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Evaluation of Biochemical Composition of Salt and Garlic Treated Smoke-Dried Chapila (*Gudusia chapra* Hamilton, 1822) and Kaika (*Xenentodon cancila* Hamilton-Buchanan, 1822) Fish at Laboratory Condition (27-31^{0}C)

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Abstract

Investigation on the effects of salt and fresh garlic extract on the biochemical-composition of smoke-dried chapila and Kaika fish showed that in fresh process condition, moisture, protein, lipid, ash and TVB-N contents were found 6.77%, 45.24%, 30.52%, 18.71% and 4.09 mgN/100g in case of salt-garlic treated smoke-dried chapila (S+G-C) and 9.57%, 62.76%, 5.37%, 22.30% and 5.97 mgN/100g in case of salt-garlic treated smoke-dried Kaika (S+G-K) fish respectively. During storage at room temperature (27-31^{0}C), the percentage of moisture and TVB-N value was increased significantly ($p<0.05$) whereas total protein, lipid and ash contents were considerably decreased. The values of moisture (%) content and TVB-N value were increased 10.74% and 20.46 mgN/100g (16th months) in S+G-C while 11.90 % and 21.39 mgN/100g (12th months) in S+G-K respectively. The percentage of protein, fat and ash content were decreased 42.66%, 28.75% and 17.34% in case of S+G-C (16th months) and 61.91%, 4.50% and 21.71% in case of S+G-K (12th month) respectively. The study showed that natural curing agent like salt and garlic extend the shelf life of fish products and among these two types of salt-garlic treated smoke-dried fish products, Chapila fish has better shelf-life because of it fatty texture.

Keywords: Chapila, Kaika, Smoke-dried, salt-garlic, biochemical composition.

Introduction

Being a highly nutritious food item fish is particularly valued for its high quality protein compared to those of meat and egg rich in amino acids and absorbable dietary minerals contains higher amount of lysine and lower amount of tryptophan content than meat a good source of vitamins (vitamin A and D specially in liver and B vitamins) and is an exceptionally good source of minerals (calcium, phosphorus, iron etc.) and other trace elements, including iodine in marine fish and fluoride[1, 2]. Fish also contains lipid consists of nutritionally rich polyunsaturated fatty acids which helps to lower the cholesterol level in human. Fish is currently being used as a good tool for food therapy and source of therapeutic substances for the treatment of coronary diseases, auto-immune diseases, and anemia and protein energy malnutrition.

Various species of freshwater and marine fish are available in a variety of different product forms and can be bought in quantities to suit the buying power of the consumer and provides the consumer with about 60% of their animal protein intake. In 2008, freshwater and marine fish contributed about 80% and 20% of per capita consumption, respectively[3].

Spoilage proceeds with series of complex enzymatic, bacterial and chemical changes that initiates within few hours after fish being caught depending on species and the prevailing ambient temperature. A spoiled fish is unacceptable and unfit for human consumption. The seasonal heavy catch if cannot be properly preserved and processed, these can not be used in different periods and in different places. Thus it is essential to pay close attention throughout the entire process of preparation, catching, landing, handling, storage and transport.

To prolong the shelf life of fish, it is preserved by many processes including sun drying, solar drying, freezing, canning and smoking. Preservation methods such as canning and freezing are relatively expensive in developing countries like Bangladesh. In Bangladesh, a lot of works were done on drying, salting and freezing[4-6]. But few scientific works on smoke-drying and that too on freshwater small fishes such as chapila *(Gudusia chapra)* and Kaika *(Xenetodon cancila).*

Various authors have reported that smoking of fish accelerates drying and prevents microbial activities on fish[7-11]. Among several methods used for long term preservation of fish, smoking is the simplest[12]. Besides smoke curing is not affected by climatic condition, however, smoke cured fish has special taste and odor. Moreover, it has worldwide acceptability as processed fish. Smoked fish are often contaminated with microorganisms including moulds. Some species of these moulds are major cause of spoilage and others are able to produce specific mycotoxins in these smoked fish. Due to the consumer awareness of chemical preservatives, extensive

studies are been made on natural preservatives for preservation of fish products.

