chandrasekhar *et. al.*, 1979; Motohiro, 1988), the age old technique adopted in Manipur is different, as salting is not involved in the processing (Lilabati & Vishwanath, 2001). The smoked fishes are stored in small boxes made of thin split bamboo which is called 'Ngarubak' in Manipuri. As micro organisms usually grow on nutrients rich organic substances, there is a possibility of contamination of such organisms in fish samples during storage which can cause health hazards to consumers.

Colisa fasciata is a small indigenous fresh water fish, commonly available in smoked form in Manipur markets. The determination of biochemical and microbiological quality of such processed fish from the markets as well as the changes in the quality during storage is essential for adopting better hygienic practices and safeguarding consumer's health. In the present study, an attempt was made to evaluate the quality of smoked *Colisa fasciata* available in different fish markets of Manipur and to determine the quality changes and shelf life of this smoked fish during storage in low density polyethylene (LDPE) pouches.

Materials and Methods:

Fresh *Colisa fasciata* (length 7-10 cm, weight ranging from 10 to 15 g), available in markets of Manipur were brought in insulated container to the laboratory in iced condition (1:1 ice to fish) for analysis.

The freshly smoked *Colisa fasciata* samples were collected from different fish sellers of Manipur fish markets. They were brought to the laboratory in aseptic condition, packed in low density polyethylene pouches (thickness: 200 gauge) and stored under ambient conditions ($30 \pm 2^\circ\text{C}$). The product was analysed periodically to evaluate the quality as well as to establish the shelf life during storage. The analysis was done

in triplicate.

Smoking process adopted in Manipur is as follows: The small indigenous fish species after thorough washing are spread on a wire tray and then exposed to flame briefly to burn the skin. The process was repeated after turning the fishes upside down. The fishes are smoked by exposing it to smoke from burning saw dust and paddy husk from a distance of about 30 cm below for 2 to 3 hours at 70 to 80°C (Singh *et. al.*, 1990). The fish after smoking were spread in bamboo mats and dried under sunlight so as to reduce the moisture content before storage.

The proximate composition, salt soluble nitrogen (SSN) and non-protein nitrogen (NPN) of the smoked fish was determined according to the method as described by AOAC, 2000. The total volatile base nitrogen (TVB-N) was estimated by Conway's micro diffusion method (Conway, 1947) and alpha amino nitrogen (AAN) was determined by the method described by Pope & Stevens (1939). The peroxide values (PV) of the samples were determined by the method of Jacobs (1958). The free fatty acid (FFA) was determined according to the method as described by Namboodiri (1985). To determine pH, 5 g of sample was mixed well with 45 ml of distilled water and pH measured using a pH meter (Sartorius Make).

The microbial quality of the smoked fish product was determined by following standard methods outlined in USFDA (2001) and APHA (1976). Sensory evaluation of the smoked fish product was done for colour, texture and odour of the fish. The colour was recorded based on visual observation, texture by applying pressure by finger tips and odour on a three point hedonic scale as good, medium and poor based on the method as described by Lilabati *et. al.* (1999). The statistical analysis of the data was done following Snedecor & Cochran (1967).

Results and Discussion:

The quality of fresh *Colisa fasciata* was evaluated. The biochemical quality of fresh *Colisa fasciata* is given in Table 1. The fresh fish had 63.02% moisture, 23.72% protein, 8.00% fat, and 4.96% ash. The fish had high SSN content whereas the NPN content was low. The TVB-N and AAN values were also found within acceptable limit i.e. 1.65 mg % and 30.31 mg % respectively. The pH value of the fish was 7.15.

Table 1: The biochemical composition of fresh *Colisa fasciata*

Parameters	Values
Moisture (%)	63.02 ± 1.26
Crude Protein (g % wet wt basis)	23.72 ± 1.18
Crude fat (g % wet wt basis)	8.00 ± 1.38
Ash (g % wet wt basis)	4.96 ± 0.57
Salt Soluble Nitrogen (% of Total Nitrogen)	67.45 ± 2.05
Non Protein Nitrogen (g %)	0.49 ± 0.10
Total Volatile Base Nitrogen (mg %)	1.65 ± 0.29
Alpha Amino Nitrogen (mg %)	30.31 ± 3.26
Free Fatty Acid (% as Oleic acid)	29.40 ± 3.09
pH	7.15 ± 0.02

All values are mean ± standard deviation of three determinations

Table 2: Changes in proximate composition of smoked *Colisa fasciata* during storage at ambient temperature

