Evaluation on Nutritional Value of Javanese Salted-Boiled Fish During Processing with Special Reference to EPA and DHA Content

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Abstract

In order to implement a quality management concept for traditional processors, an evaluation of the nutritional value of raw materials and end products of salted-boiled fish obtained from a Javanese processor has been conducted. Chemical composition analyses which include moisture, protein, lipid and ash content was carried out to understand the changes in nutritional composition. EPA and DHA were analyzed using gas liquid chromatography to study the effect of processing on its stability.

The results showed that the moisture content of the end product decreased in the range of 0.9 to 16.7 % compared to the raw material. There were no significant changes to protein, lipid and ash content after the fish was processed. Data on fatty acid analysis revealed that EPA and DHA content were reduced by an average of 0.48 to 5.02 % and 0.16 to 9.97 % respectively. The loss of EPA and DHA was higher in the product which was processed using dry-salt boiling technique compared to those boiled with brine.

Introduction

Salted-boiled fish, which is locally called *pindang,* plays an important role in the staple diet of Indonesians because of its nutritional value particularly as a low cost food. This traditional fish product is generally prepared through two different ways of processing, which are dry-salt boiling and brine boiling (Saleh *et al.*, 1982). The major types of fish which are processed into salted-boiled fish by Indonesian traditional fish processors particularly in Java island are scad, *Rastrelliger* sp. and little tuna. However some processors also use sardine and milkfish as the raw material, although in a relatively small quantity compared to the former (Fitriati *et al.*, 1994).

Many research studies investigated the effect of processing methods on the quality of salted-boiled fish as well as the efforts to increase the shelf life of the product. Chemical composition of salted-boiled *Rastrelliger* sp. and *Euthynus* sp. which have been processed by several different methods has been determined by Ibrahim (1986). It was found that the content of protein, lipid, moisture and salt ranged between 17.9 - 31.4 %, 1.1 - 8.4 %, 45.0 - 71.4 % and 0.6 - 9.1 % respectively. Mulyani (1993) studied the effect of processing and storage on the quality of protein in salted-boiled mackerel by focusing mainly on the changes in the available lysine. The work revealed that the brine-boiling technique caused a higher loss of available lysine than that of dry-salt boiling and, in contrast, dry-salt boiling yielded higher loss of available lysine during storage at room temperature. A study on the changes in lipid quality which focused on omega-3 fatty acids (EPA and DHA) stability of several fishery products, including salted-boiled fish, during processing found that the decrease of EPA and DHA was not only influenced by the method of processing but also by the types of fish, which relates to its chemical composition, particularly fat content (Sunarya *et al.*, 1994).

Due to the limited information on the effect of processing on the omega-3 fatty acids, particularly EPA and DHA of salted-boiled fish produced by Javanese traditional processors, a study to understand the level of omega-3 fatty acids losses during processing of salted-boiled scad and little tuna was carried out. This paper describes the results of the work. A suggestion to support the efforts on the introduction of quality management concept to traditional processors in Indonesia is also made.

Materials and Methods

The raw materials and end products of salted-boiled fish processed using two different methods (dry-salt and brine boiling) were taken from traditional processors of major production centres in Java including Jakarta, Cirebon (West Java), Pekalongan (Central Java) and Muncar (East Java). The fish were scad (*Decapterus russelli*) and little tuna (*Auxis thazord*) of regular sizes. The samples were frozen and packed in insulated boxes filled with ice to keep the temperature low. They were then sent to The National Centre for Fishery Quality Control and Processing Technology Development (NCQC), Jakarta and kept frozen prior to chemical analysis.

The chemicals used for analysis were analytical grade (AR) from E. Merck whenever possible. Otherwise, general purpose reagent (GPR) grade was used, whereas standard fatty acid for individual identification were obtained from Sigma Chemical Co.

