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PREPARATION AND STORAGE OF SALTED AND DRIED PRODUCTS OF FRESHWATER FISH, *GUDUSIA CHAPRA* (HAMILTON, 1822)

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ABSTRACT
Biochemical and organoleptic quality of dry salted fish products prepared from *Gudusia chapra* were evaluated during storage. During the storage period Total Volatile Base Nitrogen (TVBN) value for dry salted samples varied from 21.43mg% to 98.24mg%, for wet salted samples from 25.06mg% to 114.54mg% and for unsalted samples from 32.48 mg% to 148.30 mg%. Alpha Amino Nitrogen (AAN) values at the end of storage period recorded were 137.80mg%, 160.20mg% and 189.56mg% for dry, wet and unsalted samples respectively. Free Fatty Acid (FFA) content (% of total lipid as oleic acid) at the end of storage was 28.34% for dry salted samples, 34.72% in wet salted samples and 42.10% in unsalted samples. A marginal decrease of salt content was recorded in both dry and wet samples. Sensory evaluation indicates that among the three products dry salted products were found to be superior.

INTRODUCTION

The state of Assam is endowed with its vast water resources comprising of Brahmaputra and Barak river systems with their large number of tributaries, beels, swamps etc. provide a good amount of freshwater fishery resources. Even though there is a gap between fish supply and daily demand of large section of fish eating population in the state, yet a sizable quantity of fish is being preserved traditionally by way of drying, salting, fermentation and other local specific methods as there is lack of sophisticated fish storage and preservation facilities in the state (Dutta *et al.*, 1992). Moreover, after recession of recurring flood and also during jeng fishing (a community fishing method practiced in Assam) fishes of different sizes are abundantly caught and sold at a cheaper rate; a lion's share of which are salted and sun-dried products. Popularity of such products in the North-Eastern states is reflected by Jagiroad dry fish market of Morigaon district of Assam, which is considered as one of the largest dry fish markets in South East Asia and plays a key role in distribution of such dried and other preserved products in NE region (Vijayan and Surendran, 2012).

Unfortunately dry fish products prepared by the local fish curers are not much in demand. It is to be noted that use of poor quality raw material, unhygienic processing, improper salting, inadequate drying etc. lead to poor quality end products with limited self life and they fail to attract the local consumers. Patterson and Govindan (2000) revealed that experimentally dried fish had good nutritional quality than commercially dried fish for the same species.

Fish drying practices followed in different regions of India and measures to improve the product quality have been studied by many workers (Eyo, 1993; Kalaimani *et al.*, 1988; Vijayan *et al.*, 1998 and Karthikeyan *et al.*, 2007). However, not much effort has so far been done on preparation and storage of local dry fish on scientific line in the state of Assam and the literature is scanty.

Considering the popularity of salted sun-dried fish among the tea tribes, tribal communities in Assam as well as in other NE states, it is envisaged to prepare good quality salted-dried fish products. It is expected that such type of products if prepared scientifically with attractive packaging for retail sale, it would definitely capture the urban markets of this region too.

MATERIALS AND METHODS

Gudusia chapra, locally called 'Karati' was used in the present study. Fishes were procured from local market, iced and brought to the processing hall. Fishes were then washed, cleaned thoroughly, divided into three batches and processed as follows.

One batch of fish was dry salted in a plastic trough using salt to fish ratio of 1:4. The trough was covered tightly with polythene sheets to prevent exposure to atmosphere. Fishes were stored at an ambient temperature. After 20h fishes were taken out of the container and rinsed with fresh water to remove the adhering salt particles. Then fishes were sundried by spreading them out on a bamboo screened rack.

The second batch was wet salted by dipping in saturated brine in a plastic trough. Weights were kept on the top to prevent floating of fish. To prevent exposure of fish to atmosphere, the trough was covered tightly with polythene sheets. After 18h of brining fishes were taken out; rinsed with fresh water and

spread on a bamboo rack for drying. The third batch of fish was sundried without salting. Dried products were packed airtight in 120 gauge polyethylene bags and stored at room temperature.

Samples were taken from each of the three batches after production and analyzed for proximate composition. Various biochemical parameters of the products were analyzed at regular intervals of two months during storage.