Spices are often added while cooking meat and fish in order to add taste, aroma, color and flavor. Many reports are there on the antioxidant and antimicrobial potential of herbs and spices like basil, rosemary, clove, pepper, mustard[13].

Since time immemorial, fish is salted before smoking to protect food against bacteria, mold, and spoiling. Different salting methods are also being practiced by smoked fish industry in different parts of the world[14, 15]. Basically, salt works by drying food. Salt absorbs water from foods, making the environment too dry to support harmful mould or bacteria.

The objectives for the present study was to extend the shelf life of fish treated with salt and spice extracts (garlic) which will not alter the taste and flavor of the food product or add a new undesirable taste. Thus the present research is aimed at studying the effectiveness of fresh salt and garlic on extending the shelf-life by analysis biochemical composition (proximate and chemical composition) smoke-dried chapila and Kaika fish at room temperature.

Material and Methods

Two freshwater fish species; Chapila *(Gudusia chapra)* and Kaika (*Xenentodon cancila*) was collected from the Meghna River early in the morning. Fresh mature fish samples weretransported to laboratory in sterile polythene to avoid any type of microbial contamination. The present study was conducted between October 2011 and June 2013 at the Fish Technology Section of the Institute of Food Science and Technology (IFST) of Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka.

Preparation for Smoke curing of the Experimental fish: Collected chapila fish were descaled while kaika fish were beheaded. Both fishes were then gutted and washed properly. After weighing dressed fishes were prepared for smoke curing. For preparation, fishes were dip in freshly prepared 30% salt and 30% garlic solution for 15 minutes followed by draining. Then these fishes were smoked in improved traditional type of smoking kiln[12]. The fish smoking kiln was operated by first loading tamarind wood chips and rice-husk into the heat chamber, preheating for some minutes and then loading the fish-samples onto removable wire mesh trays in its central chamber for the smoking process. The desired temperature (75-80^{0}C) was maintained manually. Smoking was done approximately for 4 hours. During smoking, fish samples were turned upside down in middle period, to make the sample smooth and steady in texture and appearance. The smoked fishes showed characteristic attractive golden brown color and acceptable texture with smoky flavor, which was followed by cooling for 20-30 minutes at ambient temperature to make fish muscle compressed and facilitate to prevent breaking of smoked products. The cooled smoked fish samples were then packed and sealed in vacuum condition for marketing. Two groups of

