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IMPACT OF MICROWAVE COOKING ON THE HEALTH BENEFICIAL OMEGA 3 FATTY ACIDS OF SARDINES

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Abstract: Sardine is a marine pelagic fish rich in omega 3 fatty acids available plenty in the South east coast of India. In the current study, sardines, *Sardinella gibbosa* were subjected to microwave cooking at different duration of 20, 30 and 40 sec. The changes in the fatty acid composition was examined. The major fatty acids were found to be mrystic, palmitic, stearic, palmitoleic, oleic, Eicosapentaenoic acid and Docosahexa enoic acid in raw and microwave cooked sardines. The health beneficial omega 3 fatty acids were found to be retained upon microwave cooking. The microwave cooking can be suggested as an alternative to traditional curry and frying to retain health beneficial omega 3 fatty acids.
Keywords: Sardine, Micro wave cooking, Omega 3 fatty acids, EPA, DHA

Introduction

Fish has long been recognized as a valuable source of high quality protein in human diet. Recently there has been a growing interest in the consumption of fish and fishery products as sources of omega 3 poly unsaturated fatty acids (PUFA's) which includes Eicosa pentaenoic acid (EPA) and Docosa hexaenoic acid (DHA). Fish lipid contains high content of PUFAs that reduce levels of triglycerides and LDL cholesterol in blood serum and reduce blood pressure and tendency of blood to form clots and thus reduces the risk of atherosclerosis, cardio vascular disease and arterial hyper tension. DHA is essential for infant brain development and eye function (Birch, 1998). Omega 3 PUFA's has potential therapeutic benefits for rheumatoid arthritis, as there is a mechanism that involves immune system modulation to reduce the action of inflammatory compounds (Darlington & Stone, 2001). According to the American Heart Association, at least two servings of fish per week are recommended to confer cardio- protective effects (Krauss et al., 2000).

Fish is normally cooked by several methods such as boiling, steaming, poaching, grilling, smoking etc. During cooking of fish, the digestibility is increased due to protein denaturation

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but the content of thermo labile compounds and polyunsaturated fatty acids is often reduced. As the fats of fish are highly unsaturated they are prone to oxidation during cooking or thermal processing and there is a loss of these health beneficial omega 3 fatty acids.

Microwave ovens are gaining momentum in Indian households for cooking, heating and reheating purposes. Microwave ovens change regular electricity into high frequency microwaves that water, sugar and fat can absorb causing food particle vibration, and therefore resulting in heating of food. (Garcia – Arias et al., 2003). Microwave cooking has advantages that no oil needs to be added, heat source can be standardized, the product is heated throughout its volume and microwave ovens are readily available. Moreover, information available regarding how microwave cooking affects nutritive value of fishery products is also less. Also their usage in cooking fish is limited.

Several works have been carried out on the impact of different cooking methods on fish lipids and few works on effect of microwave cooking on the lipids. There is a decrease in EPA and DHA content of fishes upon frying (Gladyshev et al., 2007, Weber et al, 2008 and Laly and Venkateswarulu 2016). Hearn et al. (1987) studied the stability of polyunsaturated fatty acids after microwave cooking of butterfish, mullet, mackerel and sardines. Effect of microwave cooking on the fat content and fatty acid profile of *Scomberomorous guttatus* have been studied by Bakar et al. (2008), New Zealand King Salmon (*Oncorhynchus tshawytscha*) by Larsen et al. (2010).

Sardine, *Sardinella gibbosa* is a pelagic fatty fish available plenty along the coast of Tamil Nadu. It is consumed normally in the form of curry, fry or dry salted form. It is rarely cooked in microwave ovens. This work is carried out to study the impact of microwave cooking at different time intervals on the changes in fatty acid profile of sardines.

Materials and methods

Sardines, *Sardinella gibbosa* was purchased from fish landing centre, Thoothukudi and brought to the laboratory in iced condition. They were washed, beheaded and gutted. The dressed sardines were divided into four lots. From each lot, every time, two sardines were placed on a pre weighed ceramic plate and cooked on 100% power for 20, 30 or 40 sec using LG convection type microwave oven. The core temperature immediately after microwave cooking was recorded. For comparison, from another lot 6 pieces of sardines were placed inside polythene pouch and kept immersed in vessel of boiling water for 10 min. in LPG stove.

The moisture content was estimated by standard AOAC method.

Fatty acid analysis

Fish lipids from the raw sardine and different sub lots were extracted following the procedure of Folch et al. (1957). Fatty acid composition was determined by gas chromatography technique following the method described by Stephen et al. (2010) with slight modification. Perkin Elmer Autosystem XL Gas Chromatography fitted with a flame ionisation detector (FID) and a fused silica capillary column (PE-225, 0.25 mm ID, 30 m length) was used for the separation. Peaks were identified by comparison of their retention times with those of authentic fatty acid standard mixture (Sigma Chemicals Co.) and expressed as peak area percentage.

