Histamine in Dried Fish

P.K. VIJAYAN, P.K. SURENDRAN and JOSE JOSEPH
Central Institute of Fisheries Technology
P.O. Matsayapuri, Cochin - 682 029, India

Development of toxic levels of histamine in fish and fish products is due to gross abuse of the raw material in the preprocessing stage. Preprocessing activities with little or no ice, undue delay before processing, unhygienic handling etc lead to rapid spoilage and accumulation of high levels of histamine and volatile bases at tropical ambient temperature. Dried fish samples from jew fish, silver belly, ribbon fish and anchovy contained insignificant levels of histamine while those from mackerel, anchovy, smoked and dried tuna (*masmin*), and flying fish contained high amounts of histamine. Two samples of mackerel contained histamine 33.45 and 36.21 mg.100g^{-1} each, dried prawn 40.25 mg.100g^{-1}, and *masmin* 73.39 mg.100g^{-1} fish. Histamine content of dried flying fish sample was 189.86 mg.100g^{-1}.

Key words : Histamine, dried fish, processing conditions

Dry fish production and distribution forms an important economic activity in the coastal fishing villages of India. About 32% of the marine fish catch is processed by curing (Francis *et al.*, 1987). The dry fish products command very good demand in the country and is second only to fresh fish distribution. This sector also contributes significantly to the export earnings of the country; the average export earning of the country for the last 5 years being Rs. 450 million. India exports dry fish products from fish, shrimp, cuttlefish, shark etc to countries like Sri Lanka, Hong Kong, USA, UK, UAE, Japan, Singapore and China (Anon., 2000).

Histamine is a biogenic toxin produced in the fish muscle during bacterial spoilage. Its development in fish during storage directly correlates with the spoilage and hence has been widely accepted as an index of spoilage as well as a risk factor to the health of the consumer (Pan *et al.*, 1985). Consumption of histamine at levels more than 60 mg.100g^{-1} fish causes histamine poisoning, mainly allergic type such as facial flushing, burning and itching of the mouth, throat and tongue, urticaria, bronchospasm, hypotention, severe stomach pain, abdominal cramps and blurred vision (US-FDA, 1989). Considering the health hazards associated with histamine poisoning, several countries have introduced a rejection level of maximum 20mg histamine per 100g fish (Anon,

1987). Joseph *et al.* (1998) reported that the major quality problems associated with dried fish are: spoilage and decay; crumpling, cracks in the meat, gaping, and fragmentation; red discolouration; fungal growth; rancidity; high sand content; insect infestation; yellow and brown discolouration.

Chakraborthy (1991) reported significant levels of histamine in 20% of the dried fish samples collected from local markets in Andhra Pradesh. Wood (1984) reported that 8 samples of dried fish out of 9 collected from different markets in Kerala contained high levels of histamine. The dried fish samples examined by Wood were sardine, mackerel and tuna and contained histamine more than 100 mg.100g^{-1} fish, while dried seer fish contained only 5 mg per 100g fish. In the present study an evaluation of the dried fish samples collected from different centers is carried out to examine whether histamine is a threat to the commercially produced dried fish samples.

Materials and Methods

The dried fish samples were collected from the local markets in Cochin. The flying fish (*Hirundichthys coramandelensis*.) was collected from Thirumalaivasal, a fishing village in Tamil Nadu and dried and smoked tuna (masmin) from Lakshadweep. Moisture, salt, and total volatile nitrogen (TVN) were determined by the conventional methods. Histamine was separated by column chromatography using Amberlite resin, diazotisation with p-bromoaniline and measuring the concentration at 495nm using a spectrophotometer, Spectronic-21 (Hardy & Smith, 1976). The total viable bacterial count (TPC) was determined using Tryptone Glucose Agar (TGA). The plates were incubated at 28±2°C (RT) for 48 hours and counts taken. The total coliforms were determined using Desocycholate Lactose Agar (DLA), *Escherichia coli* using Tergitol 7 agar, faecal streptococci using KF agar and coagulase positive staphylococci using Baird- Parker agar (FDA, 1973; DIFCO, 1971). Histidine decarboxylating bacteria (HDB) was determined by direct plating of the fish tissue with tryptone - yeast extract – histidine agar (TYMA) of Nevin *et al.* (1981).

