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HYGENICITY AND NUTRITIONAL QUALITY OF TRADITIONAL DRIED AND SMOKED FISHES AT KAWARDHA FISH MARKET, (CHHATTISGARH), INDIA

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ABSTRACT
Microbial load was determined as (log_{10} Cfu/g) fresh fish (*Mystus tengara)*, fresh prawn (*Macrobrachium lamarrei)*, dried and smoked fish (*Mystus tengara)* obtained from fish market in Kawardha town. Smoked fish had the lowest bacterial count ($4.84^{ab} \pm 0.15$) while dried fish had highest bacteria count ($8.50^{c} \pm 0.76$). The fresh fish and fresh prawn had the medium bacterial count of $6.33^{b} \pm 0.08$ and $5.42^{a} \pm 0.07$ respectively. The moisture content for fresh fish and fresh prawn were $72.34 \pm 1.45\%$ and $63.00 \pm 1.53\%$ respectively. The moisture content was reduced to $14.34^{a} \pm 2.34$ % and $22.67^{b} \pm 1.45$ % for smoked and sun dried fish respectively. The protein content in smoked dried fish was the highest ($40.00^{d} \pm 1.15$ %) in comparison to fresh prawn ($17.50^{b} \pm 0.87\%$), fresh fish ($13.34^{a} \pm 0.60\%$) and dried fish ($23.34^{c} \pm 1.45\%$) respectively. Total ash content obtained in this study were $1.74^{a} \pm 0.15\%$, $2.50^{a} \pm 0.29\%$, $3.50^{b} \pm 0.40\%$ and $5.07^{c} \pm 0.35\%$ for fresh prawn, fresh fish, dried fish and smoked fish respectively. Higher total plate count of 10^{6}/g or above is considered to be of poor quality for fish. In the present study it was found that total plate count for fresh fish, prawn and smoked fish was under the acceptable limit (10^{6}/g) except for smoked fish.

INTRODUCTION

Curing is a simple, cheap and an ancient method of preservation involving drying, salting and smoking in India. Curing has great significance and relevance in the socioeconomic system of small scale fisher folk (Felicia and Patterson, 2003). With regard to fish processing in Chhattisgarh it is estimated that 35% of total catch is lost due to lack of storage facilities and cold chain. The local fisher folk of Chhattisgarh have developed some traditional fish curing methods like sun drying, salting and smoking. In this respect nearly 30,000- 40,000 tones of locally available fresh fish is processed into smoked (60%) and salted dry (40%) fish. Bastar and kurud region is the most dominated region for fish curing in Chhattisgarh but the curing method employed by local fish farmers is not standardized and most parameters like temperature, relative humidity, quality of smoke, smoke temperature remains uncontrolled which gives poor nutritional quality and high microbial loaded cured fish. These factors have effect on consumer acceptability, commercial value and income of fish farmers/traders (Bostock *et al.,* 1987, Pranjyoti *et al.,* 2013).

Fish is one of the most important sources of animal protein and has been widely accepted as a good source of protein and other elements for the maintenance of healthy body (Andrew, 2001). Biochemical composition of fish tissues are considerable interest for their specificity in relation to food values of fish and evaluating their physiological needs at different periods of life (Shahana Banu *et al.,* 2010). Fish represent an essential component of global food basket to improve the nutrition, health and well being of people. It is a good source of essential micro and macro nutrients but it is an extremely perishable commodity and quality loss can occur very rapidly after catch (Khan and Khan, 2001; Dewi *et al.,* 2011). The processing and preservation of fish is of utmost importance since fish is highly perishable and so various methods of preservation are used to avoid microbial spoilage and increase shelf life (Al-Jufaili, 2006). Traditional methods are followed for the preservation of fish especially in rural areas (Chakrabarti and Varma, 1999). In India about 17% of the total catch is being used for the production of dry fishes (Jeya Shakila *et al.,* 2003).