Statistical analysis

All data represent average of triplicate samples. Data analysis was carried out using one way ANOVA using Statistical Package for Social Science (SPSS) software version 16.0.(SPSS Inc, Chicago, Liinois, USA). All mean separations were carried out by Duncan multiple range test using significance level of 95% ($p< 0.05$)

Results and Discussion

Fig.1 Moisture content (%) of raw and cooked sardines

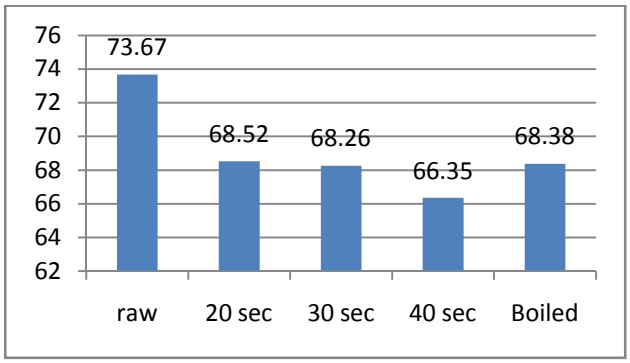

Table 1. Fatty acid composition of raw and boiled fish

Fatty acid	Raw fish	20 sec	30 sec	40 sec	Boiled fish
C12:0	0.36±0.01	0.26±0.02	0.15±0.01	0.3±0.01	n.d
C13:0	0.24±0.01	0.21±0.01	n.d	0.17±0.00	0.56±0.01
C14:0	8.3±0.87	4.59±0.57	4.55±0.71	6.05±0.95	8.93±0.97
C15:0	n.d	n.d	1.19±0.02	1.33±0.01	1.75±0.02
C16:0	29.33±1.54	23.05±1.21	25.75±0.91	29.47±1.12	29.7±1.32
C17:0	1.94±0.36	1.29±0.02	1.34±0.01	1.3±0.02	1.52±0.04
C18:0	6.89±0.89	5.77±0.61	8.07±1.25	7.63±0.87	6.07±0.42
C20:0	n.d	0.47±0.01	0.43±0.01	0.42±0.01	
C21:0	2.57±0.01	n.d	n.d	n.d	2.61±0.04
C22:0	n.d	0.18±0.01	n.d	n.d	n.d
C24:0	n.d	0.46±0.06	n.d	n.d	n.d

Σ SFA	**49.63±3.69^{a}**	**36.28±2.52^{b}**	**41.48±2.92^{b}**	**46.67±2.99^{ac}**	**51.14±2.82^{a}**
C16:1	4.46±0.57	3.11±0.54	3.64±0.61	3.65±0.08	5.72±0.89
C18:1	6.45±0.34	5.48±0.09	7.3±1.12	6.51±0.12	2.06±0.03
C20:1	2.15±0.05	n.d	n.d	2.58±0.07	1.82±0.07
Σ MUFA	**13.06±0.96^{a}**	**8.77±0.63^{b}**	**10.94±1.73^{cd}**	**12.74±0.27^{ad}**	**9.6±0.99^{bc}**
C18:2(n3)	1.6±0.09	2.05±0.04	2.26±0.01	1.64±0.10	1.72±0.08
C18:3	1.71±0.02	1.55±0.07	2.18±0.02	1.41±0.09	1.66±0.09
C20:2	n.d	n.d	0.34±0.00	n.d	n.d
C20:3(n6)	1.83±0.21	0.11±0.00	0.34±0.01	n.d	n.d
C20:5	5.53±0.89	5.61±0.14	5.57±0.87	4.84±0.06	5.45±0.74
C22:2	n.d	n.d	0.2±0.01	n.d	n.d
C22:6	21.62±1.07	25.74±1.54	22.9±0.88	20.96±1.05	20.82±1.12
Σ PUFA	**32.29±3.08^{ab}**	**35.48±1.81^{a}**	**34±1.82^{a}**	**28.85±1.30^{b}**	**29.65±2.03^{b}**

All values are mean ± standard deviation of triplicate analysis (n=3). Different superscript in the same row indicates significant differences (P<0.05)

The moisture content of raw sample (Fig.1) was found to 73.67% which reduced to 68.52, 68.26 and 66.36% upon microwave cooking at 20, 30 and 40 sec respectively and to 68.38% in boiled fish. The moisture content in cooked samples was lower than that of raw fillets (Gokoglu et al. 2004, Unusan, 2007). The core temperature immediately after cooking of 20, 30 and 40 sec microwave cooked and boiled fish were found to be 52.5^{0}C, 64.5^{0}C, 70.5 ^{0}C and 71^{0}C

The major fatty acids in raw sardines were mrystic, palmitic, stearic, palmitoleic, oleic, EPA and DHA (Table 1). The total saturated fatty acid content of raw sardine was 49.63% which reduced significantly (P< 0.05) in 20 and 30 sec. microwave cooked sardines. This was mainly due to the reduction of myristic and palmitic acid and the absence of C21:0. Similar decline in palmitic acid and myristic acid content of microwave cooked seabass was reported by Turkkan et al (2008). However there was no significant difference (P> 0.05) between the saturated fatty acid content of raw and 40 sec. microwave cooked and boiled sardines. The total MUFA content of 20 and 30 sec. microwave cooked sardines were found to be significantly lesser (P<0.05) than raw sardines and no significant change (P> 0.05) in MUFA between raw and 40 sec microwave cooked and boiled sardines. Oleic acid (C18:1) was reduced in microwave cooked herring (Ilow et al. 2002). There was significant increase in total PUFA content of 20 sec and 30 sec microwave cooked fish due to the increase in concentration of EPA and DHA. The protection of EPA and DHA might be due to the presence of Squalene which is a natural antioxidant found in fish fat that have a protective activity relative to fatty acids, protecting them against oxidation (Ilow et al.2002). Thus

PUFA were not destroyed in the process of microwave cooking. (Hearn et al. 1987). The loss in EPA and DHA of 40 sec microwave cooked sardines were 12% and 3 % respectively.

Conclusion

The results of the study show that microwave cooking of sardines does not cause any significant change in the fatty acid composition. The retention of EPA and DHA in sardines is a very good information which can be suggested to the common household to switch over to this alternative method of cooking as microwave cooking is fast, safe and convenient.

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