EFFECT OF DIFFERENT COOKING METHOD ON PHYSICOCHEMICAL AND PROXIMATE COMPOSITION OF INDIAN SQUID

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Abstract

The study investigated the influence of cooking methods (boiling, steaming, frying, microwaving) on proximate, physicochemical paramets (cooking loss, water activity, pH,WHC,), of Indian Squid (*Loligo Duvacelli*) fillets was evaluated. In all the processing methods, there was reduction in moisture and increase the protein, ash and lipid content. Physicochemical parameters of Indian Squid significantly differed both in raw and cooking state. WHC was influenced significantly ($p<0.05$) by cooking process, since the lowest WHC values were founded in fillets from microwave method. Considering overall proximate composition, physicochemical parameters and total antioxidant capacity: micro waving and frying were good quality cooking methods among other methods.

Introduction

Fish is a nutritionally recognized source of proteins with high biological value in human nutrition. The most popular marine fish species, extensively distributed in the tropical Indo-Pacific region is Indian Squid (*Loligo Duvacelli*). This species is an significant revenue yielding variety in South India [1-3] with an estimated annual production of tamilnadu region being 1,061 metric tons in the year 2015-16 [4]. This fish species have lengthy bodies with a slightly thick appearance [5]. It has conventional interest for consumers because it is well identified for taste, easily cooked, highly rich nutrient content in the muscle part and low cost. [6].

Cooking methods and influence of temperature also plays a vital role on the nutrient and anti oxidant activity. As cooking of fish is essential to achieve a safe and palatable dish it is essentially important to understand the physico-chemical changes of fish during heating. Methods of cooking can alter structure of food component and cooking methods involving heat include boiling, steaming, frying and microwave. Microwave cooking has been the most commonly used methods to cook food in the last decade. These cooking methods not only help increase shelf life by inactivating pathogenic microorganism, they also enhance flavor and taste of the fish. Specific cooking treatments (boiling, steaming, frying and microwaving) time and temperature are one of the prevailing factors to denature the myofibrillar protein (myosin and actin) which causes the muscles toughness and juice loss of fish fillets [7-8]. The aim of the study is to investigate the changes under the influence of different cooking methods on the physico-chemical and proximate of Indian Squid

2. 2. Materials and methods

2.1. Chemicals and fish sample

2.1.1. Chemical materials

All reagents were purchased from Himedia, India with of the highest grade.

2.1.2. Fish preparation

Indian Squid (n = 20) were purchased from a local fish market in Ukkadam, Coimbatore, Tamilnadu India. The average weight and length of Indian Squid was 110.05±15.02 g and 20.5±3.0 cm, respectively. Upon collection the fish was placed in plastic iced box and shifted to the laboratory. After arrival, fish was washed several times with tap water, and eviscerated.

2.2. Cooking process

The fish fillets weighing 300g each were divided into five groups, four groups of fillets were subjected to different cooking processes including boiling(100°C for 10 min), steaming (100°C for 10 min), microwave(2450MHz, 6 min) and frying(180°C, 5 min) using AOAC method [12] (976.16; cooking method of sea food) another one group was used as control (raw fish fillets). Sunflower oil was used a medium for frying. After completion of cooking process, the fish fillets were cooled at laboratory temperature and skin and backbone were removed. All fish fillets were homezenised with food blender to evaluate proximate composition and physicochemical characterization. Cooked samples were further freeze dried for analysis of total antioxidant capacity. All fish fillets homogenates were assayed in triplicate.

2.3. Chemical composition

The chemical composition including moisture, protein, fat and ash content of processed and control fish samples were analysed using standard AOAC methods [13]. Moisture content was done by gravimetric method in a hot air oven at 105ºC until constant weight was obtained, and the quantity of ash was analysed using a muffle furnace at 550ºC until constant weight was obtained. The lipid content was analyzed using a Soxhlet extraction system and the crude protein content of fish was measured by standard Kjeldahl method using 6.25×N as the conversion factor.

