

## A CSE POLICY BRIEF

# POTASSIUM BROMATE/IODATE IN BREAD AND BAKERY PRODUCTS

## CSE study results and recommendations

### INTRODUCTION

Use of chemical food additives is a common practice in packaged and processed foods. Not all of them are safe. One such additive is potassium bromate ( $\text{KBrO}_3$ ) which, until over two decades ago, was routinely used in most parts of the world to treat flour for bread and bakery products.  $\text{KBrO}_3$  helped give the product a high rise and uniform finish. Its use as a flour treatment agent was allowed based on the assumption that no residues of bromate would be found in the final product.

But following studies demonstrating detectable residues and linking bromate to cancer, global scientific expert committees – during the 1980s and early 1990s – first suggested reducing the allowed limit of use; subsequently, it was recommended that potassium bromate should not be used as a flour treatment agent. Countries across the world started to ban it – but India did not. Use of potassium bromate continues to be allowed to treat flour in our country.

In the light of this, Centre for Science and Environment (CSE) decided to check for levels of potassium bromate in breads and bakery products produced in India. Tests conducted by CSE's Pollution Monitoring Laboratory (PML) **found residues of potassium bromate/iodate in over 84 per cent of bread and bakery samples sourced from Delhi.** CSE also got few samples tested by an external third-party laboratory, which confirmed the presence of bromate residues.

CSE's consultations and discussions with industry and scientific experts indicate that potassium bromate is widely used by this sector as it gives high quality results and is permitted by the law. With bread and bakery products being one of the most widely consumed food articles, it is important to prevent the population from being exposed to this cancer-causing chemical. It is time the Food Safety and Standards Authority of India (FSSAI) took cognizance of why and how this chemical is regulated in the rest of the world, and bans its use in India. The use of potassium iodate as a flour treatment agent should also be banned. It is not allowed to be used in several countries on account of possible higher intake of iodine.



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**Table 1: PML test results – potassium bromate/iodate in bread and bakery products**

Sample type	Brands with potassium bromate/iodate	Concentration (ppm)	% samples with potassium bromate/iodate
White bread	Harvest Gold White Bread – Premium Quality	17.32	100 (4/4)
	Britannia Daily Fresh Healthy Slice Bread	17.12	
	Perfect Premium Quality White Bread – A Classic Bake	15.01	
	Le Marché Jumbo Bread Slice (White Bread)	11.52	
Whole wheat/ Atta bread	Le Marché Whole Meal Bread	4.67	75 (3/4)
	Britannia 100% Whole Wheat Bread	2.58	
	English Oven Atta Bread	1.52	
	Defence Bakery Whole Wheat Bread	Not detected	
Brown bread	Perfect Premium Quality Brown Bread	8.16	75 (6/8)
	Harvest Gold's Hearty Brown – Stone Ground Wheat Brown Bread	8.03	
	Le Marché Brown Bread	5.75	
	Britannia Daily Fresh Healthy Slice Brown Bread	5.48	
	Le Marché Jumbo Bread Slice (Brown Bread)	1.65	
	English Oven Brown Bread	1.15	
	Defence Bakery Jumbo slices Brown	Not detected	
	Defence Bakery Brown Bread	Not detected	
Multigrain bread	Le Marché Multi Granex Loaf	4.20	80 (4/5)
	English Oven Multigrain bread	2.37	
	Harvest Gold Multi Grain Gourmet Bread	1.99	
	Britannia Multi Grain Bread	1.66	
	Defence Bakery Multigrain	Not detected	
Sandwich bread	Harvest Gold Sandwich Bread – Premium Large Size	22.54	66.6 (2/3)
	Perfect Sandwich Bread – A Classic Bake	20.09	
	English Oven Sandwich Bread	Not detected	
Pav	Perfect Premium Quality Pav – A Classic Bake	21.70	100 (3/3)
	Britannia Super Tasty Pav	15.01	
	Harvest Gold Bombay Pav – Premium Quality	14.89	
Bun	Harvest Gold Sweet Bun – Premium Quality	20.58	100 (3/3)
	Perfect Premium Quality Fruit Buns – A Classic Bake	19.81	
	Britannia Fruit Fun Bun	16.74	
Ready-to-eat burger bread	KFC Aloo Burger	6.23	75 (3/4)
	Subway Subz Burger	1.36	
	McDonald's McAloo Tikki Burger	1.23	
	Nirula's Chatpata Aloo Burger	Not detected	
Ready-to-eat pizza bread	Nirula's Cheese Tomato Onion Pizza	6.63	100 (4/4)
	Pizza Hut Margherita Pizza	2.30	
	Slice of Italy Margherita Classic Pizza	1.23	
	Domino's Margherita Pizza	1.18	