Storage days	Moisture (%)	Crude Protein (g % wet wt basis)	Crude Fat (g % wet wt basis)	Ash (g % wet wt basis)
0	9.77 ± 0.26	67.67 ± 0.50	10.02 ± 0.57	13.53 ± 0.84
30	11.34 ± 0.87	65.85 ± 1.11	9.21 ± 0.79	12.89 ± 0.65
60	11.38 ± 0.26	65.28 ± 0.60	8.68 ± 0.30	12.81 ± 0.35
90	11.79 ± 0.62	64.16 ± 1.27	8.43 ± 0.82	12.71 ± 0.58
120	11.88 ± 0.90	62.06 ± 0.99	7.72 ± 0.47	12.83 ± 0.69
150	11.96 ± 1.02	61.62 ± 0.63	6.91 ± 0.19	12.39 ± 0.46

All values are mean ± standard deviation of three determinations

The changes in proximate composition of smoked *Colisa fasciata* during storage are given in Table 2. The smoked fish had a moisture content of 9.77% which increased significantly during storage. The moisture plays an important role in the spoilage of fish and lowering of moisture retards the spoilage (Stansby, 1963). The crude protein, crude fat and ash content of the smoked fish were found to decrease

significantly during storage. The decrease in protein content might be attributed to the denaturation of protein during storage lead by various factors and decrease in fat content might be attributed to the oxidative and hydrolytic rancidity of fat during storage.

The smoked fish product was evaluated for its biochemical quality during storage. The salt soluble nitrogen as percentage of total nitrogen of the smoked fish was found to be 14.99 and it decreased significantly during storage. This decreasing trend of SSN values might be attributed to denaturation of protein during smoking. This was further confirmed by a significant increase in non protein nitrogen content (Fig 1). The total volatile base nitrogen

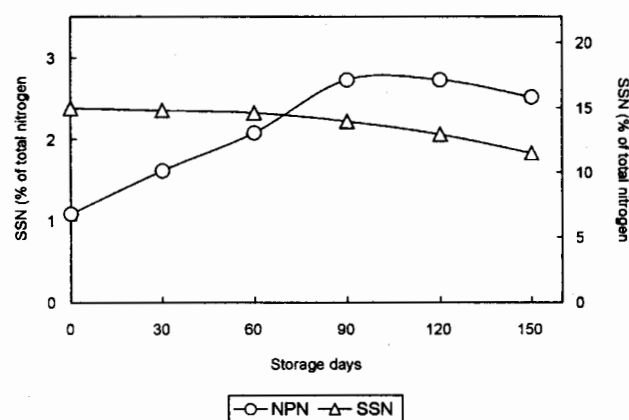


Fig. 1. Changes in salt soluble nitrogen (SSN) and non protein nitrogen (NPN) of smoked *Colisa fasciata* during storage

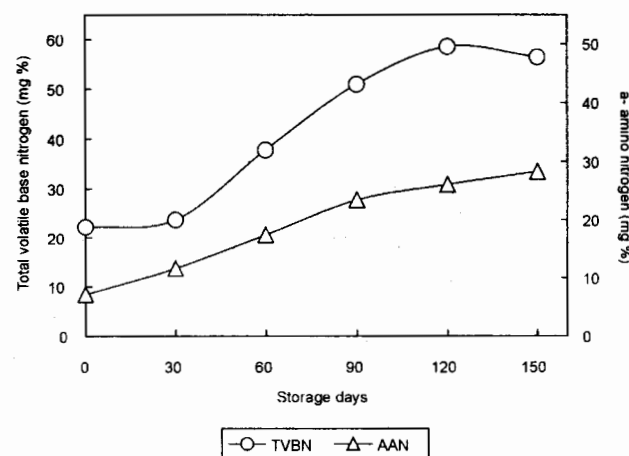


Fig. 2. Changes in total volatile base nitrogen and alpha amino nitrogen of smoked *Colisa fasciata* during storage

(TVB-N) and alpha amino nitrogen (AAN) of the smoked fish increased during storage (Fig 2). The TVB-N values were in the range of 22.2 to 56.46 mg% during storage. Lilabati & Vishwanath (2001) reported that the TVB-N value in the range of 40 to 60 mg% in case of *Puntius sophore* obtained from Manipur markets. This high value of TVB-N after smoking might be due to the subsequent microbiological and biochemical changes in the fish muscle during smoking (Lilabati & Vishwanath, 2001). TVB-N does not affect the organoleptic qualities of smoked samples. The increase in alpha amino nitrogen might be attributed to the hydrolysis of proteins during storage of the smoked fish samples (Lilabati & Vishwanath, 2000). The changes in peroxide value (PV) and free fatty acid (FFA) of smoked fish are given in figure 3. The peroxide value increased up to 90 days of storage and decreased during further storage period whereas the free fatty acid value showed an increasing trend up to 120 days. The increase in peroxide value and free fatty acid content of the smoked fish may be attributed to the degradation of fat during storage.

