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Benzo (a) Pyrene in Traditional Smoked Shrimp from Kakinada Coastal Area

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Benzo (a) pyrene content in pre-cooked edible portion of traditionally smoked small shrimps from Kakinada coastal area ranged from 0.021 to 0.048 ppm. The losses of smoke aroma and benzo (a) pyrene content on storage (30±8°C; RH-70±25%; One year) were noticed in all samples, the losses being highly rapid in samples containing high moisture contents. Low moisture samples had longer storage life upto nine months at ambient temperatures (30±8°C) than those stored with high moisture content.

Keywords : Benzo (a) pyrene, Traditional smoked shrimp, Storage, Smoke aroma.

In addition to the improvement of colour and flavour, wood smoke helps to preserve fish and fishery products due to its preservative action (Draudt 1963). The presence of carcinogenic polycyclic hydrocarbons in wood smoke was recognized by many workers (Porters et al. 1965; Rhee and Bratzler 1968; Tilgner 1968). The level of carcinogenic polycyclic hydrocarbons in smoked fishery products depends on the method of smoke generation and the temperature of smoking (Tilgner 1968).

In addition, the physico-chemical characteristics of fishery products, such as moisture and fat contents, and the size as well as shape, also play an important role (Rhee and Bratzler 1970). Benzo (a) pyrene (3, 4 benzopyrene), a carcinogenic polycyclic aromatic compound present in wood smoke, is considered as an arbitrary indicator of the presence of carcinogens in smoked food products by many workers (Rhee and Bratzler 1970; Lijinsky and Shubik 1964). Conditions to minimise the content of benzopyrene in smoke cured chicken meat have been reported (Raja et al. 1980).

About 35% of the annual shrimp catch of 3966 tonnes (CMFRI 1993) at Kakinada coast are commercially not very important small penaeids. Large portions of these are being utilized for smoked products. Simplest type of natural convection smoker, popularly termed as *Jithaka*, is being traditionally used in Kakinada coastal area for smoking (Khasim et al. 1989). The present study was undertaken to find out the level of benzo (a) pyrene in the traditional smoked shrimps, and its relation with other storage characteristics.

Jithaka *and smoking procedure*: *Jithaka* is a small thatched hut with one window fixed opposite to the door. In the hut, a perforated table, made of bamboo sticks, is fixed over a fire pit. The fresh small shrimps are first spread on a net/floor, and sun, dried for 3-4 h. The semi-dried shrimps with wide difference in moisture content (30-50%) are then spread on the table in the smoking kiln, and smoked for 1 h by burning locally available wooden logs and branches. The thickness of smoke in the kilns is controlled by closing the door and/or the window to different degrees.

Analytical methods: Smoked shrimps were collected at random from *Jithaka* smoking kilns, packed in 200 gauge polythylene bags and stored at ambient temperatures (30±8°C), and relative humidity (RH) of 70±25%. The smoked shrimps were analyzed at a regular intervals to observe the changes during the storage. After removing head, legs, tail fins and loose shell, the tail part was considered as edible part of smoked shrimp. Moisture, fat, ash, benzo (a) pyrene and acid insoluble ash content, were determined by standard methods (AOAC 1975). Total volatile base nitrogen contents was estimated by the modified Conway micro-diffusion method (Beatty and Gibbon 1937). Overall quality of samples (Table 1) were rated on

TABLE 1. ORGANOLEPTIC QUALITY RATING SCHEME

Scale	Physical characteristics	Overall quality
1	Brittle; golden brown colour and fresh aromatic smoke flavour.	Good
2	Loss of brittleness; pale yellow colour; slight loss of smoke flavour.	Slightly good
3	Loss of brittleness; dull colour; weak smoke aroma.	Fair
4	Loss of brittleness; slight black discolouration; weaker smoke aroma and slight ammonical odour.	Slightly poor
5	Soft; black discolouration; visible mould growth; unpleasant tarry odour; ammonical odour.	Poor

TABLE 2. PROXIMATE COMPOSITION OF THE EDIBILE TAIL PART OF SMOKED SHRIMP

Length of whole shrimp,/cm	Yield of edible tail part,%	Constituents of edible tail part, %				
		Moisture	Protein	Fat	Ash	Acid insoluble ash
Up to 5 (5)	45 - 55	11.2 - 17.5	67.1 - 71.5	3.9 - 4.5	10.4 - 12.0	1.6 - 2.1
Above 5 to 8 (5)	43 - 52	12.1 - 18.6	68.2 - 72.5	4.0 - 4.7	8.7 - 10.4	1.5 - 1.9
Above 8 to 11 (5)	39 - 45	16.0 - 20.6	59.6 - 63.2	4.2 - 4.9	8.5 - 9.6	1.0 - 1.5

Number of samples analyzed in parenthesis

a 5 point-scale by five experienced panel members by giving Hedonic opinion on deteriorative changes. Samples receiving an overall score of 3 and above were considered acceptable,

Proximate composition: Table 2 shows that the proximate composition of the edible part of smoked shrimps. Acid insoluble ash was high in some cases, probably because of drying on unclean floor. On an average, the smaller shrimps contained lower moisture levels, because of higher exposed drying surface per unit mass. As the shrimps with the sizes above 8 cm length were mostly cheap big headed species, the yield was considerably less. It was also noticed that consumer's acceptability of smoked shrimps of sizes below 3 cm length was too poor.