The moisture, crude protein and ash content of freshly prepared samples were analyzed as per AOAC (1975), whereas total lipid was determined by the method described by Bligh and Dyer (1959). The total volatile base nitrogen of the sample was determined by Conway micro diffusion method described by Beatty and Gibbons (1937). Alpha amino nitrogen was estimated by following the method of Pope and Stevens (1939). For estimation of FFA value the method described by Olley and Lovern (1960) was followed. Sodium chloride content was determined as per FAO (1981).

RESULTS AND DISCUSSION

Proximate composition of prepared products: The proximate composition of freshly prepared products is shown in Table 1. The moisture content of dry salted and wet salted products was found to be 17.26% and 20.12% respectively. Unsalted products showed moisture content of 15.23%. Crude protein content was 54.20% and 50.34% for dry and wet salted products respectively. Unsalted products contained 60.24% crude protein. Total lipid content for dry salted, wet salted and unsalted products were 11.20%, 10.48% and 14.94% respectively. Ash content for dry salted and wet salted products were 17.04% and 18.25% respectively and for unsalted products 8.63%.

In the present study, as regards the moisture content, the wet salted fish had about 20% followed by dry salted (17.26%) and unsalted (15.23%) fish. Joseph *et al*. (1983) have reported a moisture content of 25.5% in salted sole. Kalaimani *et al*. (1984) have recorded 24.8% moisture in salted anchovy along west coast of India. Joseph *et al*. (1986) have recorded a minimum of 17% moisture along Tamilnadu coast and 23.7% along Maharashtra coast. Vijayan and Surendran (2012) reported 25.85% moisture content in small freshwater fish of Jagiroad dry fish market of Assam. The dry fish (both salted and unsalted) supply protein in a concentrated form with unsalted fish having higher protein content (60.24%) than the salted fish *i*.e. 54.20% in the dry salted fish and 50.34% in wet salted fish in the present experiment. Solanki and Sankar (1988) have recorded a protein content of 61% and a lipid content of 9.20% in salted and dried sole. In the present study total lipid content for dry and wet salted fish were 11.20% and 10.48%

Table 1: Proximate composition of freshly prepared sundried and salted Karati (*Gudusia chapra*)

Products	Constituents			
	Moisture (%)	Crude protein (%)	Total lipid (%)	Ash (%)
Dry salted	17.26 (0.84)	54.20 (0.90)	11.20 (0.73)	17.04 (0.50)
Wet salted	20.12 (0.52)	50.34 (0.34)	10.48 (0.70)	18.25 (0.25)
Unsalted	15.23 (0.41)	60.24 (0.91)	14.94 (0.22)	8.63 (0.53)

(Values presented are the mean of five estimates and in parenthesis indicate standard deviation)

respectively and 14.94% for unsalted fish. The higher values of ash content in dry and wet salted fish may be attributed to the salt content. The ash content in salted products can be as high as 30% in heavy salted fish.

Storage studies

The changes in nitrogenous bases such as TVBN in salted-sundried and sundried products during storage are presented in Table 2. From the table it is seen that the TVBN content showed an increasing trend during the storage period. TVBN increased from the initial value of 21.43 mg/100 g for dry salted products and 25.06mg/100g for wet salted products to 98.24mg/100 g and 114.54mg/100 g for respective samples at the end of storage. In case of unsalted products the TVBN content increased from an initial value of 32.48mg/100g to 148.30mg/100g after six months of storage.

It is evident from the Table 2 that TVBN content has steadily increased in all the three samples *i*.e. dry salted, wet salted and unsalted samples. But the rate of increase is higher in unsalted fish. Perhaps salt has hindered TVBN production in salted samples. The higher rate of increase of TVBN value during storage may also be attributed to high bacterial load and enzymatic action. High TVBN value of commercial samples has been reported by Vijayan and Surendran (2012). Connell (1980) has suggested a limit of 200mg% TVBN for salted and dried fish. Joseph *et al*. (1986) have reported TVBN content up to 72.7% in salted anchovy and 105.0% in salted sole.

The changes in AAN content of the products is shown in Table 2. From the table it can be seen that AAN showed a gradual increase from the initial value of 32.82mg/100g for dry salted products and 34.26mg/100g for wet salted products to 137.80 mg/100 g and 160.20 mg/100 g in respective samples at the end of the storage. For unsalted products the AAN content increased to 189.56mg/100g from its initial value of 46.25mg/100g.

The AAN content has steadily increased in all the samples due to the breakdown of protein. The higher values in unsalted fish could be attributed to higher proteolytic activity due to increased moisture content. Wet salted fish showed higher AAN content than dry salted fish. Increase in AAN content during storage has been reported.

