

CHEMICAL COMPOSITION OF BOMBAY DUCKS (HARPODON NEHEREUS) AND CHANGES OCCURRING IN THE NUTRITIVE VALUE OF DRIED BOMBAY DUCKS ON STORAGE

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[Fresh Bombay ducks and Bombay ducks dried (a) without any pre-treatment or (b) after brining with NaCl solutions of 15% and 7.5% concentrations for 18 hours were analysed for moisture, ash, minerals, vitamins, fat, free fatty acids, peroxide value, thiobarbituric acid value, total protein, total amino nitrogen, soluble proteins and trimethylamine contents. All the dried samples were stored in (a) tightly closed tin containers or (b) polythene bags and analysed for the above mentioned constituents every 1½ months. It was observed that brining did not exercise any marked influence on keeping properties. Organoleptic observations showed that fish stored in tin containers kept better and longer than those stored in polythene bags.]

INTRODUCTION

The Bombay Duck (*Harpodon neherus*) is an extremely common shoaling fish which is caught in enormous numbers near Bombay. Bombay ducks accounted for 9 to 14% of the total annual fish catch in India between 1958 and 1961 (Anon, 1959-1962). It has been reported that Bombay ducks are preserved mainly by sundrying. (Anon, 1951). While published statistics are not available, the data supplied by the Statistics Officer, Department of Fisheries, Maharashtra State indicate that about 80% of the total catch of Bombay ducks is preserved by sun-drying. It was therefore considered important to determine the nutritional status of this item of the diet as well as the changes that take place in dried Bombay ducks during storage. Though Bombay ducks are usually plain dried com-

mercially, the effect of pretreatment with brine of two different concentrations on its keeping properties was also studied.

EXPERIMENTAL

Freshly landed Bombay ducks were washed thoroughly, eviscerated, washed once again and then divided into three groups. The fish in one group were sun-dried at once by hanging the fish from ropes strung horizontally between two vertical poles while those in the two other groups were placed in brine of 15% or 7.5% concentration for 18 hours. At the end of this period, the fish were removed from the brine and sun-dried. The drying period necessary for a final moisture content of 11 to 14% was about 2 to 2½ days for the untreated Bombay ducks and 2 days for the pre-treated samples. The fish in each

group were sub-divided into two lots; one was stored in polythene bags and the other in tightly closed tin containers. All the samples were analysed every 1½ months to determine changes in chemical composition.

The Official Methods of the A. O. A. C. (Anon, 1955) were employed for determining moisture and ash. The ash was dissolved in the minimum amount of HCl necessary and the solution was made up to 100 ml. with distilled water. Measured portions of this solution were taken for the determination of copper and cobalt by Chilton's method (Chilton, 1953) with sodium diethyldithiocarbamate; phosphorus, iron and calcium were determined by the methods of Sterges, Hardin and MacIntyre (Sterges *et al.* 1950), Moss and Mellon, (Moss and Mellon, 1942) and the A. O. A. C. procedure (Anon, 1955) respectively; sodium and potassium were determined directly on a Baird Atomic flame photometer with the appropriate filters for sodium and potassium. Total nitrogen was determined by a micro-Kjeldahl method. (Wilson, 1938).

Thiamine, riboflavin and niacin were determined after enzymatic hydrolysis with papain and takadiastase at pH 4.5 for 18 hours at 43°C by the methods of Harris and Wang, (Harris and Wang, 1941), Scott, Hill, Norris and Houser (Scott *et al.*, 1946) and Sweeney (Sweeney, 1951) respectively.

Fat was obtained by extracting the well ground muscle with ether and then with an ethanol-ether mixture. The solvent was removed under reduced pressure, and the residue was dissolved in light petroleum (40-60°C). After complete removal of the

solvent, the residue was weighed for determination of fat content.

The method of Mehlenbacher (Mehlenbacher, 1946) was used for determining free fatty acids (FFA); the peroxide value was determined by Wheeler's method (Wheeler, 1932) as described in the 'Report of the Committee on Analyses of Commercial Fats and Oils' (Anon, 1948).

Nazir and Magar's method (Nazir and Magar 1958) was used for the determination of the tocopherol in the fish fat.

The thiobarbituric acid (TBA) value was determined by Yu and Sinnhuber's method. (Yu and Sinnhuber, 1957). The results are expressed in terms of colour density per unit weight of muscle used.

Total amino nitrogen was determined by Spies and Chambers method. (Spies and Chambers, 1951). Soluble proteins were extracted overnight in 5% NaCl in a refrigerator, as suggested by Dyer, French and Snow (Dyer *et al.*, 1950) and determined by the biuret method, as proposed by Snow. (Snow, 1950).