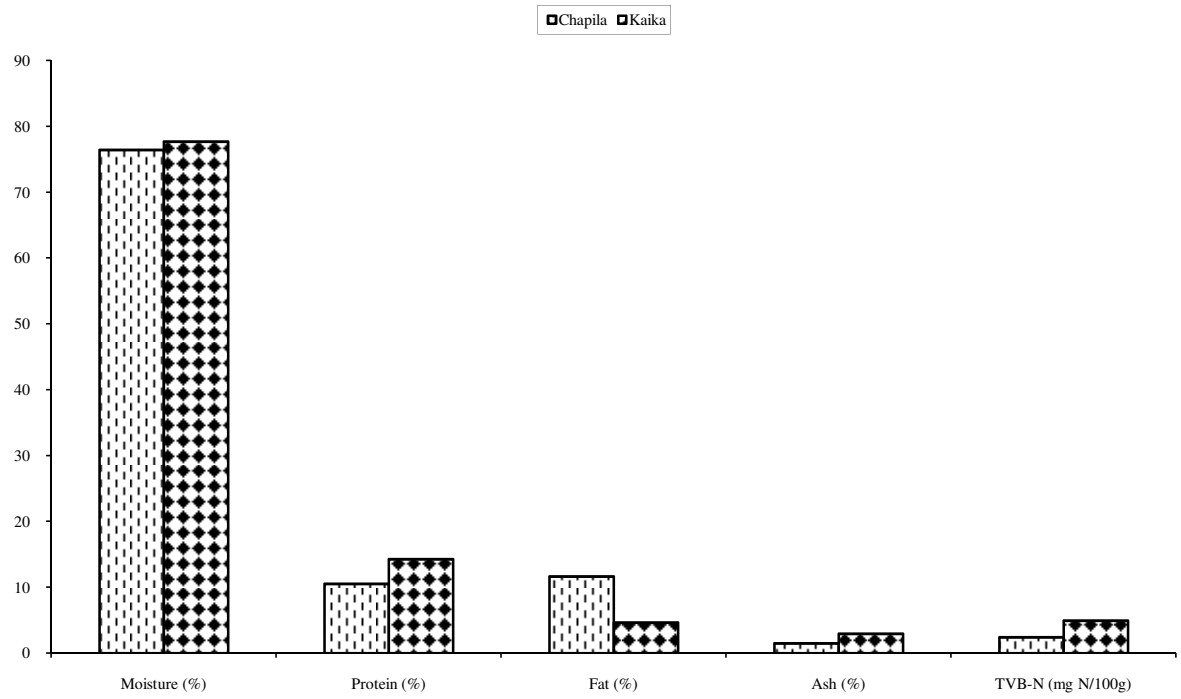

Figure1
Changes in biochemical composition of fresh chapila and kaika fish

smoke-dried fish product were then kept for storage at room temperature for further analysis of biochemical compositions. During the storage period two types of smoke-dried fish samples were checked on two month interval.

Biochemical analysis: Analytical methods were applied for the determination of biochemical composition of the processed fish products on experimental basis. The analytical methods are given below: Moisture, fat and ash contents of the fish were determined by AOAC method[16]. The crude protein of the fish was determined by Micro-Kjeldhal method[17]. Chemical changes were studied by determining the TVN using Conway modified micro-diffusion technique[18].

Statistical analysis: To calculate significance at $p< 0.05$ level all data was analyzed with the help of SPSS for windows, version 20 statistical software.

Results and Discussion

Moisture, protein, fat, ash and TVB-N of fresh Chapila fish was 76.41%, 10.53%, 11.62%, 1.50% and 2.40mgN/100g and Kaika fish was 77.67%, 14.27%, 4.66 %, 2.94% and 4.92mgN/100g respectively figure 1. Fresh sample presented low protein content.

Proximate analysis: During smoke-drying, the percentage of moisture content decreased and protein, lipid and ash content increased significantly ($p<0.05$) due to water loss. This observation is in agreement with the findings of Atlantic mackerel and European eel, pike perch and rainbow trout.

Moisture (%) content: The moisture content can be used as a pointer to the rate at which deterioration occurred in fish samples resulting in the early decomposition. During storage at room temperature, percent of moisture were found to vary from 6.77 % (o day) to 10.74 % (16 month) for salt- garlic treated smoke-dried chapila and 9.57 % (o day) to 11.90 % (12 month) for salt-garlic treated smoke-dried Kaika respectively figure-2 and figure-3. There was a gradual increase in the moisture content of this two types of salt- garlic treated smoke-dried fish samples with increasing storage period. The gutted smoke dried fish samples of African cat fish (*Clarias nigrodigitus*) had moisture content as 6.27 to 10.92 % which is similar with present study[19]. Moisture content of 12% is the level beyond which fish products begin to grow moulds after few days[20]. In this study the final moisture of salt- garlic treated smoke-dried fish samples was less than 12%.

Protein (%) content: Protein decomposes with passing time[21]. Protein (%) were found to vary from 45.24 % (o day) to 42.66 % (16 month) for salt-garlic treated smoke-dried chapila and 62.76 % (o day) to 61.91 % (12 month) for salt-garlic treated smoke-dried Kaika respectively figure-2 and figure-3. In storage condition, the protein content decreased significantly with the time due to water soluble protein diffused out to the surrounding for exosmosis[22].

