BIOCHEMICAL AND NUTRITIONAL STUDIES ON EAST PAKISTAN FISH

Part VII.—Chemical Composition and Quality of the Traditionally Processed Fish

M. Qudrat-i-Khuda, H. N. De, Nur Mohammad Khan and J. C. Debnath

Food and Fruit Research Division, East Regional Laboratories, Pakistan Council of Scientific and Industrial Research, Dacca

(Received November 27, 1961)

Analysis of some samples of sun-dried fish locally known as 'Shutki' from both marine and fresh water sources showed that those which are dried whole, retaining the heads and bony portions, are good sources of both protein and calcium. These may enrich the East Pakistan rice eaters' dietaries which are deficient in both these nutrients. Chemical spoilage tests like the determination of iodine absorption, titratable acidity and tyrosine values, total dehydrogenase activities and the total bacterial count revealed that these products correspond to fresh fish rather than to the decomposed products with respect to the above tests. Smoked product of Puti (*Barbus puntius sophore*) fish, however, responded to the above tests of decomposition.

Introduction

At present a considerable quantity of fish caught in this region is processed by the traditional methods of drying in the sun and by smoking over firewood oven and these are consumed by a large section of the people. This paper presents the results of investigation on the proximate composition and on the quality of some such cured marine and inland water fish from spoilage point of view evaluated by chemical tests.

Experimental

Samples of dried marine fish (Shutki) were collected from one of the curing centres of Cox's Bazar and those of fresh water fish from the local market. Their moisture, protein, fat, ash, calcium and phosphorus contents were determined according to the A.O.A.C. methods[1] and iron by the method of Farrar[2] and copper by the method of Eden and Green.[3] Some of the samples were subjected to the assessment of their degree of spoilage, if there was any, by adopting the improved techniques previously reported by Qudrat-i-Khuda and others for the determination of the iodine absorption,[4] titratable acidity,[4] total dehydrogenase activities,[5,6] tyrosine values,[7] and bacterial count,[8] and these values were compared with those of fresh fish and their decomposed products due to storage at ordinary room temperature of 80°-84°F. for 24 hours.

The smoked puti fish along with the fresh fish and its decomposed product was also analysed in the same way as before. The list of the traditionally cured fish analysed, the portions which were cured for edible purposes and the analytical values of the proximate constituents of cured and of some fresh fish are shown in Tables 1 and 2. The results of spoilage tests of fresh, cured and decomposed products are shown in Table 3.

Results

Chemical Composition of Sun-Dried Shutki, Smoked and Fresh Fish.—It will be noted from the results presented in Table 1 that the moisture level in the marine fish Shutki is higher than those from fresh water fish. Highest amount of 30.02% of moisture was noted in the smoked product of Puti. This variation in the moisture retention depends on the nature of fish as is evident from the fact that different fish cured in the same pit under identical condition retain variable quantities of residual moisture. The protein contents of sun-dried Shutki of both marine and inland water fish ranged from 55.3 to 74.18%. The protein content of smoked Puti fish was only 40%. On careful scrutiny of the data it is further observed that the degutted and beheaded cured products contained comparatively more protein but less minerals than the degutted ones retaining the heads and other bony parts. The latter group of Shutki, because if its richness in calcium, in addition to protein, will be a better supplement to the rice eaters' diet as is evident from the results of previous human metabolic experiments by Basu, De and Basak[9] in which it was observed that consumption of 70 g. of small fish like Chela (*Chela phulo*) or Kechki (*Mugil cascasia*), with heads and bones, supplied a fair amount of calcium to the extent of nearly 400 mg. and shifted the balance of this mineral in the body of the subjects from the negative to the positive side of retention. Consumption of equal quantity of bigger species of fish could not, however, improve the deficiency of calcium although the protein deficiency was made up by such fish (Basu, Basak and De).[10] Regarding the Nutritional quality of the cured products it has already been reported by Basu and De[11] that the digestibility and nutritive value of the protein of sun-dried fish are higher than those of the fresh ones.

