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CHEMICAL COMPOSTITION AND STORAGE STABILITY OF BOLTI FISH AS INFLUNCED BY COOKING, SMOKING AND IRRADIATION

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Abstract

Gamma irradiation with 5 KGY was suggested to increase the stability of ready to eat fish products during stargae . Bolti Fish was prepared by frying, roasting after bran coating, roasting on spit using charcoal or cold smking. Irradiation caused negligible changes in the organoleptic properties, and increased the shelf life at 4 ^{o}C, from 7 to 20 days, from 12 to 15 days , from 12 to 52 days and from 2 to 6 months for fried , spit roasted, bran coated then roasted and cold smoked samples respectively. Spoilage occurred when values of T. V. N., T. M. A., A. N. and T. B. A. were 25.00 - 33.46 mg/100 g, 5.82 -8.46 mg/100, 308-386 mg /100 g and 1.01 -1.37, respectively.

INTRODUCTION

Bolti (*Tilapia nilotica*) is the most popular fish in Egypt and its annual production as a fresh water fish exceeds the amount of any other fish landed locally as reported by Esmail (1984). Bolti is cooked either by oil frying or roasting in an oven on a metal plate, both procedures are widely used in Egypt. and considerd dry heat methods of cooking ,

In Misr Co. for fish Marketing, instead of cooking bolti in each of its numerous retail ready to eat fish shops , it is planed to establishe central cooking and packaging unit before distribution in these ratail shops. This means the requisite for a

proper preservation method after processing until marketing.

Badawy (1979)reported that Cold smoking was used to obtain a ready to eat bolti product. and the storage of smoked fish was associated with changes of lipids by hydrolysis and oxidation. However, smoke components retarded the oxidative changes of lipids. As reported by Hammad (1985), irradiation of smoked fish by doses of up to 5 KGY retarded the growth of micro -orgainsms which cause the protein and fat changes, meamwhile, increased the stability during storage of the product. It should be noted that a cold - smoked product are produced centrally in Misr, Co. for fish Marketing , and then transported to retail shops.

The aim of this work was to sutdy the effct of irradiation of cooked bolti fish (by frying, bran coating then roasting, and cold smoking)during cold storage at $4^{o}C$, after irradiation with a dose of 5 kilo gram. in comparison with the storage without pretratment. The fish obtained by spit roasting on charcoal (barbqued) was also investigated.

MATERIALS AND METHODS

Fresh bolti fish (Tilapia nilotica) of nearly similar size about 400g each were chasen. After washing, ungutting , fish were packaged in polyethylene bags, then stored at $4^{o}C$ after irradiation with a dose of 5 KGy . This was done at the National Center for Radiation Research and Technology at Nasr City, using Mega Gamm Unit J-6500 Co. Packageing and irradiation of smoked and cooked samples was similar to that of fresh fish . For frying, eviscerated and washed fish was spiced with the commonly used at homes cumin-garlic-salt paste, then deep fat fried in vegetable oil until well done and left to cool. other sample (Ungutted) was bran coated, roasted (on both sides) on a hot metal surface until well done, then rapidly immersed (for about 5 seconds) in well mixed liquied spices preparation (composed of 50ml lime Juice, 30g salt, 3g powdered black pepper, 6g. powdered cayenne pepper, 10g ground garlic) and left to cool . For roasting on charcoal, the fillets were prepared, cut in pieces (about 15gm each) , soaked in the above liquied spices preparation for 1min, left out of liquied for 10 min, then hanged on spit, roasted on charcoal until well done and left to cool

For cold - smoking, the whole fish was firstly soaked in satruated NaCl solution for 24 hours , partially dried in air for 24 hours, then cold-smoked (at about

4°C) for 8 hours and left to cool.

Packaged, irradiated samples were stored at 4°C . Spoilage was indicated by the development of off odour.

Samples were analyzed for moisture, protein (Nx6.25, Kjeldahl method) fat (soxhlet apparatus, hexane as solvent) and ash before and after irradiation using the methods published in the A. O. A. C. Total volatile nitrogen (T. V. N.) and trimethylamin (T. M.A. were determined by the method given by Maurice and Stansb (1958) while amino nitrogen (A. N.) was determined by the formol titration method as described by kolchov (1952). Thiobarbituric acid Value (T.B.A.) was determined by the method published by Pearson (1970). using 10gm of sample , and absorbance at 538 mu was multiplied by 1.8 to obtain the amount of malonaldehyde (mg/kg sample).

