Smoke curing of *Pleuroploca trapezium* meat (Gastropoda: Fasciolariidae)

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Best quality of the smoked meat of *Pleuroploca trapezium* was obtained after 5 min of blanching in 5 % brine and 45 min of smoking. The microbial load decreased substantially with the increase of smoking time. Biochemical and organoleptic analysis were also carried out and their nutritive value and consumer preference were included.

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INTRODUCTION

The horse conch, *Pleuroploca trapezium* is available in all seasons along the southeast coast of India with a peak from January to June and a lean season from October to December, due to less fishing activities during the monsoon season. They are collected by trawl net, lobster net and skin diving. The total landings of *P. trapezium* along southeast coast of India during the year 1991-92 was 441 tons and increased to 627 tons during the year 1992-93 (Patterson Edward 1992, 1993, 1994)

The foot and the adductor muscle are consumed by a small section of the fishermen community. The meat is not popular like other seafoods because of food preferences and lack of knowledge of its delicacy and nutritive value. However, after 1991, it gained market value and is now being exported to Southeast Asian countries. At present, the meat value is Rs. 60/ kg. The meat is tough and takes a long time to soften by conventional cooking. Thus it is generally sun dried and eaten after frying.

Smoking offers an alternate method for utilization of the meat. It obtains a longer shelf life and characteristic flavour. Smoking has been considered as a technique for preservation of fish and also to impart the smoky flavour since time immemorial. Smoking is often combined with a period of sun drying and/or preliminary brining. Smoking combines cooking and drying of the meat due to the high temperature produced by smoking. This dries the meat, destroys the enzymes and kills bacteria. Apart from this the smoke contains a large number of compounds some of which, *e.g.*, phenols will kill bacteria.

The long storage life of some smoked meat products is more due to drying and cooking than to the preservative value of the chemical compounds deposited on the meat from the smoke. In the present study, the meat of *P. trapezium* was smoked and the quality of the final product was assessed.

MATERIALS AND METHODS

Fresh *P. trapezium* meat was procured from the fishermen and brought to the laboratory. One gram of raw meat was taken before cleaning for microbial analysis to enumerate the total heterotrophic bacteria and *Salmonella* sp. The meat was cleaned to remove the mucous and dirt in the foot muscle, and cut into thin rounded slices of about 1 mm thickness. 20 g

of the raw meat was dried in oven at 55 to 60 °C for moisture and biochemical analysis. The remaining meat was divided into 3 equal parts and blanched in 5, 10, and 15 % boiling brine for 5 minutes. The blanched meat was drained and spread on trays and dried for 20 minutes to facilitate smoke penetration.

A conventional vertical type smoking kiln was used for smoking the meat and burning sawdust generated smoke. The meat blanched at different concentrations of brine was smoked. During smoking samples were drawn every 15 minutes to observe the effect of smoking time on the quality of the meat.

For enumeration of bacteria, one gram of the sample was macerated with distilled water and serial dilutions of the samples were made in distilled water. Pour plate method using Zobell's marine agar medium and Xylose Lysine Deoxycholate agar medium enumerated the total heterotrophic bacteria and Salmonella respectively. Plates for estimates of THB and *Salmonella* were incubated at 37 °C for 48 and 24 hrs respectively. Bacterial colony counts were made and expressed as Colony Forming Unit (CFU) per gram.

The moisture content was calculated by the difference between the wet and dry weight of the tissue. The salt content was determined by taking one gram of sample and homogenizing in distilled water to thoroughly extract the salt. It was centrifuged and 5 ml of the supernatant was titrated with silver nitrate. The volume of silver nitrate used was proportional to the salt content.

The carbohydrate content was estimated by the phenol sulfuric acid method (Dubois *et al.* 1956) protein by Biuret method (Raymont *et al.* 1964) and lipid content by using chloroform methanol (Folch *et al.* 1956).

The organoleptic characteristics like colour, flavour and overall acceptability of the smoked meat were evaluated on a 5 point hedonic scale. The limit of acceptability was fixed at 3.