From the above discussion it would appear that traditionally cured sun-dried Shutki, specially those in which the head and other bony parts are retained, may be a good supplement for enriching the rice eaters' diet with protein and calcium.

Assessment of Quality.—(*i*) *Iodine Absorption:*—The iodine absorption value of fish which depends on the quantity of protein decomposition products like cystine, methionine and other compounds containing -SH group and also fat decomposition products like unsaturated fatty acids etc., serves as a measure of the degree of spoilage. By the application of the improved iodine absorption technique, Qudrat-i-Khuda, De and Debnath[4] have reported the absorption of 21.92 to 46.19% of 0.01N iodine by eleven species of fish per g. on dry basis. On decomposition these values increased to the level of 53.51 to 104.07 ml. per g. Sun-dried Shutki investigated here showed iodine absorption value from 19 ml. to 43 ml. per g. Values of fresh fish, from which some of the

TABLE 1.—THE COMPOSITION OF TRADITIONALLY CURED INLAND WATER AND MARINE FISH.

Zoological name of the fish & nature of curing	Local name	Portion of the body cured	Moisture % (g.)	Protein % (g.)	Fat % (g.)	Ash % (g.)	Calcium % (g.)	Phospho-rus % (g.)	Iron % (mg.)	Copper % (mg)
GROUP A: SUN-DRIED "SHUTKI" OF FRESH WATER										
Catla catla	Katla	Degutted & beheaded fish	19.72	66.34	4.28	7.06	1.03	2.68	11.0	0.8
Labeo calbasu	Kali Baus	,,	16.32	68.67	5.38	6.55	0.94	2.25	13.0	1.0
Silonia silondia	Shillong	,,	13.94	72.78	6.28	4.77	0.73	2.05	9.2	0.9
Eutropiichthys vacha	Bacha	,,	18.72	67.64	6.20	5.42	0.56	2.24	11.2	1.3
Ophicephalus marulius	Gazar	,,	12.94	74.18	3.24	4.77	0.78	2.88	8.4	0.8
Labeo gonius	Ghania	Degutted whole fish	20.42	63.25	2.42	12.19	2.68	6.84	18.0	1.2
Mugil cascasia	Kechki	Whole fish	15.93	69.28	1.81	10.48	1.88	4.38	15.0	1.5
GROUP-B: SUN-DRIED "SKUTKI" OF MARINE WATER										
Trichiurus haumela	Churi	Degutted whole fish	16.99	61.52	7.24	10.56	2.21	5.08	23	1.6
Labotes surinamensis	Katkoi	,,	24.91	55.30	5.22	10.26	2.40	4.20	21	2.6
Mugil corsula	Corsula	,,	14.07	61.45	6.48	12.01	1.83	5.31	15	1.6
Polynemus indicus	Laukoi	,,	14.28	66.81	4.68	10.48	1.74	4.63	17	1.7
Scioenoides pama	Popa	,,	19.96	59.32	7.25	9.64	2.17	5.22	15	1.3
Mystus gulio	Tengra	,,	16.78	60.62	6.47	12.92	1.98	5.08	22	2.5
Stromateus unereus	Rupchanda	,,	15.51	61.84	8.21	12.70	2.47	4.56	26	1.4
Barbus (puntius) sarana	Sarputi	,,	17.13	61.38	4.01	15.03	2.77	6.78	28	1.6
GROUP-C: SMOKED FRESH WATER FISH										
Barbus (Puntius) sophore	Puti	,,	30.02	40.21	8.2	9.8	1.42	3.68	13	0.8

TABLE 2.—THE COMPOSITION OF FRESH FISH FROM INLAND WATER.