Organoleptic evaluation was carried out before and after irradiation according to Molander (1960).

Ten trained persons were asked to evaluate samples, for aroma, taste, texture, colour and overall acceptability according to following Judging scale (average value is given) :

Very Good	8 - 9	Poor 2 - 3
Grood	6 - 7	Very poor 0 - 1
Fair	4 - 6	

RESUTLS AND DISCUSSION

1- Gross Chemical Composition

Data Presentad in Table 1, show the gross chemical composition of bolti flesh as influnced by cooking, cold smoking and irradiation.

Irradiation, cooking as well as cold-smoking wre asociated by loss of moisture, and accordingly all other components (Protein, fat , ash) increased in the wet sample . But on dry weight basis such treatments were accompanied by loss of protein and fat, and the increase of ash , except for fried sample where the fat in-

Table 1 The chemical composition of Bolti-flesh as infleunced by cooking, cold-smoking and irradiation.

Componests %	Raw				Frying				Roasting								Cold - Smoking			
									Uncoated - spit roasting				Bran Coated Roasting on metal plate surface							
	Irradiated		Unirradiated		Irradiated		Unirradiated		Irradiated		Unirradiated		Irradiated		Unirradiated		Irradiated		Unirradiated	
	W.W	D.W	W.W	D.W	W.W	D.W	W.W	D.W	W.W	D.W	W.W	D.W	W.W	D.W	W.W	D.W	W.W	W.W	W.W	W.W
Moisture	76.96	_	77.98	_	47.93	_	48.99	_	64.25	_	65.23	_	67.01	_	67.74	_	60.01	_	60.45	_
Protein	19.80	85.93	18.97	86.15	42.87	82.33	42.19	82.71	30.39	85.01	29.66	85.30	27.83	84.36	27.44	85.06	33.47	83.70	33.3	84.20
Fat	2.07	8.98	2.00	9.08	6.53	12.54	6.42	12.59	3.13	8.76	3.10	8.92	2.92	8.85	2.89	8.96	3.52	8.80	3.50	7.85
Ash	1.16	5.03	1.05	4.73	2.66	5.11	2.35	4.61	2.22	6.21	2.00	2.23	2.23	6.76	1.92	5.95	2.99	7.48	2.74	6.93

W.W: Wet weight basis D.W Dry weight basis

creased (possibley due to absorption of some frying oil in tissues). This was also found for irradiated samples . For unirradiated and irradiated samples (wet weight basis) lowest moisture was found for the fried fish, followed by the smoked sample , spit roasted sample , while bran coated fish showed highest moisture content. The reverse was noticed for protein and fat , and markedly for ash. Therefore highest nutritional value in conecern to protein and fat contents were found for the fried sample . But on dry weight basis unirradiated and irradiated fried sample had lowest protein (possibley due to containing highest fat content) while bran roasted sample, spit roasted fish and cold smoked samples showed less protein. The last three samples had higher ash and les fat than the fried sample. By irradiation, the moisture showed some decrease (on wet weight basis) while protein, fat and ash increaed (for raw cooked and smoked samples) On dry weight basis however, protein and fat decreased, while the ash increased . these results agree with those reported by Lawrie (1974) and El-Ebzary (1978). Irradiation was accompanied by some drip loss and weepage fluids (containing wome protein and fat) due to the decrease of water holding capacity of muscle tissue. But in general from Table 1, the changes in nutritional value (loss of protein fat or minerals) were actually small.

2- Oraganoleptic Evaluation

Average scores for aroma, taste , colour and overall acceptability of unirradiated and irradiated (unstored) samples are give in Table 2.