Note: ppm = parts per million; UV-visible spectrophotometer cannot differentiate between potassium bromate and potassium iodate.

## WHAT THE PML TESTED

The PML collected a total of 38 bread and bakery samples from retail shops, bakeries and fast food outlets in Delhi in May-June 2015. The samples included popular varieties of white bread, whole wheat/atta bread, brown bread, multigrain bread, sandwich bread, pav, bun, ready-to-eat burger bread and ready-to-eat pizza bread. The tests were conducted on UV-visible spectrophotometer using a published method which can detect the presence of both potassium bromate and potassium iodate, as both of them oxidize the dye producing the same color.

## PML TEST RESULTS<sup>1</sup>

- Over 84 per cent (32/38) samples tested were found having residues of potassium bromate/iodate in the range of 1.15–22.54 ppm (parts per million). All tested product categories were found with residues of potassium bromate/iodate (*see Table 1*).
- All samples of white bread, pav, bun and ready-to-eat pizza bread were found to contain potassium bromate/iodate. Over 79 per cent (19/24) samples of bread and about 75 per cent samples of ready-to-eat burger breads were also positive.
- The highest level of potassium bromate/iodate was present in sandwich bread. This was followed by pav, bun and white bread. Even the average levels were high in these products.
- Products of Perfect Bread, Harvest Gold and Britannia were found with high average levels of potassium bromate/iodate. Harvest Gold sandwich bread had highest concentration.
- Products of all seven popular fast food outlets selling pizza and burger were found positive with potassium bromate/iodate – but at levels lower than those found in bread, pav and bun.

## RESULTS OF EXTERNAL THIRD-PARTY LAB TESTS<sup>2</sup>

In September 2015, CSE sent few samples to a reputed external third-party application laboratory to confirm for presence or absence of bromate residues. These samples were of same products but different batches, produced on different dates than those tested earlier by the PML. The third-party laboratory conducted tests using ion chromatograph with conductivity detector, a prescribed technique for testing bromate. The PML also tested these samples for potassium bromate/iodate.

- Out of the four samples sent, presence of potassium bromate was confirmed in two brands i.e. Harvest Gold and Perfect Bread (*see Table 2*).
- Absence of potassium bromate/iodate in breads of Defence Bakery confirmed the results of the PML.
- While Perfect Bread labels its use of potassium bromate, Harvest Gold does not mention it – which suggests that the use of potassium bromate is not limited to one bread-maker or to those who label it.



- The results of the external lab also point towards possible use of potassium iodate by the bread-making industry. Potassium iodate is also a food additive, but its main source seems to be the salt used in bread-making.

**Table 2: Results of the external third-party lab tests**

Sample	PML result – potassium bromate/iodate levels (ppm)	Potassium bromate in confirmation test	Concentration of bromate in confirmation test (ppm)	Concentration of equivalent potassium bromate in confirmation test (ppm)
Harvest Gold Sandwich Bread – Premium Large Size	17.52	Yes	6.7	8.7
Perfect Premium Quality Pav – A Classic Bake	15.57	Yes	5.2	6.8
Defence Bakery Brown Bread	Not detected	No		
Britannia Daily Fresh Healthy Slice Bread	14.29	No		

Note: Variation in these results of PML and those of May-June 2015 is possibly due to different batches of samples.