Results and Discussion

Results of biochemical analysis of dried fish samples are presented in Table 1. All dried fish samples contained high moisture content. Moisture content below 40% is recommended for salted and dried fish and below 20% for unsalted and dried fish such as anchovy, shrimp etc. (Clucas, *et al.* 1996). Total volatile base nitrogen (TVN) values were above 150

mg.100g^{-1} for all samples indicating inferior quality, but a correlation is not seen with histamine content. Significant levels of histamine were found in mackerel (33.45-36.21 mg.100g^{-1}), dried shrimp (40.25 mg.100g^{-1}) and flying fish (189.86 mg.100g^{-1}). Dried jew fish, silver belly, ribbon fish, and anchovy did not contain histamine above the permitted level. The bacterial quality of the dried fish is presented in Table 2.

Table 1. Biochemical quality of dried fish samples

S.No	Name of fish	Histamine (mg.100g^{-1})	Salt %	TVN (mg.100g^{-1})	Moisture %
1	Jew fish	0.812	20.41	147	46.90
2	Silver belly	0.819	20.82	302	41.33
3	Ribbon fish	2.30	19.77	224	4886
4	Anchovy	6.713	9.04	406	23.37
5	Dried prawn	40.253	2.65	441	18.78
6	Mackerel (A)	33.445	16.83	266	48.42
7	Mackerel (B)	36.206	18.17	525	51.06
8	Flying fish	189.86	-	700	32.0
9	Anchovy	9.34	12.44	312	21.26
10	Masmin flakes (A)	20. 74	-	-	-
11	Masmin flakes (B)	58.48	-	-	-
12	Masmin steaks (A)	64.01	-	-	-
13	Masmin steaks (B)	73.39	-	-	-

All values are average of two samples

Table 2. Bacterial quality of dried fish samples

S.No	Name of fish	TPC.g^{-1}	Faecal streptococci.g^{-1}	HDB.g^{-1}	Entrobacteri-aceae.g^{-1}	Coagulase positive Staphylococci.g^{-1}
1	Jewfish	$6.64x10^{5}$	nil	$2.72x10^{3}$	$1.36x10^{2}$	nil
2	Silver belly	$6.04x10^{1}$	nil	Nil	$6.47x10^{2}$	nil
3	Ribbon fish	$5.68\ x10^{4}$	nil	$5.17x10^{2}$	nil	nil
4	Anchovy	$8.27x10^{4}$	$1.2x10^{2}$	Nil	$8.62x10^{2}$	nil
5	Dried prawn	$9.17x10^{4}$	$11.76x10^{5}$	$1.41x10^{2}$	$6.52x10^{2}$	nil
6	Mackerel (A)	$4.46x10^{3}$	nil	$1.4x10^{1}$	nil	nil
7	Mackerel (B)	$11.81x10^{3}$	nil	$9.64x10^{2}$	$5.06x10^{3}$	nil
8	Flying fish	$3.75x10^{6}$	-	-	-	-
9	Anchovy	$6.12x10^{1}$	$4.14x10^{2}$	$1.86x10^{2}$	$1.64x10^{2}$	nil

TPC - Total Plate Count at 28±2°C; HDB - Histidine decarboxylating bacteria

A very high TPC of $3.75x10^6.g^{-1}$ was observed in flying fish, which had a histamine content of 189.86 $mg.100g^{-1}$. Coagulase positive staphylococci were not detected in any of the samples. The biochemical and bacteriological factors are not showing a direct correlation to histamine content. Since all the dried fish samples analysed from different markets are of inferior quality, it is to be assumed that the raw material for the production of dried fish was already spoiled. This is true in the case of certain fishes such as flying fish and mackerel, where the fish is kept for longer duration before the fish is taken for curing and drying. Apparent quality rating based on visual and sensory features (Table 3) rated two samples of mackerel and one sample of flying fish as unacceptable.

Tables 4 and 5 show the spoilage of flying fish and mackerel at ambient temperatures. At ambient temperature (30°C) the flying fish developed 113mg histamine per 100g in 17 hours. Similarly a delay for 16 hours at 26°C produced 92.25 mg histamine/100g in Indian mackerel (Table 5). These observations show that toxic levels of histamine can be formed in commercially produced dried fish when the raw material quality is poor and can be a problem to the consumer. Several workers have reported that no histamine will be present in fresh fish and that no histamine will be produced in fresh fish kept at low temperatures such as 0°C and below (Ota & Kaneko, 1958; Edmunds & Eitenmiller, 1975; Ames *et al.*, 1987).