This could be due to gradual degradation of initial crude protein to more volatile products such as total volatile bases, hydrogen sulphide and ammonia[23].

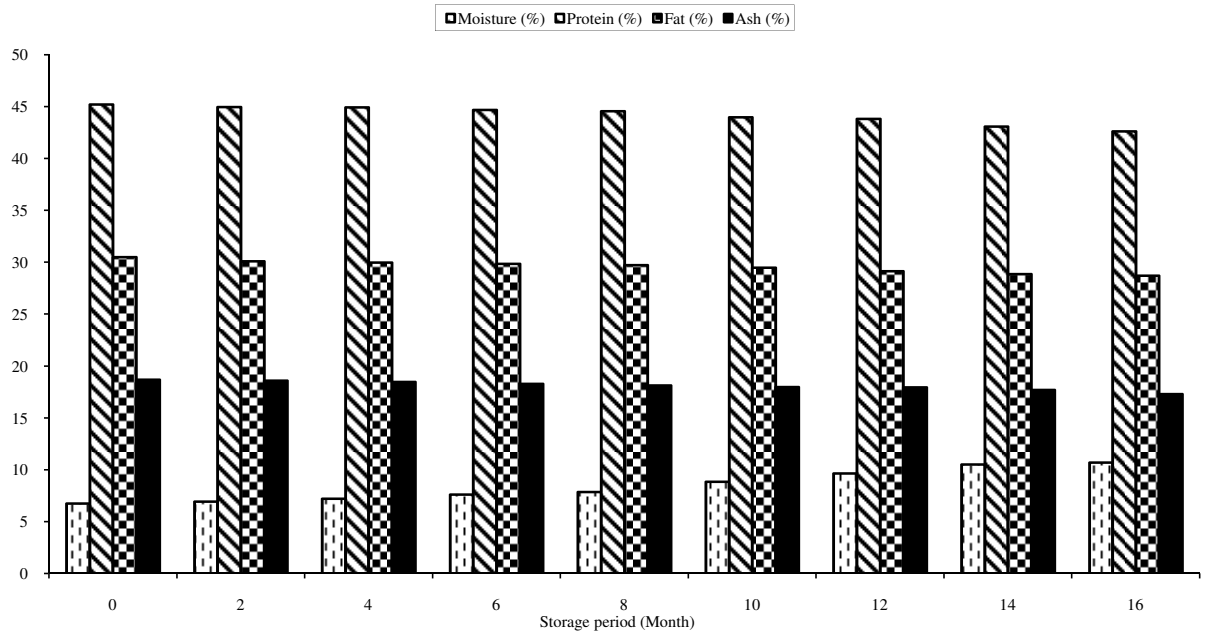

Figure2
Changes in proximate composition of salt and garlic treated smoke-dried chapila fish during storage at room temperature