The qualities of cured fish or fish products are often adversely affected by the growth of fungi in dried fish, which has been reported in several studies (Philips. and Wallbridge, 1976; Anon, 1982; Gupta and Samuel, 1985; CIFT, 1994). In some of the studies have been reported that pathogenic organisms are present in the internal and external surfaces of the fishes but in low concentration (Huss, 1997) and the absence of pathogenic microbes in salted fishes is reported (Kakatkar *et al.,*2010). Although much research has been conducted on the microbial and nutritional analysis of dried and smoked fish in different areas and the effect of curing on the quality parameters of many fish species (Ahmed Ali *et al.,*2011; Abolagba and Igbinevbo 2010; Immaculate *et al.,*2013; Abidemi-Iromini *et al.,* 2011),

Generally in fisher folk sell low quality fishes which are unhygienically captured, stored and processed which lead to high microbial load of cured products. Therefore, the present

study was done to determine the proximate composition and microbial load of traditionally cured fishes and frame a guideline to farmers for curing of fish by simplest means and at the same time microbialy safe for human consumption, with longer shelf life.

MATERIALS AND METHODS

Sample Collection and Preparation for Analyses

Four different species of fresh water fish (*Mystus tengara)*, fresh water prawn (*Macrobrachium lamarrei)*, dried and smoked fish (*Mystus tengara*) were sampled from kawardha fish market, Chhattisgarh State, India. The fresh samples were wrapped in sterile polyethylene bags, labeled and analysed for microbiologicaly and nutritionally.

Biochemical Analysis of Tissues

The moisture, crude protein and ash content of fresh, dried and smoked fish tissue were determined following standard methods (AOAC, 2005).

Microbial load determination

Culture media

The media used in this study includes nutrient agar and nutrient broth (Himedia, India). The media were prepared according to the manufacturer's specification and sterilized in an autoclave at 121ºC for 15 min.

Total bacteria count

The fish samples were analyzed for Total plate count by following the methods of FDA BAM, 2001. One gram of each sample was dissolved in sterile de-ionized water and serial dilutions (10^{-1}, 10^{-2}, 10^{-3}) were prepared for Total Plate Count (TPC). After incubation and plating, the number of colony-forming units per g (Cfu/g) for all samples was calculated by multiplying the number of microbes by the dilution. One milliliter (1 ml) of appropriate dilutions was seeded on plate count agar using spread plate method, and the medium was then incubated at 37ºC for 24h. The plate count agar was examined and colonies present were counted by using colony counter and recorded after incubation at 37ºC for 24 h to get the total colony count in cfu g-1.

Data Analysis

Analysis of Variance (ANOVA) was carried out on all the biochemical and microbial parameters measured to test for variability at 5% level of significance. Duncan Multiple Range Test was used to separate means. Statistical Package for Social Science (Version 15.0) was used.

Table 1: Proximate composition of different fish samples

Treatment	Moist (%)	Protein (%)	Ash (%)
Fresh prawn	$63.00^{c} \pm 1.53$	$17.50^{b} \pm 0.87$	$1.74^{a} \pm 0.15$
Fresh fish	$72.34^{d} \pm 1.45$	$13.34^{a} \pm 0.60$	$2.50^{a} \pm 0.29$
Smoked dried fish	$14.34^{a} \pm 2.34$	$40.00^{d} \pm 1.15$	$3.50^{b} \pm 0.40$
Dry fish	$22.67^{b} \pm 1.45$	$23.34^{c} \pm 1.45$	$5.07^{c} \pm 0.35$

Mean values in the same column with different superscripts differ significantly ($p < 0.05$).
Mean value expressed as mean ± SE

RESULTS AND DISCUSSION

Proximate composition of fish

Moisture

The moisture content in different fish species has been shown in Table No 1. A significant difference was found in moisture content among different fish sample ($p \leq 0.05$). The moisture content in fresh fish was higher ($72.34 \pm 1.45\%$) than in fresh prawn ($63.00 \pm 1.53\%$). Ahmed Ali *et al.,* 2011 reported the 81.49 % to 84.33 % moisture content in the *Tilapia nilotica* and *Silurus glanis*. The moisture content was reduced to 14.34 $\pm 2.34\%$ and 22.67 $\pm 1.45\%$ in smoked and sun dried fish respectively. The similar moisture content (14.06 %) was found in the the *Tilapia nilotica* (Ahmed *et al.,* 2011).