Trimethylamine (TMA) was determined by Dyer's method. (Dyer, 1945).

Every sample was subjected to organoleptic tests. The scoring system used is shown in Table I. However, it must be admitted that this system was adopted for the sake of convenience, owing to the difficulty of finding exact descriptive terms for the products. Owing to the absence of a trained panel of tasters especially selected for evaluating dried fish, a more or less quantitative assessment was not possible.

TABLE - I. SCORING SYSTEM IN THE ORGANOLEPTIC TESTS

Rating	Appearance	Colour	Flavor (all brined Bombay ducks tasted salty)	Odour	Texture
4	Very good	Faint straw yellow	Very good, typical of freshly dried fish	Practically absent	Very firm
3	Good	Yellow	Good, palatable	Slight dry fishy	Firm
2	Fair	Yellowish brown	Fair, acceptable	Slightly stronger	Slightly softer and brittle
1	Poor, some- what broken	Brown	Neither like nor dislike	Stronger, slightly stale	Rather soft, brittle
0	Poor, mouldy disintegrates slightly when pressed	Deep brown	Flat, barely pala- table	Strong, stale un- pleasant	Poor, brittle, soft.

RESULTS AND DISCUSSION

Fresh Bombay ducks had a moisture content of 89.1% whereas the plain dried fish and the pretreated Bombay ducks

gave value of 11.2 and 13.9 — 14.4% respectively.

The moisture content of fish stored in polythene bags however showed an increase.

TABLE — II PROTEIN, ASH AND MINERAL CONTENTS OF FRESH, PLAIN DRIED AND BRINED AND DRIED BOMBAY DUCKS (VALUES EXPRESSED PER 100 g of dry muscle)

Test	Fresh	Plain dried	Pre-treatment before drying	
			15% brine	7.5% brine
Protein %	85.2	84.3	55.1	63.8
Ash %	9.02	9.61	35.6	26.4
Cu μg %	123	126	104	140
Co μg %	9	8	10	9
P mg %	843	832	456	455
Fe mg %	3.77	3.11	3.65	3.27
Na %	0.18	0.14	8.79	5.42
K %	1.50	1.39	1.10	1.13
Ca %	375	370	406	348

TABLE — III. CHEMICAL COMPOSITION OF FRESH BOMBAY DUCKS AND CHANGES IN THE NUTRIENT CONTENTS OF PLAIN DRIED BOMBAY DUCKS AFTER STORAGE (VALUES EXPRESSED IN 100 g. OF DRY MUSCLE)

Test	Fresh	Storage time in months during drying											
		Tin containers							Polythene bags				
		0	1½	3	4½	6	7½	9	0	1½	3	4½	6
Moisture %	89.1	11.2	10.6	10.3	9.74	9.45	9.12	8.74	11.2	11.8	12.1	12.5	12.9
Thiamine μ g	88	46	35	25	17	13	10	7	46	30	19	12	9
Riboflavin mg	1.71	1.30	1.18	1.11	1.02	0.90	0.54	0.55	1.30	1.20	1.05	0.89	0.74
Niacin mg %	3.91	3.45	3.11	2.96	2.89	2.51	2.20	1.90	3.45	3.09	2.80	2.59	2.28
Fat %	4.50	4.34	4.20	4.07	4.01	4.09	3.95	4.06	4.34	4.31	4.10	3.93	4.05
Tocopherol mg %	1.86	1.77	1.66	1.56	1.46	1.31	1.13	0.96	1.77	1.64	1.51	1.39	1.19
Free fatty acids %	3.22	31.6	50.3	55.3	57.0	62.5	67.7	70.9	31.6	51.2	56.5	58.3	64.1
Peroxide values	2.72	25.6	39.4	47.1	57.8	78.0	90.1	103	25.6	46.8	86.2	125	119
TBA-value	0.02	0.03	0.04	0.04	0.06	0.07	0.07	0.09	0.03	0.05	0.06	0.07	0.09
Total amino N %	10.9	10.3	10.0	9.62	9.19	8.57	8.26	7.98	10.0	9.92	9.56	9.07	8.50
Soluble proteins %	32.2	18.2	16.9	15.7	14.4	12.7	10.6	8.69	18.2	16.1	14.9	13.3	12.9
TMA-N mg %	1.79	37.0	23.6	21.0	17.1	15.7	13.0	9.67	37.0	22.3	19.5	15.5	12.7
Organoleptic observation													
Appearance		3	3	3	3	2	1	1	3	3	3	1	1
Flavour		2	2	2	2	1	1	1	0	2	2	1	0
Odour	3	3	3	3	2	1	1	3	3	3	2	1	1
Texture		4	3	3	2	2	1	1	4	3	3	2	2

