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Development of smoked products from marine gastropods

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Abstract

The marine gastropods *Chicoreus virgineus* and *Babylonia spirata*, though constitute an important fishery along the southeast coast of India remain underutilized at present. Generally the meat of gastropods is considered a delicacy due its high protein and low fat content. Presently, along the east coast of India, only a smaller section of the fisher folk consumes the meat of these gastropods. Many are still not aware of real value and delicacy of these seafood. For better utilization, the smoked products from *C. virgineus* and *B. spirata* meat were prepared and shelf life period assessed. The smoked product showed good protein content of 8.6% and 6.2% and less fat content of 3.3% and 3.3% respectively. The tests revealed that biochemically, microbiologically and organoleptically it is good and safe for human consumption till the end of the storage period. In *C. virgineus*, all the biochemical parameters were significant ($p<0.01$) however, the *p*H, moisture and TPC were not significant ($P>0.05$) in *B. spirata*. The organoleptic characters of the products such as odour and texture in the former species were statistically significant ($P<0.05$) whereas in the latter the colour, texture, flavour and overall acceptability were statistically significant ($p<0.01$) during storage period.

Key words: Smoked product-gastropods

Introduction

Smoke curing is one of the oldest methods of food preservation. The process of drying and the preservative effect of chemicals released during the thermal breakdown of wood gives the food stuff a long shelf life. Smoking gives effective bactericidal (Kochanowshi, 1962; Incze, 1965), fungicidal and antioxidative effects (Fretheim *et al;* 1980).

Seafood and seafood–based products have become very popular the world over in recent years, as they are delicious, nutritious and rich in proteins, vitamins, minerals and polyunsaturated fatty acids. The meat of marine molluscs are also protein rich with low fat content. Though the meat of snails is delicious and nutrient rich, its utilization is limited and restricted to poor and coastal fisher folk communities along the east coast of India. This is mainly due to the conservative food habits of our people and lack of knowledge on the nutritive value (Ramesh and Ayyakkannu, 1992). Among the edible marine gastropods, *Chicoreus virgineus* and *Babylonia spirata* constitute a minor fishery along the southeast coast of India. The former species is landed as by-catch in

trawl. A recent survey indicated that the species contributed to 12 tonnes at Tuticorin during the year 2003. *B. spirata* is caught by a special trap, locally called 'Katchavalai' and the annual landing in Porto Novo coast was about 211 tonnes (Ayyakkannu, 1994) At this place, it is a sustenance fishery by the local fisherfolk. Nowadays, the demand for seafood including smoked products is on the increase due to its high protein content, easy digestibility and the beneficial effects on cardio–vascular system. Hence a study was undertaken to develop a suitable product from the meat of under-utilised gastropods. The present paper deals with the development of smoked products from marine gastropods, such as *C. virgineus* and *B. spirata.* The acceptability and shelf life of the products also have been assessed and discussed.

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Material and methods

Methods of preparation: The meat of marine gastropods such as *C. virgineus* and *B. spirata* were procured from local shell meat dealer and brought to the laboratory in an icebox. The edible portions like foot and adductor muscles were separated out and washed in potable water to remove dirt and pigments. The edible portions were boiled for 20 minutes to remove mucus and then cut into thin round slices of about 1 mm thickness. The sliced meat was used for the smoking purposes. The slices were blanched separately in 5% boiling brine for 5 minutes. The blanched meat was then drained and spread on trays and air dried for 20 minutes to facilitate smoke penetration. A conventional vertical type-kiln was used for smoking the meat by burning sawdust. During smoking, samples were drawn every 15 minutes to observe the effect of smoking time on the quality of the meat. The good quality smoked meat (5% brine, 60 minutes) was collected from the kiln, dried in electrical meat drier and each packed in separate polythene bags. Samples were drawn bimonthly for biochemical, microbiological and organoleptic quality analyses.

Biochemical characteristics: The protein content was estimated by following Biuret method of Raymont *et al.* (1964) and lipid content by using chloroform methanol method of Bligh and Dyer (1959).

The spoilage indicators such as *p*H, moisture, Free Fatty Acid (FFA), Trimethyl Amine Nitrogen (TMA – N) and Total Volatile Base Nitrogen (TVB) were analysed during the storage period. The moisture content of both the products was calculated by drying the samples in a hot air oven for two days. FFA content was measured by using the titrimetric method of Ke *et al.* (1976). The estimation of TMA-N and TVB-N content in the sample were carried out using Conway's micro diffusion method (Beatty and Gibbons, 1937).