The moisture, ash, protein and lipid contents of the fish were determined; the methods of analyses used were oven drying for moisture, furnace for ash, total nitrogen of Kjeldahl for protein and soxhlet method for lipid determination (Anon., 1994). The fatty acid analysis was done according to Sunarya (1987) which is a modification of IUPAC method in which the extraction of fat was done using the Bligh and Dyer method (solvent combination with water, methanol and chloroform), formation of methyl ester (methylation) was done using potassium hydroxide in methanol with boron trifluoride (BF_3) as the catalyst and the final analysis of fatty acid was carried out using Gas Chromatography Model Packard 437A equipped with flame ionization detector and a packed SP 2330 column. Temperature of analysis was programmed starting from 180°C for 4 minutes and raised to 230°C with the increase of temperature at 5°C per minute. The individual fatty acid was expressed as its relative percentage by calculating the ratio between percentage of a fatty acid with total percentage of all identified fatty acids.

Results and Discussion

The composition of the raw materials and end products of salted-boiled fish are presented in Tables 1 and 2. It can be seen that there was a decrease in moisture content due to processing (heating) which varied between 0.9 % and 6.7 % for brine boiling and between 6.0 % to 17.2 % for dry-salt boiling. The decrease in moisture content coincided with the increase in protein content as well as ash and fat content calculated on wet weight basis. It is obvious that the increase of protein, ash and fat contents were more significant in the product processed using dry-salt boiling as the decrease of moisture content was relatively higher.

Analysis of fatty acid profile using gas chromatography on the raw material and end product of salted-boiled fish (Figs. 1 and 2) reflected that types of individual fatty acid and its relative percentage varied depending upon types of fish as shown in Tables 3 and 4. In general, types of individual saturated fatty acid which were detected in relatively large quantity were myristic acid (C14:0), palmitic acid (C16:0) and stearic acid (C18:0). Also present were palmitoleic acid (C16:1), oleic acid (C18:1), eicosaenoic acid (C20:1) and docosaenoic acid (C22:1) among the monounsaturated fatty acids (one double bond), whereas polyunsaturated fatty acid (more than one double bond) present were mainly linoleic acid (C18:2), octadecatetraenoic acid (C18:4), eicosapentaenoic acid (C20:5; EPA) and docosahexaenoic acid (C22:6; DHA). From Tables 3 and 4, it can be seen that saturated fatty acids were relatively more stable during processing compared to monounsaturated and polyunsaturated fatty acids, particularly EPA and DHA.

The loss of EPA in the product from brine boiling varied between 0.58 % to 2.78 %, whereas in dry-salt boiling was 0.48 % to 5.02 %. Furthermore, the loss of DHA was between 0.16 % to 5.24 % and between 0.67 % to 9.79 % for brine boiling and dry-salt boiling respectively. The highest loss of EPA and DHA were found in salted-boiled scad processed by boiling scad which has been known to contain quite high amount of fat.

From Tables 3 and 4, it can also be seen that the loss of EPA and DHA in dry-salt boiling process was generally higher compared to brine boiling. This is probably due to the higher temperature and longer duration of heating used in the dry-salt process. The loss of DHA seemed also to be higher in all samples compared those of EPA and the reason for this is because DHA contain double bonds (six double bonds) compared to EPA (five double bonds).

Conclusion

From this study, it can be concluded that during processing of salted-boiled fish the loss of EPA and DHA was relatively higher from the product which was processed using dry-salt boiling technique compared to those boiled with brine. It has been found also that the duration of processing (heating) influenced the level of EPA and DHA losses; longer time of processing (heating) resulting in higher loss of EPA and DHA. Furthermore, raw materials with high fat content such as scad seemed to be more susceptible to the destruction of EPA and DHA during processing.

Accordingly, it is suggested not to use the dry-salt boiling technique in the processing of salted-boiled fish for those fish that contain relatively high fat and also the cooking process must be done carefully to avoid overheating.

References

Anon., 1994. Indonesian National Standard for Chemical Analytical Method of Fish and Fishery Products, NCNC, Jakarta.

Fitriati, M., Nurzain, M. and Sunarya. 1994. Monitoring of Nutritional Composition of Raw Material and End Product of Pindang. A Report of NCQC Research Project, NCQC, Jakarta.