Benzo (a) pyrene in product: Table 3 shows that the benzo (a) pyrene content in smoked, whole shrimps was always higher than that in corresponding edible portion. The head and the major part of outer

TABLE 3. BENZO (a) PYRENE (Bap) IN SMOKED SHRIMP

Type	Parameter	January to March	April to June	July to September	October to December
	Sample analysed, No.	11	9	12	10
Whole smoked	Moisture,%	11.200 - 21.810	10.820 - 20.620	16.510 - 17.620	11.810 - 26.510
	Bap, ppm	0.275 - 1.192	0.213 - 0.701	0.332 - 0.423	0.316 - 0.515
	Sample analysed, No.	11	9	10	8
Edible tail part	Moisture,%	11.530 - 22.610	11.830 - 22.840	18.240 - 27.920	12.560 - 27.510
	Bap, ppm	0.021 - 0.048	0.023 - 0.034	0.029 - 0.033	0.022 - 0.032

TABLE 4. CHANGES IN BENZO (a) PYRENE AND TOTAL VOLATILE BASE NITROGEN CONTENT IN SMOKED WHOLE SHRIMP DURING STORAGE AT AMBIENT TEMPERATURE (30±8°C) AND 70±25% RELATIVE HUMIDITY

Period of storage, months	Moisture, %			Total volatile base nitrogen, mg%			Benzo (a) pyrene*, ppm			Mean overall quality		
	A	B	C	A	B	C	A	B	C	A	B	C
0	11.88 ± 0.56	17.66 ±0.62	26.51 ± 0.79	58.66 ± 1.21	89.52 ± 1.17	120.24 ± 1.42	0.421 ± 0.018 (0.024)	0.709 ± 0.021 (0.033)	0.512 ± 0.019 (0.028)	5	5	4.2
3	14.06 ± 0.51	17.92 ± 0.42	17.82 ± 0.52	79.22 ±1.44	120.45 ± 1.35	196.31 ± 1.35	0.332 ± 1.86	0.509 ± 0.018	0.256 ± 0.014	4.8	4.2	2.2
6	14.83 ± 0.42	18.24 ± 0.51	17.51 ± 0.54	150.23 ± 1.92	190.37 ± 1.72	345.01 ± 2.33	0.284 ± 0.012	0.367 ± 0.015	0.115 ± 0.008 (0.018)	3.8	3.2	1.0
9	15.17 ± 0.35	18.42 ± 0.47	—	201.65 ± 1.88	245.69 ± 2.235	—	0.256 ± 0.015	0.221 ± 0.012	—	3.0	2.3	—
12	15.55 ± 0.45	19.82 ± 0.53	—	271.15 ± 2.21	325.58 ± 2.76	—	0.226 ± 0.014	0.153 ± 0.011 (0.024)	—	2.2	1.0	—

All values are mean ± standard deviation of three determinations.

* ppm of Bap in edible tail part in parenthesis (mean value);

A, B and C denote samples with 11.8, 17.6 and 26.5 moisture contents, respectively,

— : Samples discarded due to poor quality

shell, where benzo (a) pyrene concentration was higher than in inner parts, were removed to get the edible portion (Rhee and Bratzler 1970). The benzo(a) pyrene content in the pre-cooked edible part varied in the range of 0.021 to 0.048 ppm. Seasonal variation of benzo (a) pyrene in products is also evident. Rhee and Bratzler (1970) observed benzo (a) pyrene concentrated on the outer casing of meat products. Zaitsev et al (1969) reported that the 3, 4 benzopyrene in smoked fish varied from 0.012 to 0.034 ppm in hot smoking method, which involved the use of logs and wood shavings. The benzo (a) pyrene contents in a few smoked shrimp samples are high in the present case, probably due to lack of controlling system in *Jithaka* smoking kiln.

Changes on storage: Table 4 shows that the higher moisture contents in samples decreased their storage life at ambient temperature. Total volatile base nitrogen contents in all samples increased during storage, the increases being highly rapid in samples with higher moisture contents. Benzo (a) pyrene contents in samples decreased with the length of storage. Rapid losses of smoke odour and benzo (a) pyrene content were noticed in samples with higher moisture contents. Samples B, containing higher moisture and benzo (a) pyrene contents had shorter storage life than samples A, which contained lesser moisture and benzo (a) pyrene contents. Similiar results were noticed in case of samples C, which had higher moisture and benzo (a) pyrene content than those of samples A. Moreover, samples C, which had with highest moisture contents, showed minimum storage life. Thus, the reduction in moisture content in sample is important to improve the storage life of smoked shrimps.

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