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QUALITY OF TRADITIONALLY SALTED AND DRIED FISHES OF RATNAGIRI FISH MARKET, MAHARASHTRA

S.B. Gore, S.S. Relekar*, A.K. Kulkarni, S.A. Joshi, J.G.K. Pathan, P.A. Telvekar and S.S. Bankar

College of Fishery Science, MAFSU, Nagpur - 440 006, (MS) India

E-mail: shailendrarelekar2007@rediffmail.com (**Corresponding Author*)

Abstract: An investigation was carried out on the biochemical, microbiological and organoleptic characteristics of various dried fishes from Ratnagiri fish market. Ribbon fish, dhoma and seer fish with different processing styles namely whole and split open were chosen for study. Moisture contents in the various dried fishes except seer fish were well below the IS specification. The salt values were found far away from the IS specification. Acid insoluble ash observed higher in the dried fishes except whole dhoma. In bacteriological analysis, THC ranged from 3.406 x 10^3 to 8.074 x 10^3 cfu/g and TFC from 0.72 x 10^1 to 1.8 x 10^1 cfu/g for different fishes. Higher fungal count was noticed in split open ribbon fish followed by split open dhoma. The possible reason for occurrence of bacteria of public health significance like *E coli.* and *Staphylococci* in the dried fishes was unhygienic handling of raw material, drying of fish on open area, use of contaminated water for cleaning, etc. All the dried fishes studied were rated 'slightly good to good' on organoleptic basis.

Keywords: Biochemical, microbiological, organoleptic, Ribbon fish.

1. Introduction

Preservation of fish by curing is perhaps the oldest preservation techniques ever practiced by the fishing trade in developed and developing countries. The term "curing" includes sun drying, salting, pickling, smoking, artificial dehydration etc. The major traditional fish curing processes are drying, salting and smoking practiced along the coast of India.

Keeping quality of dried fishes is of utmost importance. Quality of cured fish vary widely, especially in moisture and salt content mainly due to non-uniformity in processing practices followed at curing centers. The quality of dried fish should be maintained especially with respect to the size, moisture content, freedom from excessive sand and salt, absence of deterioration, freedom from fungus and mites etc. Only few workers carried out the detailed investigation on the quality of cured fish produced along Konkan coast of Maharashtra (Pillai *et al*; 1951; Joseph *et al*; 1988). Therefore, an attempt was made in the present study to investigate quality status of some important cured fishes of Ratnagiri. The quality of these dried fishes was compared with IS specification.

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2. Materials and Methods

Samples of dried and cured ribbonfish (*Lepturacanthus savala*), croaker fish (*Otolithus ruber*) and seer fish (*Scomberomorus guttatus*) were procured from local fish market of Ratnagiri. The drying methods for these fishes differ slightly from each other. After landing of the fishes, which are diverted for drying are dumped onto land as a heap before salting. The processing of dried ribbonfish is carried out in two ways i.e. whole and split open. The salting of fish is generally carried out in bamboo baskets using red or brown colored salt. The ribbonfish are dried in curing yards for 3-6 days depending upon weather condition. The processing of croaker in whole and split open form is done in the same way as for ribbon fish. Slightly variation in the processing of seer fish is observed. Seer fish is mainly dried in split open form by hanging them on ropes. Then yellow or orange yellow coloured split open seer fish is then marketed.

All the dry fish samples were procured at monthly intervals from local fish market. All samples were analyzed within a period of seven days after collection. Samples were analyzed for proximate composition, acid insoluble ash, salt content (AOAC; 1990), TMA-N, TVB-N (Beatty and Gibbons; 1937), Peroxide value and non-protein nitrogen (AOAC; 1990) and Microbiological tests i.e. Total Plate Count (EIA, 1995), Total Halophilic Count, Total Fugal Count (APHA; 1976) and pathogenic bacterial count (EIA, 1995) were conducted. Organoleptic evaluation was done using a 10 point hedonic scale. Statistical analysis was carried out as per Snedecor and Cochran (1967).

