DETECTION OF NITRITE IN PROCESSED AND READY TO EAT MEAT PRODUCTS IN AND AROUND KOLKATA

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In processed meat items, nitrites are common ingredients used as preservatives as well as to increase the aesthetic value of the food items. However, its regular and excessive intake may impair oxygen transportation, cause cancer, type I diabetes in children, irritate the digestive system, abdominal pain, damage to blood cells and blood vessels, difficulty breathing etc. The present study was undertaken with an objective to find out the level of nitrites present in various processed and ready to eat meat products namely Kabiraji, Nuggets, Pakodas, Sausages, Salami and Chicken Popcorn collected from different restaurants and retail outlets in and around Kolkata by using Ultra Violet spectrophotometer. Out of total 66 samples tested 6 samples of Kabiraji, 5 samples of chicken pakodas, 8 samples of nuggets, 3 samples of chicken burgers, 3 samples of salamis and 3 samples of chicken popcorns were found to be loaded with more than the acceptable limit of nitrites in them, which is highly alarming from the public health point of view.

Key words: Curing, Fast food, Meat foods, Preservatives, Spectrophotometry

In India, consumption of ready to eat meat products are increasing tremendously due to rapid urbanization, modern life style, increased monthly income and easy accessibility of fast food items (Manohar *et al.*, 2005). Preservatives or additives like sodium nitrite (NaNO_2), sodium nitrate (NaNO_3), potassium nitrate (KNO_3),

potassium nitrite (KNO_2), or their combinations are commonly added to meat products for extending the shelf life. These preservatives serve a good purpose to the products by giving it a pinkish-reddish colour and antioxidant effects. They also prevent the growth of *Clostridium botulinum*, have anti-microbial action,

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develop cured meat flavor, and retard development of rancidity and off-odors during storage (Zanardi *et al.*, 2002).

However, these preservatives can cause serious health damages to the consumers by creating nitrosamines (highly carcinogenic substances) when they combine with secondary and tertiary amines present in the meat (Greer and Shannon, 2005). They can also combine with haemoglobin creating methaemoglobin, which damages the blood oxygen transport and in long term it causes methemoglobinemia mainly in children (Greer and Shannon, 2005), causing face redness, vasodilatation, cyanosis, gastrointestinal discomfort, vomiting and headache (Harada and Silva, 2002). Regular consumption of processed meat (containing nitrite) elevated the risks of various cancers in humans including that of thyroid gland, ovary, kidney and bladder (Ferrucci *et al.*, 2010; Kilfoy *et al.*, 2011; Dellavalle *et al.*, 2013).

The FDA regulates the allowable levels of inorganic nitrite in foodstuffs (FDA, 2003), and they recommended that the level of sodium nitrite should not exceed 200 ppm in the finished product. Noncompliance of maintenance of this level in any of the food items which are used to be taken by the consumers readily and regularly may lead to different health hazards. Therefore, the purpose of the present study was to find out the amount of nitrite present in different ready-to-eat meat products which are being consumed by people in and around Kolkata.

MATERIALS AND METHODS

The study was conducted following the guidelines as prescribed by Food Safety Standards Authority of India (FSSAI, 2012).

Reagents used and their methods of preparation:

(a) Alumina cream: Saturated solution of potassium aluminium sulphate was prepared and ammonia was added slowly to make the pH 7.0.

(b) N - n a p t h y e t h y l e n e d i a m i n e dihydrochloride solution: 0.1% in distilled water.

(c) Arsenilic acid monohydrate: 0.1% in 5M HCl.

(d) Standard nitrite solution: 10mg pure sodium nitrite was dissolved in distilled water and diluted to 100 mL volumetric flask that constitutes the solution 'A'. 5mL of solution 'A' was taken and transferred to a 1000mL volumetric flask and adjusted to that volume to prepare solution 'B'. Series was prepared by pipetting 4 mL, 5 mL, 6 mL and likewise up to 15 mL in 12 different volumetric flasks from solution 'B'. These standard solutions now contain 2 microgram, 2.5 microgram, 3 microgram and so on up to 7.5 microgram of nitrite respectively in each flask.

Collection and preparation of the samples: Sixty six samples of ready to eat meat products were collected from 12 different restaurants and retail outlets mostly in the morning in and around of

Kolkata. Firstly, each sample was properly macerated or homogenized and 5 gm of that sample was taken in a 150 mL beaker. An amount of 50mL distilled water was then added to it and heating was done at 80°C for 10 to 15 minutes with continuous stirring. To it 20 mL alumina cream was added and after proper mixing whole content was transferred to a 100 mL volumetric flask. It was diluted with distilled water to the mark. Filtering was done with the Whatman No. 4 filter paper after washing the filter papers several times by distilled water to eliminate any residual nitrite in them. Initial 10 mL of the filtrate was discarded.

Methodology: The following methodology was undertaken as per the guidelines given by Food Safety Standards Authority of India (FSSAI, 2012).