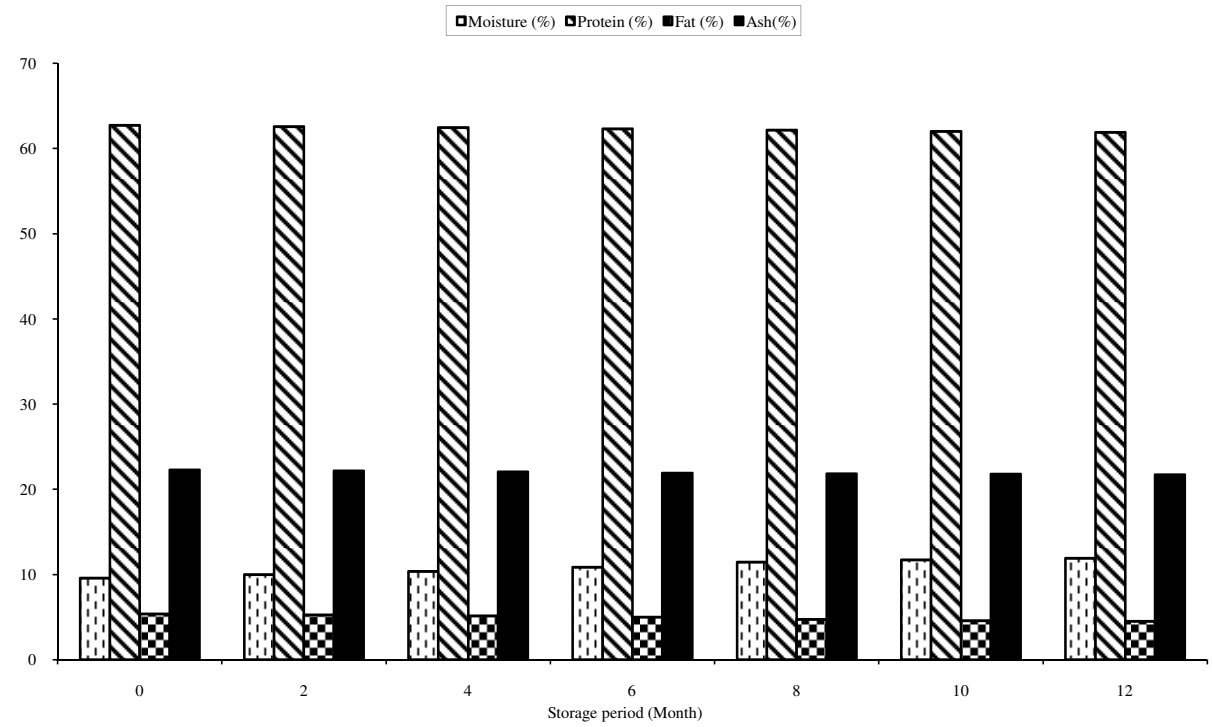

Figure-3
Changes in proximate composition of salt and garlic treated smoke-dried Kaika fish during storage at room temperature

Similar drop in protein concentration was reported for *Heterobranchus longifilis*[24]. These agreed with Stround who reported that smoking process has been found to affect the nutritional value of fish, mainly by reducing the biological availability of proteins.

Fat (%) content: Fat (%) were found to vary from 30.52 % (o day) to 28.75 % (16 month) for salt-garlic treated smoke-dried chapila and 5.37 % (o day) to 4.50 % (12 month) for salt-garlic treated smoke-dried Kaika respectively figure-2 and figure-3. Usually moisture and fat contents in fish flesh are inversely related and there sum is approximately 80%[25]. This inverse relationship was also well defined in this experiment.

Ash (%) content: Ash (%) was found to vary from 18.71 % (o day) to 17.34 % (16 month) for salt-garlic treated smoke-dried chapila and 22.30 % (o day) to 21.71 % (12 month) for salt-garlic treated smoke-dried Kaika respectively figure-2 and figure-3. The ash content changes with the time of storage due to absorbance of moisture and loss of protein[26]. Smaller sized fish species has higher ash content due to the higher bone of flesh ratio[27].

During storing at room temperature, after 12th month it was found that the salt-garlic treated smoke-dried Kaika fish product was spoiled while the salt- garlic treated chapila fish were found to be in their normal characteristics up to the 16th months. Because of antifungal effect of garlic, there is no fungal attack shown on salt-garlic treated smoke-dried chapila and kaika fish product.

Significant statistical differences were found between the initial product and end product ($P < 0.05$) after storage period.

TVB-N value: Total Volatile base Nitrogen (TVB-N) is widely used as an indicator of the degree of lipid oxidation[28]. It helps to measure the level of fish spoilage and to explore the shelf life of fish. During storage period total volatile base nitrogen value (TVB-N) increased. In salt-garlic treated smoke-dried chapila fish product, the TVB-N values ranges from 4.09 (0 day) to 20.46 mgN/100g (16th month) whereas ranges of TVB-N value was 5.97 (0 day) to 21.39 (12th month) mgN/100g in salt-garlic treated smoke-dried kaika fish product respectively figure-4.