The microbiological characteristics such as Total Plate Count (TPC), was done by

using Plate Count Agar (APHA, 1992) and Total Fungal Count (TFC) using Potato Dextrose Agar (APHA, 1992). Pathogenic bacteria like *Escherichia coli, Salmonella* and *Vibrio* were enumerated by following the method of USFDA (1995).

Organoleptic characteristics: The organoleptic characteristics of both the smoked meat were found out by frying the smoked meat in edible oil and serving to a taste panel of 6 to 8 members and the overall acceptability was determined by using hedonic scale of 1 to 9 (Amerine *et al.,* 1965). Products with scores above 6 were considered as good and below 5 as poor or unacceptable.

Statistical analysis

The data collected were analysed with Analysis of Variance (ANOVA) to find out the differences in biochemical, microbiological and organoleptic characteristics during the storage period of the products.

Results and discussion

The protein and lipid content of the products from *C. virgineus* and *B. spirata* were 8.6, 6.2% and 3.3, 3.3% respectively. The protein content was moderately high. Similar high protein content was reported in smoked fishes by Lilabati and Vishwanath (2000).

Tables 1 and 2 give the biochemical and microbiological quality of the products from *C. virgineus* and *B. spirata* meat. The *p*H decreased in both products during storage period. The reduction in the values was from 6.9 to 5.8 in the former and from 6.8 to 5.6 in the latter. The gradual decrease in *p*H (acidic) appeared to be due to phenolic/acidic constituents deposited on the meat during smoking (Lilabati and Vishwanath, 2000). ANOVA showed that there was a significant difference ($P<0.01$) in the *p*H with the increasing storage days of *C. virgineus*. But in the other gastropod it was found to be insignificant ($P>0.05$).

The Free Fatty Acid (FFA - % oleic acid) content of *C. virgineus* increased slowly from 0.03 and reached 0.22 (% oleic acid) after 180 days of storage in polythene bags. Gradual increase in FFA values was observed (0.02 to 0.12% oleic acid) in *B. spirata* during storage period. Oxidation and hydrolysis of lipid in fish and fishery products during storage cause quality deterioration. The hydrolysis of lipid results in the formation of Free Fatty Acid. In the present study, FFA values increased gradually in both the products with storage period. Lilabati *et al.,* (1997) have reported higher FFA levels in smoked fish products. The increase in FFA concentration in both products were low and it may be due to the less lipid content of the meat (Lilabati *et al.,* 1997).

The levels of Trimethylamine –Nitrogen (TMA-N) and Total Volatile Base-Nitrogen (TVB-N) of *C. virgineus* and *B. spirata* products increased from 1.45 to 9.81 (mg/100g) and 1.3 to 11.8 (mg/100g) respectively. TMA-N is often used as an index to assess the keeping quality and shelf life of seafood products (Hebard *et al.,* 1982). The TMA-N levels showed an increasing trend and the values were well

Table 1. *Biochemical and microbiological quality of smoked product from* C. virgineus *meat*

Parameters	Storage period				F
	0 day	60th day	120th day	180th day	
*p*H	6.90±0.30	6.62±0.03	6.41±0.01	5.93±0.23	13.81**
FFA (% of oleic acid)	0.03±0.00	0.06±0.01	0.16±0.02	0.22±0.00	200.47**
TMA-N (mg/100g)	1.45±0.01	2.58±0.00	3.46±0.00	9.81±0.00	1668997**
TVB-N (mg/100g)	3.70±0.00	6.94±0.06	9.82±0.02	14.68±0.14	10270.9**
Moisture (%)	1.90±0.10	3.06±0.04	4.40±0.01	5.84±0.09	1738.64**
TPC ($X10^2$ CFU/g)	41.00±3.00	36.00±1.00	58.00±2.00	86.00±4.00	203.57**
TFC ($X10^2$ CFU/g)	2.00±1.00	3.00±1.00	8.00±2.52	13.00±2.00	19.65**

Mean ± SD; n=3; ** - P<0.01

within the acceptability limit of 15mg/100g (Connell, 1975). The initial TMA-N values were low and this may be due to lower microbial load in the samples. The increase in TMA-N concentration was correlated with the total Plate Count and similar results were noted by Reddy *et al.* (1998).