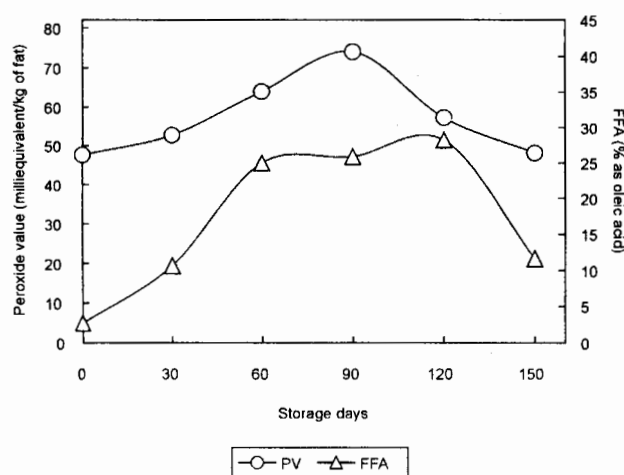


Fig. 3. Changes in peroxide value and free fatty acid of smoked *Colisa fasciata* during storage

The pH value showed that the product was in the slightly acidic range and the pH decreased during initial periods of storage

(Fig. 4). Lower pH values in smoked fish might be due to the effect of phenolic/acidic constituents deposited on the fish muscle during smoking (Joseph *et al.*, 1987). The smoked compounds reduce the surface pH and thereby make the smoked fish a less favourable environment for most bacteria.

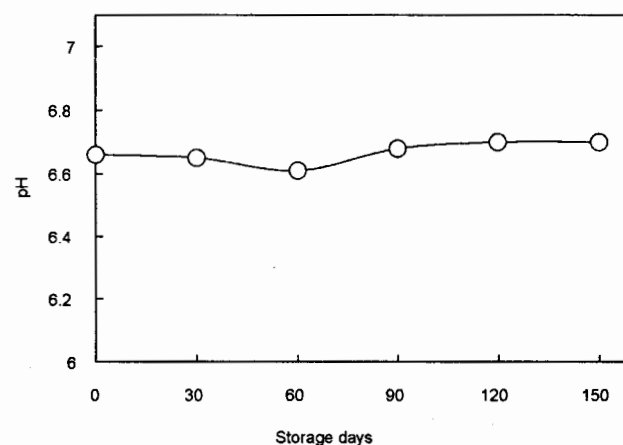


Fig. 4. Changes in pH of smoked *Colisa fasciata* during storage

The microbiological quality of smoked *Colisa fasciata* and the changes during storage are given in Table 3. Smoking of fish is reported to impart a degree of microbiological stability to the product which is a function of reduced water activity, heating and smoking (Eklund *et al.*, 1988). Smoking in Manipur does not involve salting and this might be the reason for higher microbial count. The total plate count (TPC) of the sample showed no significant change during storage. In general, TPC are high in smoked fishes of high moisture level (Lilabati & Vishwanath, 2000).

Table 3. Changes in microbiological quality of *Colisa fasciata* during storage at ambient temperature

Storage days	TPC (log cfu/g)	<i>E. coli</i> (cfu/g)	Moulds & Yeast (log cfu/g)	Visible fungal colonies	<i>Vibrio cholerae</i>	<i>Salmonella</i> spp.
0	5.041	<10	2.398	-	Absent	Absent
30	5.491	<10	2.799	-	Absent	Absent
60	5.415	<10	1.301	-	Absent	Absent
90	5.653	<10	1.602	-	Absent	Absent
120	5.672	<10	1.398	+	Absent	Absent
150	6.041	<10	1.477	+	Absent	Absent

- No colonies; + Few scattered colonies

Traditional smoked fishes are generally of variable quality and sometimes of poor quality, essentially manifested by mould growth a few days on storage. Mould growth affects not only acceptability, but also chemical and nutritional quality (Frazier & Westhoff, 1978). The moulds and yeasts showed a slight decrease during storage and the visible fungal colonies started appearing after 120 days of storage. The count of *E. coli* was found to be minimal during storage whereas human pathogens like *Salmonella spp* and *Vibrio cholerae* were absent during the entire period of storage.