Pearson recommended that the limit of acceptability of fish is 20-30mg N per 100g[29]. While Kirk and Sawyer suggested a value of 30-40mg N/100g as the upper limit[30]. Increase in final values of TVB-N in this study is similar with other researchers[23,24]. During hot smoking fish are exposed to heat and atmospheric oxygen. These factors can accelerate the oxidation of the fish lipids resulting in an increased in TBA[30].

Conclusion

Both fishes were shown positive significant influences of smoke-drying on the proximate compositions which make it nutritionally suitable for all. This study has shown that garlic

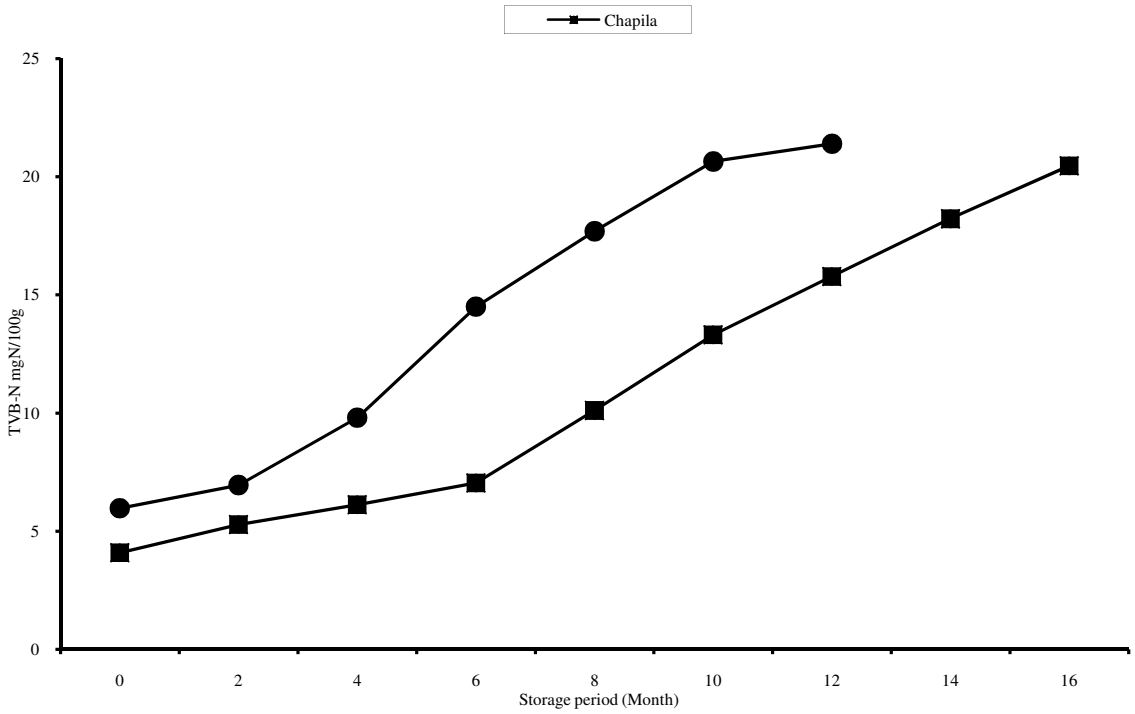

Figure-4
Changes in TVB-N (mgN/100g) contents of salt and garlic treated smoke-dried chapila and Kaika fish during storage at room temperature

has some antioxidative and antimicrobial properties which can retard the growth of micro-organisms and thus extend the shelf life of salt-garlic smoke-dried chapila and Kaika fish products. Appropriate packaging material such as polythene should be used for storing the smoked fish to reduce the post-harvest losses.

Acknowledgement

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