TVB-N is an indicator that measures low molecular weight volatile bases and amine compounds produced by microbial oxidation of amino acid (Eskin *et al.*, 1970; Jacoben and Rand, 1982) together with TMA-N and other metabolites resulting from either bacterial or enzymatic breakdown of tissue. In the present study, the increase in concentration of TVB-N was similar to that of TMA-N, and the levels were within the acceptability limit of 30mg/100g (Tanikawa, 1935) after 180 days of storage. The TVB-N levels showed a gradual increase and were within the acceptable level of sensory scores during storage. Higher concentration of TVB-N were noted in smoked fishes and did not affect the organoleptic qualities (Lilabati and Vishwanath, 2000). The statistical

Table 2. *Biochemical and microbiological quality of smoked product from* B. spirata *meat*

Parameters	Storage period				F
	0 day	60th day	120th day	180th day	
*p*H	6.8±0.8	6.38±0.38	6.16±0.16	5.63±0.63	0.786^{NS}
FFA (% of oleic acid)	0.026±0.008	0.048±0.013	0.085±0.007	0.126±0.009	19.71**
TMA-N (mg/100g)	1.3±0.04	4.32±0.1	6.42±0.22	11.89±2.39	13.81**
TVB-N (mg/100g)	4.9±1.4	9.5±1.3	12.72±1.22	16.26±1.06	14.9**
Moisture (%)	2.8±1.3	4.18±0.58	6.46±0.86	6.92±1.72	2.63^{NS}
TPC ($X10^2$ CFU/g)	47±13.0	58±16.0	76±11.0	102±7.0	3.88^{NS}
TFC ($X10^2$ CFU/g)	3.00±0.50	4.00±1.0	6.03±0.55	11.03±0.85	22.57**

Mean±SD; n=3; ** - P<0.01; NS – Not significant

Table 3. *Organoleptic characteristics of smoked product from* C. virgineus *meat*

Parameters	Storage period				F
	0 day	60th day	120th day	180th day	
Appearance	8.4±0.9	8.2±0.4	8±0.4	7.8±0.4	0.620^{NS}
Colour	8.3±1.1	8±0.6	7±0.5	8.3±0.8	1.85 ^{NS}
Odour	8.5±0.5	8.4±0.5	7±0.5	7.3±0.7	5.61*
Taste	8±0.5	8.25±0.35	8±0.4	7.5±1.1	0.68^{NS}
Texture	8.6±0.6	8.5±0.6	8.25±0.45	8±0.2	6.5*
Flavour	8.2±0.4	8±0.1	7.6±0.6	7.5±0.3	2.11^{NS}
Overall acceptability	8.5±0.5	8.25±0.25	8±0.4	7.5±0.5	3.08^{NS}

Mean±SD; n=3; * - P<0.05; NS – Not significant

analysis showed that there was a significant difference (P<0.01) between the days of storage in FFA, TMA-N and TVB-N of both products.

The initial moisture content of *C. virgineus* and *B. spirata* products were 1.9% and 2.8% and it increased to 5.8% and 6.9% respectively during storage period of 180 days. The increasing moisture content was statistically significant (P<0.01) in the case of former and in the latter it did not differ significantly (P>0.05).

The Total Plate Count (TPC) increased in *C. virgineus* from an initial level of $41x10^2$ to $86x10^2$ CFU/g, where as it was found to show slight increase from $2x10^2$ to $13x10^2$. The product from *B. spirata* followed a trend similar to *C. virgineus* and it showed a gradual increase in count from $47x10^2$ to $102x10^2$ CFU/g. The initial Total Fungal Count was $3x10^2$ and it reached $11x\ 10^2$ at the end of storage period. Significant difference (P<0.01) in TPC and TFC was observed in *C. virgineus*. But the increasing number of TPC was

Table 4. *Organoleptic characteristics of smoked product from* B. spirata *meat*

Parameters	Storage period				F
	0 day	60th day	120th day	180th day	
Appearance	8.5±0.5	8.2±0.3	8±0.2	7.6±0.4	3.17^{NS}
Colour	8.2±0.3	8±0.2	7.5±0.5	7±0.2	8.26**
Odour	8.8±0.3	8.4±0.4	8.5±0.5	8.2±0.4	1.14^{NS}
Taste	8.5±0.3	8±0.5	7.5±0.5	7.5±0.5	3.27^{NS}
Texture	8.6±0.6	8.5±0.3	7.5±0.4	7.2±0.4	7.74**
Flavour	8.7±0.3	8.5±0.3	7.5±0.5	7 ±0.3	12.52**
Overall acceptability	8.6±0.4	8.5±0.5	7.5±0.3	7.2±0.4	9.03**

Mean±SD; n=3; ** - P<0.01; NS – Not significant

not significant (P>0.05) in the other species. The TPC and TFC showed a gradual increase and were within the permissible level of fishery products. This may be due to lower levels of moisture and antibacterial action consequent on the deposition of chemical compounds from the wood smoke. Pathogenic bacteria like *Escherichia coli, Salmonella* and *Vibrio* were not encountered in both products throughout the storage period.