Ibrahim, R. 1986. Production and Storage of Salted-boiled Fish (Pindang) using Atlantic Mackerel (*Scomber scombrus*), A Master Thesis, Loughborough University of Technology, UK.

Mulyani, H. 1993. Nutritional Quality Assessment of Protein of Salted-boiled Mackerel (*Scomber* *scombrus*) During Processing and Storage, A Master Thesis, University of Humberside, UK.

Saleh, S., Sudarsono, P., Ibrahim, R., Sunaryo, B., and Ariffudin, R. 1982. The Study on Techno-economics of Pindang Business in Central Java, A Research Paper, Research Institute for Fishery Technology, Jakarta.

Sunarya. 1987. Extraction and Storage Stability of Nutritionally Important Components of Shark Liver Oil, A Ph.D. Thesis, HCHE-CNAA, UK.

Sunarya, Suparno and Irianto, H.E. 1994. Effects of Processing on the Fatty Acid Composition of Several Fishery Products, An FAO Research Project Report, NCQC in Collaboration with Slipi Research Station for Marine Fisheries, Jakarta.

Discussion

Regarding the query on decreased EPA and DHA of the end products as compared to the raw materials, Mr Achmad explained that the losses were only in the fatty acid and not in the lipid contents. He also stressed that the analysis was done only for EPA and DHA and not on the individual lipids and added that the result was derived from the mean of triplicate analysis.

During the discussion, it was suggested that the procedure used in the analysis should have been included in the paper. In response, Mr Achmad explained the process briefly which included brining for 2-3 days and dry-salt boiling for 6-7 days.

Table 1. Chemical composition (g/100g) of salted-boiled fish processed by brine boiling.

No.	Area	Type of sample	Moisture	Ash	Protein	Lipid
1.	Jakarta	Little tuna a	75.17	2.04	17.02	0.39
		Little tuna b	68.50	2.42	21.88	0.82
2.	Cirebon	Scad a	70.30	1.01	21.01	2.55
		Scad b	66.10	2.65	23.83	3.45
3.	Pekalongan	Scad a	74.55	1.58	20.12	1.18
		Scad b	70.12	2.61	23.12	0.96
4.	Muncar	Little tuna a	67.83	1.51	22.81	0.90
		Little tuna b	67.83	1.89	25.27	3.20

Note : a : Raw material b : End product

Table 2. Chemical composition (g/100g)of salted-boiled fish processed by dry-salt boiling.

No.	Area	Type of sample	Moisture	Ash	Protein	Lipid
1.	Cirebon	Little tuna a	71.48	1.24	23.42	0.37
		Little tuna b	63.51	1.60	28.17	4.38
2.	Pekalongan	Scad a	73.32	1.32	20.71	0.62
		Scad b	61.77	3.46	25.44	3.78
3.	Muncar	Little tuna a	56.82	2.13	18.44	1.93
		Little tuna b	52.26	5.63	24.15	2.50

Note : a : Raw material b : End product

Table 3. Relative percentage of fatty acid in salted-boiled fish processed with brine boiling.

Area	Sample	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2	C18:4	C20:1	C20:5	C22:1	C22:6
Jakarta	Little tuna a	6.48	25.53	5.58	10.41	12.09	5.40	1.28	3.20	4.20	2.11	23.46
	Little tuna b	6.00	29.44	6.33	13.51	10.45	1.23	1.27	2.76	3.62	2.13	23.30
Cirebon	Scad a	5.26	33.00	8.88	8.58	15.72	-	1.37	2.00	7.18	2.09	15.87
	Scad b	4.32	32.30	8.02	14.45	13.63	-	1.39	2.37	4.40	1.18	17.81
Pekalongan	Scad a	4.50	24.86	6.93	12.12	11.25	3.85	1.29	3.16	6.33	1.38	24.18
	Scad b	5.20	29.97	9.14	12.60	12.50	2.35	3.63	-	5.63	-	18.94
Muncar	Little tuna a	11.42	23.06	11.45	5.86	9.34	1.61	3.97	7.68	8.08	1.36	16.12
	Little tuna b	11.29	27.00	11.42	7.12	9.57	1.22	4.02	7.37	5.93	-	15.00

Note : a : Raw material
b : End product

Table 4. Relative percentage of fatty acid in salted-boiled fish processed with dry-salt boiling.