From results presented in Table 2 it can be observed that the influence of irradiation on cooked and cold-smoked bolti flesh was actually negligible. Moreover spit roasting on charcoal, give a new fish product which was as acceptable as the widespread in Egypt bran coated then roasted fish on hot plate surface (according to judging scale 8-9 scores means very good)

3- Storage Stability

Data of Table 3 show the storage life and values obtained for some quality attributes in case of raw, cooked and cold - smoked bolti as influenced by irradiation with 5 KGy and storage at $4^{o}C$, only unstored and spoiled samples were analyzed.

It could be noticed (Table 3) that values of freshness tests were lowest for the fresh raw sample, followed by the cold-smoked one, bran roasted fish, spit roasted fish, being highest for (unstored) the fried samples. The higher temperature of frying might be possible responsible for the more changes in nitrogen and lipids

Table 2. Organoleptic evaluation of unirradiated and irradiated (unstored) bolti fish samples (Average score).

Factors	Frying		Uncoated-spit roasting on Charcoal		Bran coated-Roasting on metal plate surface		Cold-Smoking	
	Unirradated	Irradiated	Unirradated	Irradiated	Unirradated	Irradiated	Unirradated	Irradiated
Aroma	9	9	9	9	9	9	9	9
Taste	9	9	9	8	9	9	9	9
Colour	9	8	8	8	9	8	8	8
Texture	9	9	8	8	9	8	8	9
Overall Acceptability	9	9	8	8	9	8	9	9

Table 3. Some Quality attributes of raw, cooked and cold smoked bolti fish as influenced by irradiation before storage as well as spoilage during storage at 4 °C

	Raw				Frying				Uncoated-Spit roasting on Charcoal				Bran Coated-Roasting on metal plate				Cold - Smokking			
	Unirradiated		Irradiated		Unirradiated		Irradiated		Unirradiated		Irradiated		Unirradiated		Irradiated		Unirradiated		Irradiated	
	0	7 day	0	70 days	0	12 days	0	50 days	0	12 days	0	52 days	0	10 days	0	40 days	0	2 monthes	0	6 monthes
T. V. N. mg/100G	11.25	33.46	13.21	30.17	17.16	25.86	18.12	26.01	16.83	25.75	16.72	25.24	15.84	25.16	16.11	25.00	14.25	28.95	15.08	28.96
T. M. A. mg/100 g	0.22	8.46	0.35	8.15	2.01	7.82	2.54	7.15	1.33	6.98	1.45	6.74	1.18	6.90	1.43	6.54	0.65	6.3	0.96	5.82
A. N. mg/100g	296	386	273	380	293	362	299	360	285	360	287	358	280	356	383	353	575	311	279	308
T.B.A Malonalde hyde mg/kg	0.47	1.17	0.52	1.21	0.70	1.33	0.78	1.37	0.62	1.17	0.63	1.32	0.56	1.09	0.59	1.14	0.51	1.01	0.55	1.05

Samples were analyzed before storage (Zero time) as wll as at day of spoilage as indicated by development of off odour.

compounds while losses of T. V. N., T. M. A. and A. N. as well as the slow rate of lipids oxidation (because of smoke natural antioxidants as phenols and carbonyls) might be the reason for low freshness tests values in case of the cold - smoked fish. Smoke components showed both antibacterial and antioxidation effects as reported by Zaitsev *et al.* 1969. The bran coat also , seems to portect the fish from the changes of protein and lipids when compared with spit roasting on charcoal for uncoated smaple (Table 3). Irradiation (for unstored sample) was accompanied by some increase in values of freshness tests which increased markedly during storage until spoilage (Shams-El-Din 1984). But during the period consumed for irradiation and transportation to laboratory for analysis changes in nitrogen fractions also might occur which observed by El-Ebzary (1978). Irradiation, however increased the storage life of samples (Table 3) . The time elapsed during storage at $4^{o}C$ until spoilage increased from 7 to 20 days for raw samples, from 12to 50 days for fried fish, from 12 to 50 days for spit roasted fish, from 10 to 50 days for bran coated - roasted sample on metal plate surface and from 2 to 6 months for the cold - smoked fish. It seams that bran coated roasted fish on metal plate surface stored for less periods of time than for spit roasted samples on charcoal (Table 3) possibly beacuse of higher moisture content (Table 1) for the first sample (due to protection effect of coat) which probably inhanced the microbial decompsition.

