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Estimation of potassium bromate and oxalate in bread

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Abstract : *The use of potassium bromate results in a pleasing quality product that is popular with the consumer, however, it has a high potential toxicity. The aim of the study was to determine the amount of potassium bromate and oxalate in bread. Nine samples viz., SA, SB, SC, SD, SE, SF, SG, SH and SI from different brands of bread were analyzed. The results of the analysis show that the concentration of potassium bromate was high in all the bread samples, ranging from 0.0028 mg/g to 0.0076 mg/g, exceeding the safe limits as specified by the US Food and Drug Administration. In addition, all the sampled breads contained varying amount of oxalate, an anti- nutritional factor, but the concentration did not exceed lethal dose of 100mg/g. On the basis of study, bread brands sampled were considered quite unsafe for human consumption and there should be proper guidelines related to the baking industry for the safe use of potassium bromate.*

Key words: *Bread, potassium bromate, anti-nutritional factor, oxalate.*

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Introduction :

Bread is a staple food prepared by cooking dough of flour and water, often added with different ingredients. Fresh bread is prized for its taste, aroma, quality, appearance and texture. To improve the quality of bread, different ingredients like table salt, sugars, flavours and at least a flour improver such as potassium bromate are usually added (Vicki 1997). Potassium bromate is a slow acting oxidizing agent that works during fermentation and baking. The oxidation process affects the dough structure and texture of bread. It also improves dough handling properties contributing to loaf

volume, grain and texture (Emeje et al 2010). Currently potassium bromate is used in a targeted way by bakeries for certain products.

Potassium bromate has adverse effects on health which are divided into two categories. The first category deals with non cancer effect. This includes effect on nutritional quality of bread. It degrades Vitamin A2, B1, B2, E and niacin which are the main vitamins available in the bread (IARC 1999). In humans , potassium bromate can cause cough and soar throat when inhaled (Atkins 1993) and some other non cancer health problems like abdominal pain, diarrhoea, nausea, vomiting, kidney failure, hearing loss, peripheral neuropathy, hypotension, anaemia when ingested (Watson 2000). In the second category, numerous studies have revealed the potential of potassium bromate to cause cancer in the experimental animals and in humans (Watson 2000). It is worthy to mention that when used properly, potassium bromate does turn to harmless bromide in the finished baked product. It is recognized that it is inappropriate to use potassium bromate in any product or production method which cannot be formulated without residues below the level of 20 ppb in the finished product. (Himata et al 2006)

There are certain anti-nutritional chemical factors present in bread, which do not offer nourishment to the body such as phytic acid, oxalates, tannins and hydrocyanic acid. The effect of these anti-nutrients in the body depends on type and concentration in which it is present in the food material (Ekop et al 2007). The higher oxalate content in whole grain than in refined grain cereals suggests that oxalic acid is primarily located in outer layers of cereal grain.

Oxalates are insoluble complexes which are extremely insoluble even at pH 3-4 and therefore are not readily absorbed from intestinal tract (Nagabhushana et al 2011). Acute toxicity could be due to hypo calcemia while uremia from kidney damage may contribute to chronic toxicity. Oxalate inhibits a number of respiratory enzymes and also those enzymes which are activated by calcium and magnesium, its anti nutritive effect may be due to complexing with calcium (Nagabhushana et al 2011).

Therefore, there is a great need to ascertain toxicity and the anti-nutritional content of potassium bromate and oxalate content of bread samples. Thus, the main aim of this study was to analyze the level of potassium bromate and oxalate on bread samples available in localities of Patna.

Materials and Methods

Collection and Pretreatment of bread samples: Different bread samples were purchased from the open market, bread vendors and bakeries. They were labelled as SA, SB, SC, SD, SE, SF, SG, SH, SI. A circular sample of 2 cm in diameter from centre of a slice of each bread sample was taken and dried in hot air oven for 72 h at 55°C. The crust was ground to a fine powder with mortar and pestle. 5 g of each powdered sample was taken in a 250 ml beaker and 50 ml of distilled water was added. The appropriate volume of the sample was taken for treatment under the proposed procedure (Garcia et al 1989).