Traditional method of salted and dry fish production in Ratnagiri

I. Traditional method of drying whole ribbonfish & split open ribbonfish* in Ratnagiri.

Raw material (whole ribbonfish)

⇩

*Evisceration and filleting (This process is only applicable to split open ribbonfish)

⇩

Salting without washing (No definite ratio of fish:salt used)

⇩

Stacked for overnight in bamboo baskets (12-18 hrs.)

⇩

Washing in seawater

⇩

Drying of fish on net spread on land

⇩

Drying under sun for 3—4 days

⇩

Packing in bamboo baskets

⇩

Storage in gunny bags or bamboo baskets

⇩

Marketing

II. Traditional method of drying whole dhoma & split open dhoma* in Ratnagiri

Raw material (whole dhoma)

⇩

*Evisceration and filleting (This process is only applicable to split open dhoma)

⇩

Salting without washing (No definite ratio of fish:salt used)

⇩

Stacked for overnight in bamboo baskets (12-18 hrs.)

⇩

Washing in seawater

⇩

Drying of fish on net spread on land

⇩

Drying under sun for 3-4 days

⇩

Packing in bamboo baskets

⇩

Storage in gunny bags or bamboo baskets

⇩

Marketing

III. Traditional method of drying split open seer fish in Ratnagiri

Raw material (whole seer fish)

⇩

Evisceration and filleting (sometimes cut into two separate pieces)

⇩

Washing in freshwater

⇩

Salting (No definite ratio of fish:salt used)

⇩

Stacked for overnight in bamboo basket (12-18 hrs.)

⇩

Washing in freshwater

⇩

Application of turmeric power on both sides

⇩

Drying of fish under sun by hanging them on poles

⇩

Drying for 3-6 days (Market demand seems to influence the drying of seer fish)

⇩

Packing in bamboo baskets

⇩

Storage in gunny bags or bamboo baskets

⇩

Marketing

3. Results and Discussion

1 Proximate Composition of Dried Fish

It is reported from Table 1 That the moisture content of 33.6% and 34.6% was recorded in whole and split open ribbonfish respectively. The moisture content of 29-30% was reported for dhoma. The higher moisture content was found in split open seer fish (39.4 %). Joseph *et al*. (1988) recorded moisture content of 42.37% and 19.65% for whole ribbon fish from Ratnagiri and Padava region. Basu et al., (1989) recorded average moisture content of 45.2 % for ribbon fish which is much higher than the one recorded in present study. Basu *et al*. (1989) reported moisture content as high as 46.3 % in dried seer fish. The higher moisture content in split open than whole cured fish is obvious since generally thick and large sized fishes are split opened to dry as quickly as possible. As per IS standards the moisture content of 35 % has been suggested for dried dhoma and seer fish.

Protein content of 39.49 % was observed in whole dhoma while, in ribbonfish it was found in the range of 30-35 %. The protein content of 32.37 % was noticed in split open seer fish.

Solanki and Sankar (1988) reported 53.25 % protein content in dried ribbonfish and 53.37 % in the dried dhoma. Joseph et al., (1992) reported that average protein content in dried fish is 25 % which is more than that in fresh fish.

The fat content of 4.78% was reported in dhoma. High fat content of 7.83% was noticed in split open seer fish. In ribbonfish, fat content was varied from 3.23% to 3.63%. Solanki and Sankar (1988) reported 5.1% and 7.16% fat content for ribbon fish and dhoma respectively. Fat content in the range of 2.0% and 3.6% has been reported in dried ribbonfish by Joseph et al., (1992). Balachandran (2001) reported that fat in fish increases as water content decreases and vice versa. The same trend was found in the present study.

Higher ash content values of 16.05 % in split open ribbonfish and 17.43% in dhoma was observed. While lower ash content of 10.46% was noticed in split open seer fish. The ash values observed in the present study coincides with the ash values reported by Pillai et al., (1956) and Kalaimani et al., (1988). The salt, bones and mineral matter present in the fish may contribute for higher ash content in these fishes. Low ash noticed in the split open seer fish revealed better processing and drying practices for high value fish.