2.4. Physico-chemical characteristics

2.4.1. Cooking loss

The cooking loss of processed fish samples was performed using the method described by Niamnuy et al [14]. Cooking loss was calculated as the percentage of mass difference between processed and fresh fillets comparative to the weight of fresh fillets as follows. Cooking loss (%) = (weight of fresh fillet-weight of cooked fillet)/weight of fresh fillet*100

2.4.2. Water activity

The water activity of fresh and cooked fillet were determined using an electronic dew site water activity meter (Aqualab Series 4TE, Decagon Devices, Inc., USA) at room temperature (25±2°C). Sufficient amount of sample was taken in sample holder and precaution was taken so that sample does not touch the sensor. Measurement of water activity was carried out until the value was concurrent.

2.4.3. pH

The pH value of the fresh and cooked fish fillets was determined by digital pH meter (Cyber Scan 5105 pH/mV/Temperature meter, Eutech Inc, Singapore) calibrated at room temperature.

The pH electrode was inserted directly into fresh and cooked fish fillet at center part of the each sample

2.4.5. Determination of water holding capacity

Water holding capacity (WHC) of fresh and cooked fish fillets was performed using the method described by Chiavaro et al [7]. Sample weighing 3 g from the dorsal part of fillet was covered by filter paper and centrifuged at 3000 g in a centrifuge for 15 min at room temperature. The liquid was drained and the sample was re-weighed. The percentage of water retained by the sample after centrifugation was expressed as WHC. Analyses were performed in triplicate for

2.5. Statistical analysis

Physicochemical characterization of fresh and cooked fish fillets of Indian Squid was analyzed using one-way analysis of variance (ANOVA). Post hoc analysis was carried out using Duncan's Multiple Range Test (DMRT). The level of significance was static at 95%. Results were analyzed using SPSS package (Version 20).

3. Results and Discussion

3.1 Proximate composition

The proximate composition of raw and cooked Indian Squid are given in Table 1. The moisture content of Indian Squid fillet was decreased after subjecting to various cooking method from 63 to 75 per cent. Minimum moisture loss was observed in boiled fillets whereas maximum loss was noted in fried fillets. The ash content of the raw fillet was 1.3 percent and upon subjected to various cooking method the ash content of the mackerel varied. The highest ash content (1.7%) was recorded in the fried fillet. Indian Squid fillet constituted 18.8 per cent protein in the raw form and the protein content increased irrespective of the cooking method and highest was noted in microwaved (27.1%) fillet. A similar trend was also noted in the lipid content which was increased from 4.5 per cent in raw sample to 11.5 per cent (fried sample) which could have been attributed by the oil absorption during cooking process, where oil penetration is prominent after partial loss of water by evaporation [22]. The significant increase in the ash, protein and lipid in the various cooking method is correlated with the decrease in the moisture content [23].

Table 1: Proximate Composition of raw and cooked Indian Squid.

Cooking Method	Moisture	Protein	Lipid	Ash
Raw	74.6 ± 0.62^{a}	18.8 ± 0.20^{e}	4.5 ± 0.05^{d}	1.3 ± 0.01^{e}
Boiled	70.2 ± 0.57^{b}	22.5 ± 0.13^{d}	4.9 ± 0.08^{c}	1.5 ± 0.11^{d}
Steamed	68.6 ± 0.59^{b}	23.7 ± 0.25^{c}	5.3 ± 0.05^{c}	1.5 ± 0.12^{c}
Fried	63.5 ± 0.58^{c}	25.9 ± 0.44^{b}	11.5 ± 0.48^{a}	1.7 ± 0.04^{a}
Microwaved	64.9 ± 0.26^{c}	27.1 ± 0.31^{a}	6.5 ± 0.31^{b}	1.6 ± 0.01^{b}

Data expressed as Mean ± Standard Error of Triplicates

Means within the same track have no common superscripts are significantly different ($P < 0.05$)