Area	Sample	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2	C18:4	C20:1	C20:5	C22:1	C22:6
Cirebon	Scad a	3.38	25.53	6.91	8.09	15.27	1.84	1.41	3.81	10.11	1.25	22.30
	Scad b	4.50	29.11	8.79	8.11	25.60	0.91	1.36	2.89	5.09	1.26	12.33
Pekalongan	Scad a	9.94	35.21	11.26	12.24	15.69	-	1.14	1.68	3.84	-	8.76
	Scad b	9.60	40.60	10.95	13.40	16.91	-	1.27	-	2.63	-	4.60
Muncar	Little tuna a	15.56	27.98	11.17	4.19	10.99	1.27	3.18	5.61	10.46	-	9.09
	Little tuna b	14.37	27.34	11.62	5.59	12.41	1.73	4.07	6.97	7.44	-	8.42

Note : a : Raw material
b : End product

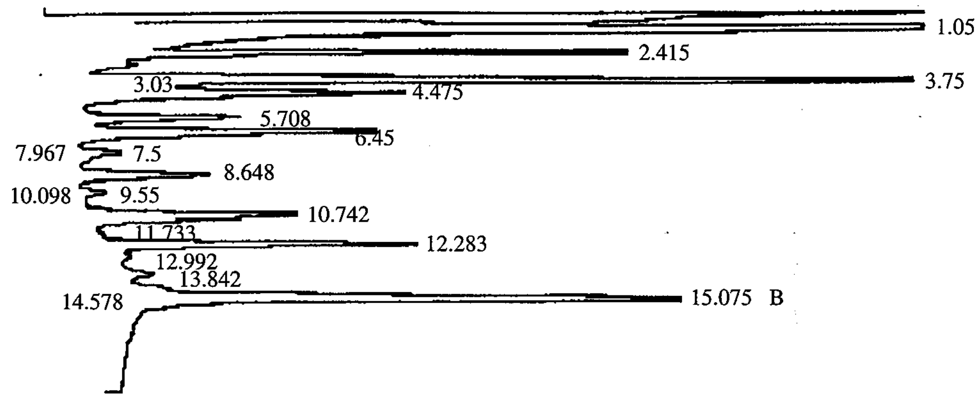

Fig. 1. Chromatogram of fresh scad taken from Pekalongan. (A=EPA; B=DHA)

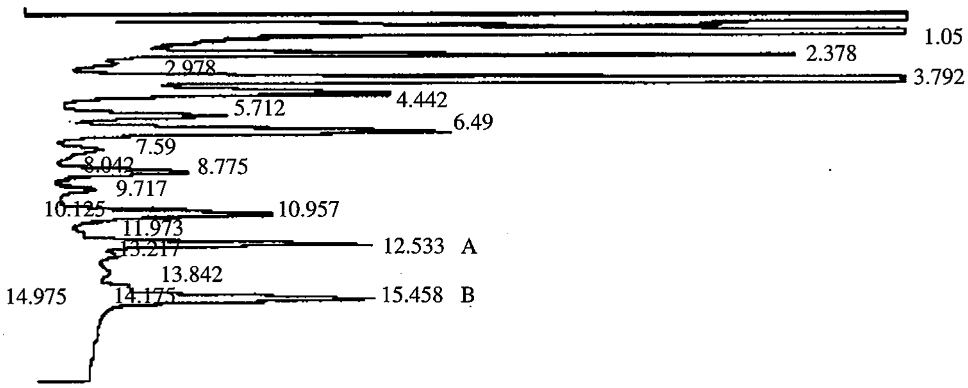

Fig. 2. Chromatogram of salted-boiled scad taken from Pekalongan (brine boiling). (A=EPA; B=DHA)