Acid insoluble ash was noted to be 3-5% in ribbonfish and 3-4% in dhoma. Low acid insoluble ash of 2.08% was observed for split open seer fish. High acid insoluble ash observed in ribbon fish and dhoma is obivious since these fishes are generally dried on open beaches or along roadsides and are found to be highly contaminated with sand and soil. Joseph et al., (1988) observed 6.08% and 7.12% acid insoluble ash for ribbonfish collected from Ratnagiri and Padava region respectively. Basu et al., (1989) reported only 2.8% acid insoluble ash for dried ribbonfish of Andhra Pradesh. Low acid insoluble ash content in seer fish may be due to the fact that highly priced fish is dried by hanging them on poles or ropes so that this fish does not come in contact with soil during drying. Basu et al., (1989) reported average 5.1% acid insoluble ash in seer fish. The acid insoluble ash value in all the dried fishes were observed to be significantly different from the IS values (except for dhoma).

Table 1: Proximate Composition of Dried Fish (Average Values)

S. N.	Fish	Moisture (%)	Protein (%) MFB	Fat (%) MFB	Ash (%) MFB	Acid Insoluble Ash (%) MFB	Salt (%) MFB
1.	Ribbonfish whole	33.6 ± 1.6613.	34.87 ± 3.1839	3.23 ± 0.1890	14.89 ± 0.8119	3.23 ± 0.3981	9.55 ± 0.8339
2.	Ribbonfish split open	34.6 ± 1.4352	30.37 ± 3.3099	3.63 ± 0.3196	16.05 ± 1.1559	5.09 ± 0.5158	10.07 ± 1.0328
3.	Dhoma whole	29.0 ± 1.8708	39.49 ± 1.8485	4.78 ± 0.2997	15.19 ± 1.1905	3.21 ± 0.5115	8.35 ± 0.4710
4.	Dhoma split open	30.0 ± 2.5298	32.99 ± 4.7409	4.57 ± 0.2123	17.42 ± 0.9436	3.97 ± 0.5708	10.45 ± 0.7733
5.	Seer fish split open	39.4 ± 1.0770	32.37 ± 1.7940	7.83 ± 0.1560	10.46 ± 0.3444	2.08 ± 0.1512	7.60 ± 0.3668

*** MFB- Moisture Free Basis**

The salt content in the dried fishes varied from minimum of 7.6% in split open seer fish to maximum of 10.45% in split open dhoma. Split open fishes takes up more salt than whole fishes due to exposure of large surface area resulting in rapid penetration of salt. Pillai et al., (1956) observed 10-20% salt content in dry salted fish. Srinivasan and Joseph (1966) and Joseph et al., (1986) noticed 14% average salt content in dry fish from Tamilnadu. Muraleedharan et al., (1989) observed highly significant salt content in the dry fish from IS specifications throughout the West Coast.

2. Chemical Indices of Spoilage and Non-Protein Nitrogen (NPN) Content of Dried Fish

In the present study it is observed from Table 2 that the TMA-N varied from 29.97 mgN% to 34.12 mgN%. Whole ribbonfish was found to contain higher TMA-N of 34.12 mgN% than split open ribbonfish, whereas whole dhoma showed higher TMA-N of 32.60 mgN% than split open dhoma. Lower TMA-N value of 29.97 mgN% was reported in split open seer fish. Srinivasan and Joseph (1966) reported 18 to 156 mgN% TMA-N for different dry salted fish. Higher TMA-N content observed in the present study may be attributed to unhygienic handling and improper processing of fish under unhygienic condition.

The TVB-N content of different dried fishes under study was in the range of as high as 139.69 mgN% for split open seer fish to as low as 107.10 mgN% in whole ribbonfish. Joseph et al., (1986) observed 73-99 mgN% and 58.91 mgN% TVB–N in split open and whole ribbonfish respectively, which was lower than the present study. Joseph et al., (1992) reported TVB-N values less than 150 mgN% for dry fish, which coincides with the present

findings. However, in all samples TVB-N was found within the acceptable limit i.e. 100-200 mgN% for dry fish (Connel, 1980).