Analysis of potassium bromate in bread samples

[A] Qualitative analysis of potassium bromate: The presence of Potassium bromate in bread samples was detected (AOAC 1984) by pouring 0.5% potassium iodide in 2M HCl over a slice of each bread sample. Black spots suggested its presence.

[B] Quantitative analysis of potassium bromate : Quantitative estimation of potassium bromate was at room temperature using the method of Ojeka et al (2006). 4ml of aliquot of each of the nine bread samples was taken into nine separate 25 ml calibrated flasks. 5 ml of 1N crystal violet dye was added, followed by 10 ml of 2M HCl solution and diluted to 25 ml marks with distilled water. Absorbance of all the samples were made at at λmax of 485 nm using UV-Visible Spectrophotometer (THERMO SCIENTIFIC, Type:UV1) against water as reference. For the preparation of working standard (ranging from 0.001 to 0.01 mg/ml) 4.3 g of potassium bromate (m.wt.- 167) was taken into a 1000 ml volumetric flask, dissolved with distilled water and diluted up to mark.

Determination of Oxalate in bread samples: The bread sample was titrated against standard potassium permanganate and sodium hydroxide. The difference in the value of potassium permanganate and sodium hydroxide consumed gave the amount of oxalate.

Results and Discussion :

Estimation of potassium bromate in bread samples : Preliminary study of the colour identification of potassium bromate in the 9 bread samples indicated positive results for all the samples. Table 1 shows the quantitative amount of potassium bromate found in each sample. The least quantity of potassium bromate was detected as 0.0028 mg/g and the maximum quantity as 0.0076 mg/g. The maximum amount of potassium bromate allowed in bread by the FDA is 20 ppb or 0.0002 mg/g (Ekop et al 2008). The amount of potassium bromate found in each of the 9 bread samples was more than permissible amount.

Table 1. The quantitative amount of potassium bromate and oxalate in bread samples

Sl. No.	Bread sample	Amount of Potassium Bromate (mg/g)	Amount of Oxalate (mg/g)
1.	SA	0.0073	12.2
2.	SB	0.0072	15.56
3.	SC	0.0060	26.84
4.	SD	0.0064	9.76
5.	SE	0.0058	23.18
6.	SF	0.0070	23.18
7.	SG	0.0067	21.96
8.	SH	0.0076	32.94
9.	SI	0.0028	13.42

Joint FAO/WHO (1992) committee's initial recommendation of acceptable level of 0 to 60 mg $KBrO_3$ kg^{-1} flour was withdrawn because in vitro and in vivo studies have revealed that long term toxicity and carcinogenicity causes renal cell tumours in hamsters. Atkins (1993) analysed bromate in bread by gas chromatography (GC) based on the formation of a volatile derivative of bromate and obtained a limit of 12 µg kg^{-1}. In a study by Ayo et al (2002), ascorbic acid compared favourably with potassium bromate in improving the loaf volume of bread. On an equivalent cost basis and non hazardous ascorbic acid can be considered a more effective improver even though bromate can achieve a higher loaf volume on equivalent weight basis.

Estimation of oxalate in bread samples

The level of oxalates in the bread samples was in the range 9.76 to 32.94 mg/g. Table 1 shows the varying amount of oxalate present in different bread samples. It is highest in sample SH and lowest in sample SD. Consumption of large doses of oxalic acid causes corrosive gastroenteritis, shock, convulsive symptoms, low plasma calcium, high plasma oxalates and renal damage. The toxic range or lethal dose of oxalates has been reported to be between 3-5 g for man (Ekop et al 2007).

Conclusion :

The potassium bromate level in the bread samples was found to be 0.0028 mg/g to 0.0076 mg/g, which exceeded the recommended level given by FDA. The anti-nutritional content determined in mg/g oxalates ranging from 9.76 to 32.94 mg/g. in different bread samples was within acceptable range of 50 mg/g.

Oxalate is produced and accumulated in many crop plants and pasture weeds. Oxalates combine with calcium and magnesium to form insoluble salts which are not available to the body. Appreciably oxalate content in all bread samples was found to be less than the fatal dose (100mg/g).

Therefore it is suggested that there should be baking industry guidelines for the safe use of potassium bromate or for the ascorbic acid, alternative bread improver.

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