Table 3. Apparent quality rating of dried fish

Name of fish	Grade	Quality Rating
Jew fish	C	Salted and dried, moist, split opened
Silver belly	C	Gills and parts of intestine present, no foul smell
Ribbon fish	C	Salted and dried, as whole, fairly dried, no foul smell
Anchovy	C	Salted and fairly dried; no foul smell
Dried prawn	C –	Unsalted and dried, appeared roperly dried, slight foul smell
Mackerel	D	Un-gutted and salted, heavily moist, foul smelling
Mackerel	D	Un-gutted and salted, heavily moist, foul smelling
Flying fish	D	Split open from bottom, unsalted and dried, worms and flies present, foul smelling and ammoniacal odour
Masmin steaks	C–	Smoked and dried, pale brown steaks a layer of mould growth present
Masmin steaks	C–	Smoked dried pale brown steaks, no mould growth
Masmin flakes	C+	Pale brown flakes
Masmin flakes	C–	Pale brown flakes

C Average; C + Above average; C – Below average ; D Unacceptable

Table 4. Development of histamine in flying fish at ambient temperature (30°C)

Storage time (h)	NPN ($mg.100g^{-1}$)	TVBN ($mg.100g^{-1}$)	TMAN ($mg.100g^{-1}$)	Histamine ($mg.100g^{-1}$)
0	424	3.3	Nil	Nil
5	458	4.8	2.2	1.8
9	553	27.0	2.8	3.5
11	635	39.2	6.4	19.9
13	594	61.1	11.1	55.5
17	664	106.0	14.0	113.0
21	790	172.o	49.0	142.0
24	1070	213.0	47.8	161.0

Table 5. Development of histamine in Indian mackerel (*Rastrelliger kanagurta*) at ambient temperature (30°C)

Storage period (h)	Overall quality	Histamine ($mg.100g^{-1}$)
4	Excellent	Nil
6	Good	0.19
8	Fair	0.58
10	Poor	7.51
12	Poor	30.00
16	Bad	92.25
20	Bad	180.00
24	Bad	234.00
28	Bad	274.00
32	Bad	260.00

From Tables 4 and 5, it is evident that on keeping raw material over night without proper icing or salting may result in the formation of substantial amounts of histamine far above the toxic level. These observations suggest that it is very important that the raw material has to be preserved in ice till it is taken for drying in order to improve the quality, safety, and commercial acceptability of the product. The problem can also be solved by salting the raw material with in 8-9 h after catch so that substantial amounts of histamine is not produced.

The authors are grateful to Dr. K Devadasan, Director, Central Institute of Fisheries Technology, Cochin for his kind permission to publish this paper and to Smt. K.P. Leelamma and Smt. K.B. Beena for the technical assistance.

References

Anon (2000) *Marine Products Export Review 2000*, MPEDA, Cochin

Anon (1987) *Infofish Marketing Digest* No **2/87**

Ames, G.R., Gopakumar, K. and Vijayan, P.K. (1987) *Infofish Marketing Digest*, No **2/87**, 41

Arnold, S.H., Brown, W.D. (1978) *Adv. Food Res.* **24**, 113

Chakraborthy, R. (1991) *Fish. Technol.* **28**, 59

Clucas, I.J. and Ward, A.R. (1996) *A Guide to Handling, Preservation, Processing and Quality* NRI, UK, 225

Edmunds, W.J. and Eiternmiller, R.R. (1975) *J. Food Sci.* **40**, 516

Francis Thomas and Balachandran, K.K. (1987) *Diversification of Post-Harvest Technology for Low Cost Fish.* : 1-15

Hardy, R. and Smith, J.G.M. (1976) *J. Sci. Food Agri.* **27,** 595

Joseph, J., Vijayan, P.K. and Gopakumar, K (1992) *Trop. Sci.* **33,** 17

Niven, C.F. Jr., Jeffery, M.B., Corlett, D.A. Jr., (1981) *Appl. Environ. Microbiol.* **41**, 321

Ota, F. and Kaneko, K. (1958) *Nippon Suisan Gakkaishi* **24,** 140

US FDA (1989) *Scombroid Poisoning – An Advisory Note*, FDA, USA

Wood C.D. (1984) *Losses in Traditionally Cured Fish – A Report*, TDRI, UK