Peroxide value in the present study ranged from 19.12 millimoles of O_2/kg fat in whole ribbon fish to 34.14 millimoles of O_2/kg fat in split open seer fish. Dhoma showed 25-28 millimoles O_2/kg fat during study. Joseph et al., (1992) observed 25.3 - 33.2 millimoles of O_2/kg fat in cured fish procured from Kerala. High peroxide value in seer fish may be due to high fat content which are prone to rapid lipid oxidation due to pro-oxidant reaction of fish. Split open fishes were found to be highly susceptible to lipid oxidation because more flesh area was exposed to drying temperature.

Table 2: Chemical Indices of Spoilage and Non-Protein Nitrogen (NPN) Content of Dried Fish (Average Values)

S. N.	Fish	TMA-N (mgN%)	TVB-N (mgN%)	Peroxide Value (millimoles of O_2/Kg fat)	NPN (%)
1.	Ribbonfish whole	34.12 ± 3.6818	123.10 ± 16.3655	19.12 ± 2.9090	2.58 ± 0.0892
2.	Ribbonfish split open	30.34 ± 1.3341	107.52 ± 13.7656	26.29 ± 0.7423	2.64 ± 0.0514
3.	Dhoma whole	32.60 ± 1.3790	138.77 ± 11.2740	25.74 ± 1.5448	2.75 ± 0.3603
4.	Dhoma split open	30.19 ± 1.9722	132.41 ± 13.7726	28.50 ± 1.5062	2.05 ± 0.2016
5.	Seer fish split open	29.97 ± 1.0034	139.69 ± 18.8853	34.14 ± 1.6357	3.13 ± 0.1257

The non-protein nitrogen (NPN) was observed between 2.05% to 3.13% in different dry salted fish under study. High NPN values recorded in whole fish than split open fish may be attributed to large amount of free amino nitrogen in fish, which is cured whole i.e. along with viscera. The results were found in agreement with the findings of Solanki and Sankar (1988), who reported 0.95% - 2.50% NPN for ribbonfish and 1.06% - 2.29% for dhoma.

3 Bacteriological Qualities of Dried Fish

The Table 3 shows that the total plate count (TPC) in the present work ranged from 5.378 x 10^3 to 9.074 x 10^3 cfu/g. High bacterial load was found in split open dhoma whereas low count was recorded in split open seer fish. The TPC in dried whole and split open ribbonfish varied from 5.378 x 10^3 to 6.182 x 10^3 cfu/g. Joseph et al., (1986) reported TPC in agreement with the present result for split open ribbon fish (2.0 x 10^5 cfu/g). TPC of dried fishes of Maharashtra coast varied between 10^2 -10^5 cfu/g (Joseph et al., 1988). Joseph et al., (1992) noted higher TPC (16.69 x 10^5 cfu/g) for ribbonfish of Kerala.

Total halophilic count of 3.5 x 10^3 to 5.26 x 10^3 cfu/g in ribbonfish and 3.286 x 10^3 to 8.074 x 10^3 cfu/g in dhoma was reported in present study. Seer fish showed low halophilic count of 3.406 x 10^3 cfu/g. Basu et al., (1989) reported identical result for dried ribbonfish but found higher THC in seer fish, which may be due to higher salt content. Joseph et al., (1992) reported average 4.502 x 10^3 cfu/g THC for dried ribbonfish of Kerala.

The total fungal count (TFC) ranged from 0.72 x 10^1 cfu/g to 1.8 x 10^1 cfu/g in the present work. Low fungal count was observed in split open seer fish whereas high fungal count was noted in split open ribbonfish. The TFC in whole and split open dhoma was noticed to be 0.92 x 10^1 cfu/g and 1.32 x 10^1 cfu/g respectively. Curran (1984) observed mould growth occurred much earlier on fish with exposed bones. Abraham et al., (1993) reported 2.10 x 10^3 cfu/g fungal count for salt cured fish at the end of 30 days of storage.

Whole ribbonfish was found to contain high *Staphylococci* count of 4.88 x 10^1 cfu/g and the same was recorded low i.e. 0.48 x 10^1 cfu/g in seer fish. Dhoma was found to have S*taphylococci* count of 0.82 x 10^1 cfu/g to 3.96 x10 1 cfu /g. High S*taphylococci* count was found in ribbonfish and dhoma may be due to unhygenic handling of raw material, inadequate cleaning or contamination during processing. Prasad et al., (1994) isolated *Staphylococcus* from dry fish samples.