Table 4. Changes in sensory quality of smoked *Colisa fasciata*, during storage under ambient conditions

Storage days	Texture	Colour	Smoky odour
0	Crisp	Golden yellow	High
30	Crisp	Blackish yellow	High
60	Crisp	Blackish yellow	Medium
90	Crisp	Blackish yellow	Medium
120	Crisp	Blackish yellow	Medium
150	Soft	Black	Low

The changes in sensory quality of the smoked *Colisa fasciata* are given in Table 4. The fresh smoked fish had a crispy texture, golden yellow colour and high smoky flavour which was highly acceptable. The sensory quality of the fish decreased with storage and after 150 days of storage, the product had a soft texture, black colour and low smoky flavour. The changes in the sensory quality might be attributed to the increase in moisture and changes in the biochemical and microbiological quality of the product during storage.

The present study revealed that the smoked fish is nutritious with high protein and mineral content. The quality of smoked fish stored in LDPE bags decrease with period of storage. The product had a better acceptability shelf life up to 120 days of storage.

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References

- AOAC. (2000). *Official Methods of Analysis*. 17th edn. Association of Official Analytical Chemists, Washington, DC, USA.
- APHA. (1976). *Compendium of methods for the Microbiological Examination of Foods* (Speak. M.L. ed.) American Public Health Association. Inc., New York.
- Chandrasekhar, T.C., Rudrasetty, T.M. and Udupa, K.S. (1979). *Fish. Technol.*, **16**, pp 47-48.
- Conway, E.J. (1947). *Micro diffusion Analysis and Volumetric Error*, Crossby, Lockwood & Sons, London
- Eklund, M.W., Peterson, M.E., Parajpye, R. and Pelroy, G.A. (1988). *J. Food Prot.*, **51**, 720p.
- Eyabi, J.E. and Eyabi, G.D. (1988). *Quality changes during the storage of hot smoked mackerel: Proceedings of FAO Expert Consultation on fish Technology in Africa*. FAO Fisheries Report. No:400.
- Frazier, W.C. and Westhoff, D.C. (1978). *Food Microbiology*, Tata McGraw Hill Publ. Co. Ltd., New Delhi.
- Gopakumar, K. (2002). Smoked and Marinated Fishery Products. In: *Textbook of fish Processing Technology* (Gopakumar, K. Ed), Indian Council of Agricultural Research (India), New Delhi, pp174-175.
- Horner, W.F.A. (1992). Preservation of fish by curing: In: *Fish Processing Technology* London, Chapman and Hall.
- Jacobs, M.B. (1958). *The chemical analysis of foods and food products*. New York Krieger Publishing Co. Inc. pp393-394.
- Joseph, A.C., Prabhu, P.V. and Balachandran, K.K. (1987). *Fish. Technol.*, **24**, 96p.

- Lilabati, H., Vishwanath, W. and Singh, M.S. (1999). Changes in bacterial and fungal quality during storage of smoked *Esomus danricus* of Manipur. *Fish. Technol.* **36**(1), pp36-39.
- Lilabati, H. and Vishwanath, W. (2000). Biochemical, nutritional and microbiological quality of six species of smoked fishes from Manipur. *Fish. Technol.* **37**(2), pp89-94.
- Lilabati, H. and Vishwanath, W. (2001). Biochemical and Microbiological changes during storage of smoked *Puntius sophore* obtained from market. *J. Food Sci. Technol.* **38**(3), pp 281-282.
- Motohiro, T. (1988). *Fish smoking and drying*, (Burt, J.D. Ed.), Elsevier Applied Sciences, London & New York, 91p.
- Nambudiri, D.D. (1985). *Analytical Manual of Fish and Fishery Products*. Directorate of Extension, Kerala Agril. University.
- Pope, C.G. and Stevens, M.F. (1939). The determination of amines nitrogen using a copper method, *J. Biochem*, **33**, pp1070-1077.
- Singh, M.B., Sarojnalini, C. and Vishwanath, W. (1990). Nutritive value of sun dried *Esomus danricus* and smoked *Lipidocephalus guntea*. *Food Chem.* **36**, pp 86-89.
- Snedecor, G.W., and Cochran, W.G. (1967). *Statistical Methods*, Oxford and IBH Publishing Co, Calcutta, pp339-380.
- Stansby, M.E. (1963). Cured fishery products In: *Industrial Fishery Technology*, (Stansby, M.E., and Robert, E. Eds). Krieger Publ. Co, Hunlington, New York, 415p.
- USFDA. (2001). *Bacteriological Analytical Manual*. 8th Edn. (revised) Association of Official Analytical Chemist. Washington DC.