The ash, total protein and minerals like calcium, iron, copper and cobalt were not affected by drying, either without or after brining. The sodium content increased in the brined samples owing to the absorption of salt by the fish muscle. There were considerable losses of phosphorus and potassium in brined samples due to leaching. Part of the decrease in phosphorus could be due to its removal by the salt through osmosis during brining. About 48% of the thiamine in fresh Bombay ducks was lost during plain drying whereas about 73-75% was lost from the brined samples. The losses of riboflavin and niacin were relatively much smaller. At the end of the storage period, little thiamine was found in the fish samples, though appreciable quantities of riboflavin and niacin were still present.

The tocopherol contents of plain dried as well as brined Bombay ducks decreased to about 50% of their original value at the end of the storage period.

The free fatty acid (FFA) contents rose sharply during the drying process, reaching values between 32 to 34% immediately after drying. On storage for $1\frac{1}{2}$ months, the values rose considerably, but during the rest of the storage period further increase were more gradual.

Cardin and Bordeleau (1957) reported that in both light and heavy salt cures, the FFA content was about 50% at the end of the drying process. Dyer (1951) has also shown that on frozen storage for 9 months, even a low fat fish such as cod contained 72% FFA.

Both the peroxide values and the T. B. A. values increased considerably on drying. The increase in peroxide value showed that the fat of dried fish underwent oxidative rancidity besides hydrolysis as measured by the increase in FFA values.

The total amino nitrogen content decreased slightly from 1.9 g/100 g in fresh

Bombay ducks to 10.3 g/100 g in the plain dried samples. The brined and dried fish gave still lower values (7-7.5 g/100 g) probably owing to the decrease in percentage of total nitrogen caused by the increase in ash content. During storage, these values decreased still further by about 10 to 20%.

There was a considerable decrease in the soluble protein fraction of plain dried Bombay ducks (18.2 g/100 g) as compared with the fresh fish (32.2 g/100 g); the brined samples contained smaller quantities (10.9 to 12.9 g/100 g). On storage, these values decreased still further. Though there is meagre data about the soluble protein content of dried fish after storage, many workers (Dyer, 1951; Chang and Watts, 1950. Banks, 1937; Fraser and Dyer, 1957) have shown a decrease in soluble protein after frozen storage. The action of salt in promoting denaturation at a concentration of 8-10% was demonstrated by Duerr and Dyer (1952).

The TMA-N content of fresh Bombay ducks was 1.8 mg/100 g (dry wt. basis). On drying, this value rose to 37.0 mg in the plain dried samples and 18.5 to 21.6 mg/100 g in the brined and dried fish. The lower values obtained for TMA-N in brined and dried Bombay ducks indicated that brining inhibited the formation of TMA during the drying process.

Shelf life of plain dried and brined and dried Bombay ducks kept in polythene bags was about 6 months. On storage in tightly closed tin containers, the shelf lives of both plain dried and brined and dried Bombay ducks was extended to about 9 to 10 months. In the case of mackerel, pretreatment before drying resulted in a very appreciable increase in shelf life.

It was not possible to obtain a first class product, judged organoleptically by sun-drying. Even the freshly dried samples had turned yellowish and possessed a slight dry fishy odour.

TABLE - IV. CHANGES IN NUTRIENT CONTENTS OF BRINED AND DRIED BOMAY DUCKS AFTER STORAGE
(VALUE EXPRESSED PER 100 g. OF DRY MUSCLE)

	STORAGE TIME (in months)											
	Tin containers							Polythene bags				
	0	1½	3	4½	6	7½	9	0	1½	3	4½	6
<i>Treated with 15% brine before drying:</i>												
Moisture g	13.9	13.4	13.0	12.5	12.0	11.6	11.2	13.9	14.2	14.7	15.1	15.6
Thiamine µg	22	14	18	11	10	8	8	22	13	12	10	8
Riboflavin mg	1.15	1.10	1.02	0.96	0.87	0.68	0.56	1.15	1.06	0.95	0.88	0.81
Niacin mg	8.02	2.71	2.89	2.37	2.25	1.99	1.79	3.02	2.63	2.53	2.38	2.13
Fat g	3.07	2.91	2.73	2.98	2.64	2.47	2.43	3.07	2.81	2.73	2.77	2.69
Tocopherol mg	1.78	1.62	1.50	1.35	1.01	0.96	0.93	1.73	1.62	1.39	1.13	0.88
Free fatty acids %	33.0	54.6	60.6	62.7	68.9	70.2	72.8	33.0	55.9	59.7	60.8	67.8
Peroxide value	28.7	31.7	53.8	72.5	89.6	98.3	107	28.7	44.9	79.8	123	101
TBA-value	0.04	0.06	0.07	0.07	0.08	0.10	0.11	0.04	0.06	0.08	0.09	0.10
Total amino N g	6.99	6.79	6.53	6.42	6.40	6.17	6.10	6.99	6.77	6.52	6.31	6.07
Soluable proteins g	10.9	10.2	9.10	8.51	7.89	7.32	6.74	10.9	9.82	8.74	7.68	6.87
TMA-N mg	18.5	14.9	14.1	13.0	9.04	10.1	8.76	18.5	14.9	13.7	11.6	8.87