Determination of nitrite: 10 mL filtrate was taken in a 50 mL volumetric flask and to it 2 mL arsenelic acid solution was added. After mixing, it was left for 5 minutes and 2mL N-naphthyethylenediamine solution was added and mixed. It was left for 10 minutes. If the solution was clear it was diluted to 50 mL distilled water and the absorbance was read at 538 nm using 1cm cell. If the solution was cloudy, it was transferred to 100 mL separator and saturated with salt. It was then extracted with N-butanol using 20 mL, 15 mL and 5mL and butanol extracts were passed through cotton pledget (small flattened pad) in a funnel into dry 50 mL calibrated flask.

Dilution was done to volume by N-butanol and absorbance was read at 545 nm in a 1cm cell.

Preparation of standard curve: Series of 50 mL volumetric flask were taken and pipetting was done with standard solutions of sodium nitrite containing 2-15 microgram of nitrite nitrogen and final volume of 50 mL was made by using distilled water and colour was developed by above procedure. Absorbance was read at 545 nm and standard curve was plotted (FAO, 1980).

RESULTS

Standard curve of standard nitrite solutions containing 2-15 microgram of nitrite nitrogen (40-300ppm respectively) was prepared on a graph (Table 1 and Chart 1). In the said curve it was evident that the concentration of the standard solution that contains 10 microgram/50mL corresponds to 200 ppm of nitrites, which shows the absorbance unit (AU) value of 0.0876 in the spectrophotometer. Therefore, the AU value of 0.0876 was considered as the highest acceptable limit of nitrite that may be safe for the consumers (FDA, 2003). Results obtained from different food samples were then compared with this safe limit and while compared it was observed that 6/11 (54.5%) kabiraji, 5/11 (45.4%) chicken pakoda, 8/11 (72.7%) nuggets, 3/11 (27.2%) chicken burger, 3/11 (27.2%) salami and again 3/11(27.2%) chicken popcorn samples were found to contain more than acceptable limit of nitrites in

them. The amount of nitrites present in 1/11 (9.0%) each from kabiraji, chicken pakoda, nuggets, chicken burger, salami

and 2/11 (18.1%) chicken popcorn samples were statistically highly significant level ($p < 0.01$) as shown in Table 2.

Table 1. Different gradients of standard sodium nitrite solutions and their corresponding ppm values

Sl. No.	Standard solution concentration of sodium nitrite	Reading in ppm
1.	2 microgram/50mL	40
2.	3 microgram/50mL	60
3.	4 microgram/50mL	80
4.	5 microgram/50mL	100
5.	6 microgram/50mL	120
6.	7 microgram/50mL	140
7.	8 microgram/50mL	160
8.	9 microgram/50mL	180
9.	10 microgram/50mL	200
10.	11 microgram/50mL	220
11.	12 microgram/50mL	240
12.	13 microgram/50mL	260
13.	14 microgram/50mL	280
14.	15 microgram/50mL	300

Table 2. Meat samples with their readings (Absorbance Units- AU) in spectrophotometer

Sl. No.	Kabiraji	Chicken Pakodas	Nuggets	Chicken Burger	Salami	Chicken Popcorn
1.	0.0825	0.0725	0.0896	0.0952	0.0986*	0.0845
2.	0.0913	0.0820	0.0835	0.0841	0.0745	0.0820
3.	0.0922	0.0890	0.0721	0.0825	0.0785	0.0986*
4.	0.0895	0.0896	0.0886	0.0928	0.0745	0.0989*
5.	0.0789	0.0909	0.0885	0.0654	0.0734	0.0845
6.	0.0820	0.0820	0.0784	0.0628	0.0625	0.0854
7.	0.0952*	0.0845	0.1124*	0.0971*	0.0786	0.0897
8.	0.0700	0.1025*	0.0895	0.0723	0.0898	0.0839
9.	0.0926	0.0826	0.0913	0.0654	0.0939	0.0798
10.	0.0900	0.0921	0.0890	0.0756	0.0821	0.0732
11.	0.0752	0.0851	0.0920	0.0752	0.0854	0.0812

*($p < 0.01$)

Chart 1. Standard curve prepared by comparing the ppm values of the standard solutions with their corresponding AU values in spectrophotometer

DISCUSSION

The presence of nitrite in foods and its ill effects on consumers is a debatable issue since last many years. One school of thought explained it as a harmful agent for human health whereas others denied it (Sindelar and Milkowski, 2011). However, the exact impact is debatable and not beyond doubt. Therefore, the findings of the present study where 42.4% (28/66) of the total ready to eat meat food products that contains more than the permissible limit of the said chemical is alarming. Again, 10.6% (7/66) of the total samples where the amount of the preservative is significantly higher than the permissible limit; further

demands a more serious attention of the food safety authorities in order to safeguard the general health of the consumers. Khodadady *et al.* (2012) from Birjand, Iran also reported the presence of nitrite residues in 10% of the total 120 sausage and salami samples tested containing more than the accepted national standard.

To conclude the findings of the present study, we can say that nitrates and nitrites may be a promising alternative for preservation of meat against different primitive preservative techniques. But, its ill health effects due to excessive consumption are not undoubtful. Therefore,

it should be judiciously used by the food technologists and food retailers under the stringent supervision of the regulatory bodies.

Conflict of interest: Authors declare that there is no conflict of interest regarding the present research work.

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