FFA content: The changes in lipid parameters in terms of free fatty acid (FFA) content for all the products during storage are presented in Table 2. The FFA content for both salted as well as unsalted products showed an increasing trend throughout the storage period and at the end of storage the values were 42.10% of total lipid as oleic acid for unsalted products and 28.34% and 34.72% of total lipid as oleic acid for dry salted and wet salted products respectively.

The FFA content estimated during the study period showed an increasing trend in all the products. The initial FFA content for dry salted and wet salted products were 5.24% and 8.86% of total lipid as oleic acid respectively and at end of storage the values were 28.34% for dry salted and 34.72% of total lipid as oleic acid for wet salted products. For unsalted products FFA content increased from an initial value of 12.90% to 42.10% of total lipid as oleic acid at the end of storage period. The presence of FFA is an indication of lipase activity and other hydrolytic action. The production depends on factors

Table 2: Changes in total volatile base nitrogen (TVBN), alpha amino nitrogen (AAN), free fatty acid (FFA) and sodium chloride (NaCl) content of sundried and salted sundried Karati (*Gudusia chapra*) during storage

Parameter Product Storage Period (months)	TVBN (mg/100g)			AAN (mg/100g)			FFA (% of total lipid as oleic acid)			NaCl (%)		
	DS	WS	US	DS	WS	US	DS	WS	US	DS	WS	US
0	21.43 (0.67)	25.06 (0.49)	32.48 (0.25)	32.82 (0.35)	34.26 (0.39)	46.25 (0.44)	5.24 (0.77)	8.86 (0.62)	12.90 (0.82)	10.25 (0.31)	9.96 (0.79)	-
2	57.33 (0.57)	62.58 (0.31)	78.24 (0.37)	86.62 (0.71)	82.14 (0.20)	108.34 (0.57)	11.36 (0.48)	15.64 (0.56)	20.40 (0.78)	9.16 (0.34)	7.98 (0.78)	-
4	68.90 (0.73)	84.74 (0.45)	106.46 (0.66)	114.26 (0.42)	124.74 (0.35)	152.08 (0.48)	18.44 (0.45)	22.45 (0.88)	25.62 (0.94)	8.06 (0.76)	7.20 (0.39)	-
6	98.24 (0.44)	114.54 (0.50)	148.30 (0.48)	137.80 (0.92)	160.20 (0.27)	189.56 (0.31)	28.34 (0.68)	34.72 (0.24)	42.10 (0.92)	6.60 (0.54)	6.10 (0.64)	-

DS: Dry salted, WS: Wet salted and US: Unsalted; (Values presented are the mean of five estimates and in parenthesis indicate standard deviation)

such as lipid concentration, pH and temperature; and salt has no effect on FFA formation in fish at low concentration and is inhibitory at higher concentration for the formation of FFA (Damodaran, 1980).

Sodium chloride content of the products during storage is presented in Table 2. As far as salt content is concerned, there has been a decreasing trend in both dry salted and wet salted fish during the storage. This decrease in salt content can be attributed to uptake of moisture, due to hygroscopic nature of salt during the storage period. Dutta *et al.* (1992) have reported a decrease of salt content in salted sundried freshwater fish during eight months of storage.

Organoleptic characteristics and statistical analysis

The results of organoleptic evaluation for overall quality of the products based on average opinion of a panel of judges were recorded using 9 point hedonic scale. From the consumer's point of view, the non-measurable attributes like appearance, colour, texture, taste and flavor are the most important aspects of the quality of the cured fishery products. It has been observed that when freshly prepared both salted and unsalted sundried products were extremely good being uniformly dried with pleasant odour. Mean panel scores of more than 7 have been recorded for all the freshly prepared samples. However, the mean panel scores for overall quality of the products decreased as storage time increased. Unsalted products were acceptable up to 4 months. After 4 months products were rated unacceptable due to colour change and unpleasant odour. Both dry salted and wet salted products were acceptable till the end of storage period. However, quality of products obtained by dry salting method was rated superior than those obtained by wet salting method. The study by Karthikeyan *et al.* (2007) showed that freshwater fish dried to a moisture content of 6.8 to 19.9% had microbiological and sensory factors within acceptable limit.

During the storage study, the analysis of variance test was adopted for testing significant difference in mean panel scores for overall quality of the products. A highly significant difference ($p < 0.01$) in mean panel scores was observed between the months of storage, between the products and interaction between products and storage months.

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