At the time of spoilage for irradiated and unirradiated fish, T.V.N. was 25.00 - 33.46 mg/100g, T.M.A. 5.82-8.46 mg/100g, A.N. 308-386 mg/100g and T. B. A. Value 1.01-1.37mg malonaldehyde /kg. These values coincided with the previously fixed levels of freshnes tests value charecteristics for spoiled fish . Thus, spoilage of fish occured when T. V. N. was 25.30 mg/100 gm as reported by persons, 1970. Over 5mg/100gm T.M.A. as shown by Maurice and Stansby (1958). and when malonaldehyde content exceeds 1mg/kg as reported by Ibrahim (1980).

Finally irradiation of cooked and cold - smoked fish was valid for preservation fish and icrease of storage stability .

REFERENCES

1 . A.O.A.C. 1975. Official Methods of Analysis. Association of official Analytical Chemists. 12 th Ed. Washington, D. C., U.S.A.

2 . Badawy, R.M., 1979. Chemical and Technological Studies on Lipid of Some Local

Smoked Fish. M. Sc. Thesis , Fac. Agric., Assiut Univ.

3 . El-Ebzary, M.M.E. 1978. Studies on the Preservation of Meat by Irradiation. M. Sc. Thesis . Fac. Agric., Zagazig Univ.

4 . Esmail, T.M.H., 1984. Chemical, Physical and Histological Studies on Super-Chilling of Fish. Ph. D. Thesis, Fac. Agric., Zagazing Univ.

5 . Hammad, A. A. I. , 1985. Chemical , Physical and Microbiological Changes in Different Fish Products Preserved by Different Methods Including Iradiation. Ph. D. Thesis, Fac. Agric., Cairo Univ.

6 . Ibrahim, A.A., 1980. Studies on Preseravtion of Bolti Fish by Irradiation, M. Sc. Thesis , Fac. Agric., Cairo Univ.

7 . Kolchove, V.V., 1952. Methods of Analysis of the Fish and Fish Products. Food Industry Pub., in Russ.

8 . Lawrie, R.A., 1974. Meat Science , the Storage and Preservation of Meat . 268-279, 2nd Ed . Oxford, New York Toronto, Brounseheweig.

9 . Maurice, E. and M. Stnasby, 1958. Problems in Determining Fish Freshness. Food Technology, 12, 260-262.

10 . Molander, A.L., 1960. Discernment of Primary Taste Substance and Probable Ability to Judge Food, Iowa State Univ. Food Sci. and Techn., Iowa, U.S.A.

11 . Pearson, D., 1970. The chemical Analysis of food. National Collage of food technology , Univ. of Redading , T. and A. Churchill Pub. Weybrdge, Surry.

12 . Shams - El - Din, Nariman M. M., 1984. Studies on Changes in Certain characteristics of Meat Subjected to Radiation, Ph. D. Thesis , Fac. Agric., Ain - Shams Univ.

13 . Zaitsev, V., I. Kizevetter, L. Lagunov, T. Makarrova, L.Minder and V. Podsevalov. 1969. Fish Curing and Processing . Mir. Pub. Moscow.

تأثير الطبخ والتدخين والتشعيع علي التريكب الكيماوي وثبات السمك البلطي أثناء تخزينه

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ادي استخدام جرعة اشعاع 5KGY الي زيادة فترة الثبات السمك البلطي ومنتجاته اثناء التخزين وبتالي زيادة مدة صلاحية هذه المنتجات في الأسواق . وقد تم اجراء عمليات الطبخ والتدخين قبل تشعيع العينات وادي ذلك الي زيادة فترة التخزين علي درجة ٤م لمدد مختلفة حسب المعاملات المختلفة التي تمت علي السمك وقد حدث فساد العينات وصلت قيمة كل من TBA,AN, TMA, T.V.N. الي ١٥,٠٠ - ٣٣,٤١ ملجم / ١٠٠ جم ، ٥,٨١-٨,٤٦ ملجم/ ١٠٠جم ، ٣٠٨ - ٣٨١ ملجم ، ١٠٠ جم ١,٠١ - ١,٣١ / ١٠٠ جم علي التوالي