In the present study, the moisture content in sun dried fish was higher compared to smoked dried fish and this could be explained by the fact that during smoke drying the flesh loses moisture in the initial phase that could be compared to cooking. In case of drying, the sun dried fish moisturized the ambient air and lead to increase the relative humidity and reduce the drying rate and subsequent increase in the moisture content compare to smoked fish. The moisture content in fish sample beyond 12% lead to grow moulds after few days (FAO/APHCA, 1989) so care must be taken during storage.

Protein

The protein content in fresh fish was significantly different among sun dried and smoked fish. The smoked dried fish contained $40.00^{d} \pm 1.15\%$ protein which was higher in comparison to $17.50^{b} \pm 0.87$ %, $13.34^{a} \pm 0.60\%$ and $23.34^{c} \pm 1.45\%$ for fresh prawn, fresh fish and dried fish respectively. Similar result was found by Sengul *et al.,* 2008.The high protein content was obtained in dried and smoked fish, with the highest value was always found in smoked dried products. The increase in protein content may be due to product dehydration which concentrated proteins, thus increased protein content as obtained by Thot and Pothast

Table 2: Result of One-way Analysis of Variance (ANOVA) for the proximate composition of different fish sample.

Source of variation	Sum of Squares	Degree of freedom (*df*)	Mean Square	F Value	Significance level (*p*)
Between Groups	7486.917	3	3	277.293	0.000
Within Groups	72.000	8	8		
Total	7558.917				
Between Groups	1234.896	3	3	120.478	0.000
Within Groups	27.333	8	8		
Total	1262.229	11	11		
Between Groups	18.647	3	3	26.830	0.000
Within Groups	1.853	8	8		
Total	20.500	11			

Table 3: Bacterial count in different fish species

Fish sample	Scientific name	Bacterial count (log_{10} Cfu/g)
Fresh prawn	*Macrobrachium lamarrei*	$5.42^{a} \pm 0.07$
Fresh fish	*Mystus tengara*	$6.33^{b} \pm 0.08$
Sun Dried fish	*Mystus tengara*	$8.50^{c} \pm 0.76$
Smoked fish	*Mystus tengara*	$4.84^{ab} \pm 0.15$

Mean value expressed as mean ± SE

(1984).

Ash content:

The total ash content varied significantly in this study i.e. 1.74±0.15%, 2.50±0.29%, 3.50±0.40% and 5.07±0.35% for fresh prawn, fish, dried fish and smoked fish respectively. The value found in this study was close to the study of Ahmed *et al.,* 2011. In dried and smoked fish, the ash content was relatively high because of water loss during drying and smoking.

Microbiological quality

Microbial load was determined as (log_{10} Cfu/g) on fresh, dried and smoked fish obtained from fish market in Kawardha town. The fish meat samples were cultured and bacterial counts were carried out. Table 2 shows that the dried fish has the highest microbial load (8.50±0.76) compare to fresh (6.33±0.08) and smoked fish (4.84±0.15). Higher total plate count of 10^6/g or above is considered to be of poor quality for fish. The acceptable limit of bacterial count for dried fish is 1×10^5 at 37°C (Surendran *et al.,* 2006).

The similar studies carried out in dried fishes of Tuticorin fish market and reported high bacteria count in S. fimbriata (Ashok Kumar, 2008). In Cochin market the bacterial count in dried fishes was less than 10^7 g-1 (Sanjeev, 1997). Saritha et al. (2012) reported high bacteria count in dried fishes of Cuddalore dry fish market. In this study the dried fishes procured from fish market had bacterial count above the permissible limit and it was high dried fish. The microbial load in dried fish may be due to high humidity and also unhygienic processing and handling of fish. The least bacterial load ($4.84^{ab} \pm 0.15$) was observed in smoked fish that may be due to high smoking temperature and low moisture content.

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