RESULTS AND DISCUSSION

Table 1 shows the effect of salt concentration on the quality of smoked meat. The salt content was found to increase with increased concentration of brine and smoking time. The salt taste was normal in the meat blanched in 5 % brine. The taste was too salty in meat blanched in 10 and 15 % brine. Based on the organoleptic analysis, the meat blanched in 5 % brine and smoked for 30 minutes had a

Table 1. Effect of salt concentration on quality of smoked meat of *Pleuroploca trapezium*.

concentration of brine (%)	smoking time (minutes)	salt content (%)	remarks
5%	15	3.4	partial smoke absorption.
	30	4.0	fully smoked & salt taste normal.
	45	4.1	smoky odour marks the taste.
	60	4.2	smoky odour marks the taste.
10%	15	4.5	predominantly saltish.
	30	5.5	
	45	6.3	
	60	6.5	
15%	15	5.0	highly saltish
	30	6.2	
	45	8.2	
	60	8.3	

golden brown colour, good flavour and taste. After 45 and 60 min of smoking, the meat taste was very smoky.

Table 2 shows the effect of smoking time on the quality of smoked meat. The moisture content of the meat smoked for 15 minutes was 11.4 % and it gradually decreased to 5.3 % after smoking for 60 minutes. Smoking of meat removes water. The water activity (Aw) of a foodstuff is the water available to support the growth of microorganisms. Moisture levels of meat also play an important role in the spoilage. Lowering of moisture retards spoilage (Stansby 1963). As water is essential for the activity of all living organisms its removal will slowdown or stop microbial or autolytic activity, thus smoking is used as a method of preservation.

Table 3 shows the microbial analysis of smoked meat. The number of colonies of total

Table 2. Effect of smoking time on moisture content and the quality of smoked meat of *Pleuroploca trapezium* blanched in 5% brine. A = smoking time, B = moisture content.

A (min)	B (%)	quality of the product
0	15	raw meat
15	11.4	partial smoke absorption, sticky to touch.
30	11.1	uniformly smoked, golden brown colour, good flavour.
45	8.4	dark brown colour, unattractive.
60	5.3	unattractive, very dark brown colour.

heterotrophic bacteria in the samples decreased with smoking time. There was a direct relationship between the smoking time, moisture content and microbial counts of the samples, thus confirming the fact that smoking reduces the water activity and hence the microbial count. Also the chemical constituents of smoke itself provide bactericidal action and antioxidant properties (Hovner 1997). *Salmonella sp.* was not detected in any of the smoked meat analyzed.

The proximate composition of smoked meat is presented in Table 4. The carbohydrate and protein content of smoked meat were found to decrease with increased smoking time. Dudek & Elkins 1997 quoted McCain & Shipp (1933), who found that liquid may be lost as drip along with soluble minerals and non-protein nitrogen during hot smoking. In general, the application of heat to food, as in the case of smoking, causes a reduction on the quality of constituent proteins (Dillon *et al.* 1994). According to Hovner (1997) the deposited smoke components have reacted with the proteins of flesh resulting in the reduced biological availability of protein. In contrast, the lipid content was found to increase slightly with the smoking time. This is because cooking may concentrate the lipid fraction due to loss of moisture.

Table 3. Microbial analysis of the smoked meat of *Pleuroploca trapezium* blanched in 5 % brine. A = Smoking time, B = Total Heterotrophic Bacteria, C = *Salmonella.*

A (min)	B (CFU x 10^{-5})	C (CFU)
15	5.7	nil
30	4.5	nil
45	4.8	nil
60	0.7	nil

Table 4. Proximate biochemical composition of smoked meat of *Pleuroploca trapezium* blanched in 5 % brine.

smoking time (min)	lipid content (%)	carbohydrate content (%)	protein content (%)
15	3.4	17.6	29.34
30	4.8	12.7	14.18
45	4.8	11.1	13.76
60	4.0	4.1	12.14

Table 5. Show the organoleptic characters of the smoked meat. The meat blanched in 5 % brine and smoked for 30 min scored the highest marks in terms of colour, flavour, and overall acceptability. The meat pieces smoked

Table 5. Organoleptic characters of smoked meat of *Pleuroploca trapezium* blanched in 5% brine. Colour, flavour, and overall acceptability are evaluated on a scale from 0 to 5.

smoking time	colour	flavour	overall acceptability
15	4	3	3
30	4	5	5
45	3	3	3
60	1	2	2

for 15 and 30 min were acceptable, but after 60 min the meat was poor in terms of colour and flavour. It was unacceptable.

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