Zoological Name	Local Name	Moisture % (g).	Protein % (g.)	Fat % (g.)	Ash % (g.)	Calcium % (mg.)	Phosphorus % (mg.)	Iron % (mg.)	Copper % (mg.)
Catla Catla	.. Katla	78.88	17.25	1.58	1.06	24.2	168	4.3	0.54
Labeo rohita ..	.. Rohu	81.01	16.77	1.91	1.25	36.8	228	3.8	0.61
Ophicephalus striatus ..	.. Shoul	75.83	18.41	0.64	1.15	21.3	137	4.1	0.58
Silonia silondia ..	.. Shillong	81.20	15.24	1.52	1.10	45.5	302	3.8	0.42
Ophicephalus marulius ..	.. Gazar	79.54	18.41	1.02	0.77	22.6	158	2.5	0.38
Labeo calbasu ..	.. Kali Baus	80.50	16.77	1.32	1.25	34.7	262	1.8	0.28
Labeo gonius	.. Ghania	82.07	15.71	0.54	1.34	46.5	282	2.1	0.14
Mugil cascasia ..	.. Kechki	85.98	12.26	0.38	1.66	58.6	318	2.8	0.12
Eletris fusca (*bloch & sch*)	.. Bele	78.38	18.52	0.74	1.14	31.6	218	2.6	0.36
Heteropneustes fossilis ..	.. Singhi	77.92	19.61	1.23	1.33	20.8	158	3.1	0.58
Ophicephalus punctatus ..	.. Taki Leta	75.85	20.01	1.08	1.36	28.3	118	2.8	0.48
Barbus (*Puntius*) *Sophore*	.. Puti	79.14	16.02	3.10	1.48	43.4	251	1.0	0.32
Mastacambelus armatus ..	.. Baim	81.47	16.79	0.50	1.10	20.6	121	1.4	0.42
Eutropiichthys vacha ..	.. Bacha	82.45	15.37	0.57	0.94	18.2	102	1.1	0.12
Clupisoma garua ..	.. Garua	79.29	18.81	1.21	1.26	28.4	168	2.3	0.32

TABLE 3.—THE RANGE OF IODINE ABSORPTION VALUES, TITRATABLE ACIDITY, TYROSINE VALUES, DEHYDROGENASE ACTIVITY AND TOTAL BACTERIAL COUNT OF SUN-DRIED (SHUTKI) AND SMOKED FISH AND THEIR COMPARISON WITH SIMILAR VALUES OF FRESH AND DECOMPOSED FISH DUE TO SPOILAGE. RESULTS INDICATE VALUES PER G. DRY WEIGHT.

Nature of the product	0.01 N Iodine in ml. absorbed (range)	Titratable Acidity values equivalent to 0.01 N Sodium carbonate in ml. (range)	Tyrosine values in mg. (range)	Dehydrogenase activity = 1/T where T is the time of discharge of methylene Blue (range)	Total bacterial count in thousands (range)
Fresh fish	26-46	21-48	0.8 -4.6	Almost Nil	70-640
Sun-dried Shutki fish ..	19-43	17-57	0.76-3.1	0.004-0.072	47-120
Smoked fish (Puti) ..	58	7	1.2	0.16	—
Spoiled fish due to storage for 24 hours at room temperature of 80-84°F.	53-104	5-11	1.8-9	0.1-0.5	5590-1,70,000

above Shutki were prepared, and their stored and decomposed products showed the ranges from 26 to 46 ml. and 53 to 104 ml., respectively. Smoked Puti fish showed a high value of 58 ml.

(ii) *Titratable Acidity.*—The drop in the titratable acidity value due to decomposition of fish has been utilised for the study of fish spoilage and it has been reported by Qudrat-i-Khuda, De and Debnath[4] that titratable acidity against N/100 Na_2CO_3 of fresh fish ranged from 21.66 to 48.31 ml. per g. dry basis. On decomposition the above values dropped to the level of 5.81 ml. Investigation on sun-dried Shutki as reported in the present work showed the titratable acidity values ranging from 17 to 57 ml. and their fresh and decomposed products showed the ranges from 21 to 48 ml. and from 5 to 11 ml. per g. dry basis, respectively. Smoked product of Puti showed the minimum titratable acidity equivalent to 7 ml. of N/100 N_2CO_3 per g. on dry basis.