Table 3: Bacteriological Quality of Dried Fish (Average Values)

S. N.	Fish	TPC (cfu/g)	THC (cfu/g)	TFC (cfu/g)	*Salmonella* (cfu/g)	*Staphylococci* (cfu/g)	*E.coli.*/g
1.	Ribbonfish whole	5.378 ± 1.4346 x 10^3 (3.73)	3.556 ± 1.2884 x 10^3 (3.55)	1.46 ± 4.0199 x 10^1 (1.13)	Nil	4.88 ± 2.9915 x 10^1 (1.68)	16 ± 1.4016
2.	Ribbonfish split open	6.182 ± 1.7952 x 10^3 (3.79)	5.260 ± 0.7897 x 10^3 (3.72)	1.8 ± 2.8284 x 10^1 (1.25)	Nil	1.12 ± 1.5149 x 10^1 (1.12)	6 ± 1.0029
3.	Dhoma whole	6.068 ± 1.0137 x 10^3 (3.78)	3.286 ± 0.4435 x 10^3 (3.51)	0.92 ± 2.4979 x 10^1 (0.96)	Nil	3.96 ± 1.8347 x 10^1 (1.59)	17 ± 1.6112
4.	Dhoma split open	9.074 ± 2.1757 x 10^3 (3.95)	8.074 ± 0.3496 x 10^3 (3.90)	1.32 ± 2.2891 x 10^1 (1.12)	Nil	0.82 ± 0.7567 x 10^1 (0.91)	8 ± 0.7400
5.	Seer fish split open	4.384 ± 1.3138 x 10^3 (3.64)	3.406 ± 0.3725 x 10^3 (3.53)	0.72 ± 2.5961 x 10^1 (0.85)	Nil	0.48 ± 0.5981 x 10^1 (0.68)	3 ± 0.6116

The higher *E coli.* count was encountered in whole dhoma whereas lower *E coli.* count was noticed in split open seer fish. However, the values were found in the acceptable limits of IS specification for *E. coli*. i.e. 20 No./g (IS 14950, 2001). The presence of *E coli.* was obvious since these fishes were dried on beaches which are subjected to defecation by people living in nearby area.

4. Organoleptic Evaluation

The overall acceptability scores for all salted and dried fishes ranged from 6 to 8 on ten point hedonic scale. Split open seer fish scored higher than ribbonfish and dhoma. Lower score was noted for whole dhoma. All samples were rated 'slightly good to good'. Srinivasan and Joseph (1966) found cured fish samples classified as 'good' according to organoleptic rating having TVB-N value of less than 200 mgN %. Joseph et al., (1988) reported poor quality of ribbonfish and fair quality for dhoma collected from Maharashtra coast.

The use of potable water for washing of fish, use of good quality salt, use of cement or plastic tanks for salting, maintaining proper personnel hygiene, use of raised platform or drying yards and effective packaging can reduce the losses on storage of dried fish as well as can produce a high quality dried product.

5. Conclusion

Though salting and drying are the most important traditional methods of fish preservation along Ratnagiri coast, they have certain limitations. The major drawbacks in traditional processing of fish are unhygienic handling of raw material, improper washing, salt quality and quantity, processing time, incomplete and or improrper drying and improper packaging. The presence of pathogenic bacteria like *E. coli*. and *Staphylococci* in dried fish indicate that salting and drying process carried out in unhygienic condition.

For production of better quality salted and dried fish following suggestions are recommended.

1. The use of potable water for washing of fish before processing.
2. Anti-rust processing tables for washing, gutting, beheading operation, etc.
3. Use of good quality salt or salt prescribed by IS.
4. Use of chemicals such as propionic acid, BHT to minimize the losses and spoilage of cured fish.
5. Cement or plastic tank should be used for salting.
6. Maintain appropriate personnel hygiene of the person involved in salting and drying process.

7. Use of improved methods of drying such as solar tent dryer or raised bamboo platform.

8. The use of effective packaging for dried fish to reduce losses on storage of dried fish.

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