The results of organoleptic characteristics of products from both the species during storage are given in Tables 3 and 4. The mean scores for all the organoleptic characteristics remained within the acceptability limit throughout the storage period. The sensory scores for all characteristics showed a decreasing trend with the period of storage. But the difference in the scores of appearance, colour, taste, flavour and overall acceptability of the product from *C. virgineus* did not differ significantly (P>0.05). The scores on overall acceptability of *B. spirata* were found to be significant (P<0.01).

References

Amerine, M.A.,R.M Pangborn and E.B. Roessler. 1965. *Principles of sensory evaluation of foods*, Academic Press, New York.349pp.

APHA. 1992. *Compendium of methods for the microbiological examination of foods*, 3rd ed.,C. Vanderzant. and Splittstoesser, D, (Eds.), APHA, Washington DC. 1264pp.

Ayyakkannu, K. 1994. Fishery status of *Babylonia spirata* at Port Novo, Southeast coast of India. *Phuket. Mar. Biol. Cent.Spec.publ.*, **13**: 53-56.

Beatty, S.A and N. E. Gibbons. 1937. The measurement of spoilage in fish. *J Fish. Res. Bd Canada*, 3(1): 77-91.

Bligh, E.G and W.S.Dyer. 1959. A rapid method of total lipid extraction and purification. *Can. J. Biochem. Physiol.*, **37**:911-917.

Connell, J.J. 1975. *Control of fish quality*, Farnham, survey, U.K., Fishing News (Books) Ltd. 126pp.

Eskin, N.A., H.M. Henderson and R.J. Townsend. 1971. *Biochemistry of foods*, Academic Press, New York.24pp.

Fretheim, K., P.E. Granum and E.Vold. 1980. Influence of generation temperature on the chemical composition, and antioxidative and antimicrobial effects of wood smoke. *J. Food Sci.*, **45**:999-1002.

Hebard, C.E., G.J. Flick and R.E Martin. 1982. Occurrence and significance of trimethylamine oxide and its derivatives in fish and shellfish. *In*: R.E. Martin, G.J. Flick, C.E. Heard and D.R. Ward (Eds.), *Chemistry and biochemistry of marine food products*. Connecticut, AVI publishing co., p 149-304.

Incze, K. 1965. The bacteriostatic effect of a smoke solution and of smoke constituents. *Die Fleischwirtschaft*, **45**(11): 1309-1311.

Jacoben, L.F. and A.G. Rand. 1982. Biochemical evaluation of foods. *In*: R.E. Martin, G.J. Flick, C.E. Heard and D.R. Ward. (Eds.), *Chemistry and biochemistry of marine food products*. 347pp. AVI. Publishing Company, West Port, Connecticut.

Ke, P.J., C.W Reyier and R.G. Ackman. 1976. *News Series Fisheries and oceans* 60,1m, Canada, Halifax. 60pp.

Kochanowshi, J. 1962. Bacteriostatic properties of liquid smoke. *Technol. Mesa*; 29pp.

Lilabati, H. and W. Vishwanath. 2000. Biochemical, Nutritional and microbiological quality of six species of smoked fishes from Manipur, *Fish. Technol.*, **37**(2): 89-94.

————, N. Bijayanthi and W. Vishwanath. 1997. Biochemical and microbiological quality of smoked *Channa punctatus* available in Manipur. *ibid.* **34**(2): 21-25.

Ramesh, X. M. and K. Ayyakkannu. 1992. Nutritive value of *Chicoreus ramosus*: A status report. *Phuket. Mar. Biol. Cent.Spec.publ.*, **10**:14 -16.

Raymont, J.E.C., A. Austin and E. Linzfard. 1964. Biochemical studies on marine zooplankton. I. Biochemical composition of *Neomysis integer*. *J. Cons. Perm. Explor. Mer.* **28**: 354-363.

Reddy,G.V.S., N. Bhaskar and T.M.R. Shetty. 1998. Quality of fermented Mackerel steaks at 3± 2°C. *In*: Balachandran, K.K., T.S.G. Iyer., P. Magadavan., J. Joseph., P.H.Perigreen, M.K. Raghunath and M.D. Varghese. (Eds.). *Advances and priorities in fisheries technology*. Society of Fisheries Technologists (India), 558pp.

Tanikawa, E. 1935. Studies on measuring freshness of fish and shellfish meat. (In Japanese). *J. Soc.Ind. Fish.*, (Japan) **3**:267-296.

USFDA. 1995. *Bacteriological analytical manual*,8th ed. AOAC International Gathersburg, USA.614pp.