(iii) *Tyrosine Value.*—Qudrat-i-Khuda, De and Shariff[7] in their previous investigation reported the tyrosine value of some species of fresh fish ranging from 0.8 to 4.6 mg. per g. on dry basis. This range, on spoilage due to storage for 24 hours at 80-85°F., increased to 1.8 to 9 mg. per g. The Shutki fish investigated in a similar manner showed the range of the values from 0.76 to 3.1 mg. per g. Smoked Puti fish showed the value 1.2 mg. per g.

(iv) *Autodehydrogenase Activities.*—It has previously been reported by Qudrat-i-Khuda, De and Khan[5,6] that the dehydrogenase activity of fresh fish evaluated by Thunburg methylene blue technique is very negligible and on spoilage due to storage the value reaches the level of 0.4 to 0.9 per g. dry basis. Sun-dried Shutki investigated in a similar manner shows a very negligible activity of 0.004 to 0.02 per g. dry tissue. Their fresh samples showed almost no activity like previous investigation and the decomposed product elaborated the activity of 0.1 to 0.5. The activity of smoked Puti fish was nearly 0.16 per g.

(v) *Total Bacterial Count.*—The total bacterial count determined by agar culture dilution method[8] showed the range of values for sun-dried Shutki fish from 4.7 to 12 $\times$ 10^4 per g. on dry basis. Samples of fresh fish and their decomposed products due to storage, showed the range from 7 $\times$ to 10^4 to 64 $\times$ 10^4 and from 5.5 $\times$ 10^6 to 1.7 $\times$ 10^8, respectively, per g. From all the above results of spoilage tests as summarised in Table 3 it would appear that the values of sun-dried Shutki fish almost correspond to those of fresh fish, rather than the decomposed ones. So it is evident that the Shutki fish, though prepared by curing under the sun, had not undergone any decomposition during processing and subsequent storage. Smoked Puti fish, however, yielded the results within the ranges of the decomposed product of the fresh one. This indicates that Puti fish during smoking or on subsequent storage had undergone considerable decomposition. The high moisture level of this product to the extent of 30% may be one of the factors responsible for the spoilage of this product.

Acknowledgement.—The experiments on estimation of some tyrosine values were done by Mr. M. A. H. Shariff and of total bacterial count by Mr. G. K. Joarder of these Laboratories to whom our thanks are due.

References

1. Association of Official Agricultural Analysis. 1950, *Official methods of Analysis* —7th Ed-ition. Washington — D. C.
2. J. E. Farrar, Jr., J. Biol. Chem., **110**, 685 (1935).
3. Eden and H. H. Green, Biochem. J., **34**, 1202 (1940).
4. M. Qudrat-i-Khuda, H. N. De and J. C. Debnath, Pakistan J. Sci. Ind. Research, **2**, 217 (1959).
5. M. Qudrat-i-Khuda, H. N. De and N. M. Khan, Pakistan J. Sci. Ind. Research, **3**, 10 (1960).
6. M. Qudrat-i-Khuda, H. N. De and N. M. Khan, Pakistan J. Sci. Ind. Research, **3**, 79 (1960).
7. M. Qudrat-i-Khuda, H. N. De and M. A. H Shariff, Pakistan J. Sci. Ind. Research, **3**, 187 (1960).
8. M. Qudrat-i-Khuda, H. N. De and G. K. Joarder, Pakistan J. Sci. Ind. Reserach, **5**, 67 (1962).
9. K. P. Basu, H. N. De and M. N. Basak, Indian J. Med. Research, **30**, 417 (1942).
10. K. P. Basu, M. N. Basak and H. N. De, Indian J. Med. Research, **29**, 105 (1941).
11. K. P. Basu and H. N. De. Ind. J. Med. Research, **28**, 177 (1938).