3.2 Cooking loss

The cooking loss for the various cooking method used is presented in Table 2. Cooking loss is directly dependent on the cooking process. Microwaved fillets showed significant loss (35.5%) followed by fried (33.9%) and the boiled fillets (26.6%). Minimum loss was noted in the steamed

fillets (24.9%). Significant loss of matter is correlated with higher cooking loss and is found to have a linear relation between cooking temperature and time. Further mass transfer process in thermal variation will also affect water loss [24]. The loss of water may be attributed by the protein denaturation during cooking process as denaturation of protein may result in less entrapment of water into the protein structure [25]. Boiled fillets have comparably low cooking loss which could be due to the presence of steam in the steam pot which would have suppressed the evaporation from the fillet.

3.3 pH

The pH of the raw and fish fillet subjected to different cooking methods is summarized in Table 2. The pH value of the raw fillets was 6.53. Raw fillets had high pH values when compared to cooked fillets. Decrease in pH was not significant among boiled and steamed fillets where as microwaved fillets reported to have the lowest pH of 6.15.

3.4 Water activity

The shelf life of a particular food system is measured by its water activity (aW), as this intrinsic property denotes the availability of free water in the food system. Reduced aW of a food system provides a shield to the microbial growth and delays deterioration in biochemical reaction. Whereas increased aW decreases shelf life. In the current study, there is variability in the values of aW of sample subjected to various cooking methods (Table 2). The aW ranged from 0.77 to 0.88 in the mackerel fish subjected to different cooking methods. These findings are in agreement with those reported by Oduro et.al. [23].

Table 2: Cooking loss, pH, water activity and WHC parameters of raw and cooked Indian Squid

	Cooking loss	pH	Water activity (aW)	Water holding capacity
Raw	-	6.53 ± 0.08^{d}	0.92 ± 0.02^{a}	65.7 ± 0.69^{a}
Boiled	26.6 ± 0.39^{c}	6.39 ± 0.47^{c}	0.88 ± 0.08^{b}	53.3 ± 0.66^{b}
Steamed	24.9 ± 0.16^{d}	6.37 ± 0.03^{c}	0.85 ± 0.08^{c}	40.4 ± 0.49^{c}
Fried	33.9 ± 0.29^{b}	6.26 ± 0.05^{b}	0.74 ± 0.05^{e}	33.4 ± 0.63^{d}
Micro-waved	35.5 ± 0.52^{a}	6.15 ± 0.05^{a}	0.77 ± 0.08^{d}	31.2 ± 0.52^{e}

Data expressed as Mean ± Standard Error of Triplicates

Means within the same track have no common superscripts are significantly different ($P < 0.05$).

3.5 Water holding capacity

Water holding capacity was 65.7 per cent in the raw sample. Subject to various cooking mthods, it could be revealed that the WHC significantly decreased among the various cooking method used. Microwaved fillets showed the lowest WHC (31.2%) followed by fried fillets (33.4%). Cooking methods with increasing temperature have resulted in lower WHC. WHC is dependent on combination of reasons including physical factors as concentration and temperature gradient and protein denaturation. Protein denaturation is seen in sample as a result of change in the internal structure of muscle and capillaries there in. The highest WHC was noted in boiled fillets (53.3%) followed by steamed fillets (33.4%). The decrease in the WHC on the various cooking method can be asserted with study by (offer 1989) where the presence of water in mackerel muscles is found to be held within the myoglobin between space of the myosin and actin and

within the connective tissue. So as the increase in temperature in the various cooking method, heat induced protein denaturation occur, aggregating the shrinked filament lattice and collagen. This aggregation and shrinkage expose the hydrophophic areas of myofibrillar destruction resulting in denser structure and loss in WHC [24].

Acknowledgements

Author acknowledges the Department of Food Science and Nutrition, Nehru Arts and science College, Coimbatore, Tamilnadu, India, for providing financial assistance and laboratories, equipments and infrastructure.

Conflict of Interest

The authors declare no conflict of interest.

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