Organoleptic observations

Appearance	3	3	3	3	2	2	1	3	3	3	1	1
Colour	3	2	2	2	1	1	1	3	2	2	1	1
Flavour	3	3	3	2	1	1	0	3	3	2	2	1
Odour	3	3	3	3	2	2	1	3	3	3	2	1
Texture	3	3	3	2	2	1	1	3	3	3	2	2

Treated with 7.5% brine before drying:

Moisture g	14.4	14.1	13.8	13.2	12.8	12.2	11.4	14.4	14.9	15.1	15.5	15.9
Thiamine μ g	24	14	11	10	10	9	8	24	13	10	6	6
Riboflavin mg	1.05	0.99	0.91	0.92	0.81	0.60	0.61	1.05	0.95	0.93	0.80	0.68
Niacin mg	3.00	2.69	2.60	2.32	2.18	1.84	1.62	3.00	2.98	2.49	2.30	2.16
Fat g	3.45	3.22	3.30	3.28	3.17	3.15	3.10	3.45	3.37	3.26	3.20	3.13
Tocopheral mg	1.70	1.61	1.39	1.15	0.97	0.95	0.90	1.70	1.55	1.28	1.18	0.87
Free fatty acids%	34.5	53.3	59.1	61.7	66.4	69.7	72.1	34.5	54.3	58.0	62.4	67.7
Peroxide value	22.3	37.7	72.4	101	108	119	114	22.3	39.2	81.3	128	115
TBA-value	0.04	0.05	0.06	0.07	0.07	0.09	0.10	0.04	0.05	0.07	0.08	0.09
Total amino N g	7.56	7.32	7.22	7.65	6.71	6.62	6.49	7.56	7.34	7.18	6.95	6.61
Soluble protein g	12.9	12.1	11.3	10.2	9.64	8.97	8.51	12.9	11.7	10.6	9.82	8.90
TMA-N mg	21.6	18.0	15.1	12.5	9.16	10.7	9.28	21.6	18.5	13.5	11.1	7.47

Organoleptic observations

Appearance	3	3	3	3	2	1	1	3	3	3	1	1
Colour	3	2	2	2	1	1	0	3	2	1	1	1
Flavour	3	3	3	2	1	1	0	3	3	2	1	0
Odour	3	3	3	3	2	1	1	3	3	3	2	1
Texture	3	3	3	2	1	1	1	3	3	3	2	1

Van Pal (1955) has stated that it is often necessary to salt the fish before drying to prevent spoilage during the drying process itself, especially in the prevailing Indo-Pacific climates. Lafont (1952) has expressed the view that fish dried without pre-treatment keeps better than salted and dried fish. It has also been pointed out (Anon, 1941) that theoretically the best method for drying fish was by the action of heat or cool, dry air without the addition of any salt. A fish like Bombay duck could be dried to a low moisture content in a short time before appreciable spoilage had occurred. Again this fish had a low fat content and hence did not acquire a rancid taste even after storage. As noted above, there was no difference in storage lives between the plain dried and brined and dried Bombay ducks. Saha, Deb, Sen and Guha (Saha *et al* 1956) too have stated that in low fat, fresh water fish dehydrated under controlled conditions salting had no effect on keeping quality, though it greatly improved the taste and flavour.

Commercially Bombay ducks are preserved by sun-drying without any pre-treatment, and the present experiments have shown that brining did not enhance the storage period, in contrast to the noticeable effect of pre-treatment on the preservative properties of mackerel (Nazir and Magar, 1963). Both the plain dried, and brined and dried fish when stored in well stoppered tins showed a higher organoleptic rating than those preserved in polythene bags which have a high permeability to oxygen (Syan and Stansby, 1957; Boyd *et al*, 1957) though again no significant increase was observed in the storage period between the plain dried and brined groups. Storage in tightly closed tin containers, which do not allow insects or much air or moisture to come in contact with the fish, resulted in an appreciable increase in the storage period.

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