## LABELLING PRACTICES FOR POTASSIUM BROMATE AND POTASSIUM IODATE

While there were no labels on the samples of bread for ready-to-eat pizza and ready-to-eat burgers, the labels on other packaged samples of various brands were checked by the PML. This was what the lab found:

- Only one brand – Perfect Bread – labels potassium bromate. This directly suggests use of potassium bromate in it and the bread industry in general. No maker among those tested labels potassium iodate.
- Two brands – Harvest Gold and Defence Bakery – do not even label the class title (flour treatment agent) as required by the Food Safety and Standards (Packaging and Labelling) Regulations, 2011. Further, the class title labelled across brands is inconsistent (see Table 3).

**Table 3: Labelling of potassium bromate/iodate**

	Brand	Positive samples out of tested samples	Label on packet	Potassium bromate labelled	Potassium iodate labelled
1	Perfect Bread	5/5	Improvers (1100, 924a)	Yes	No
2	Harvest Gold	6/6	None	No	No
3	Britannia	6/6	Flour treatment agent (510)	No	No
4	Le Marche	5/5	Bread Improver	No	No
5	English Oven	3/4	Improvers (510, 923, 1100)	No	No
6	Defence Bakery	0/4	None	No	No

Note: 924a (or E924) = Potassium bromate, 1100 = Amylases, 510 = Ammonium chloride, 923 = Ammonium persulphate, 917 = Potassium iodate. Based on test results of May-June 2015

## WHY IS POTASSIUM BROMATE BANNED ACROSS THE WORLD?

Many countries across the world have banned the use of potassium bromate as a flour treatment agent. The World Health Organization (WHO), its expert scientific committees and associated organisations have recommended not using it due to detectable residues of bromate in the end product and relation of potassium bromate with cancer (see Table 4).

- Acknowledging that the exposure to potassium bromate may occur due to its

use as a dough conditioner, the International Agency for Research on Cancer (IARC), associated with the WHO, classified potassium bromate in 1999 as Class 2B, i.e. possibly carcinogenic (cancer causing) to humans. The agency in its earlier evaluation of 1986 had already stated that there is sufficient evidence in experimental animals of carcinogenicity of potassium bromate. It was found to cause renal tubular tumors (adenomas and carcinomas), thyroid follicular tumors and peritoneal mesotheliomas in laboratory animals.<sup>3</sup>

- The Joint Expert Committee on Food Additives (JECFA), administered by the WHO and Food and Agriculture Organization (FAO), started evaluating potassium bromate as a flour treatment agent in 1964. In 1983, the committee temporarily accepted the use limit of 75 ppm provided that there are negligible residues in the end product.<sup>4</sup> Clearly, the understanding that allowed its use was that all bromate gets converted into bromide during baking process. In 1989, the committee endorsed its earlier recommendation that “as a general principle, bromate should not be present in food as consumed”. As residues of bromate were still detected, the committee further reduced the use limit to 60 ppm.<sup>5</sup>
- Later in 1992, JECFA concluded that “use of potassium bromate as a flour treatment agent was not appropriate”. The previous acceptable limit was withdrawn as the committee was aware that alternatives were present. Based on long-term toxicity/carcinogenicity studies and in vivo and in vitro mutagenicity studies, potassium bromate was considered a ‘genotoxic carcinogen’. The committee commented that “Experiments using new sensitive methods have also demonstrated that, when it is used for flour-treatment at what were regarded as acceptable levels, bromate is nevertheless present in bread.” In 1995, in view of more residual data and new residue detecting techniques, JECFA considered that its conclusion of 1992 applies.<sup>6</sup>
- In 2012, the Codex Alimentarius, an international food safety reference agency run by the WHO and FAO, formally withdrew specifications of potassium bromate in line with the JECFA view.<sup>7</sup>

**Table 4: Regulatory status of potassium bromate as a flour treatment agent**

Country	Status
European Union <sup>8</sup>	Banned (1990)
UK <sup>9</sup>	Banned (1990)
Nigeria <sup>10</sup>	Banned (1993)
Canada <sup>11</sup>	Banned (1994)
Sri Lanka <sup>12</sup>	Banned (2001)
Brazil <sup>13</sup>	Banned (2001)
Peru <sup>14</sup>	Banned (2002)
Columbia <sup>15</sup>	Banned (2002)
China	Banned (2005)
Australia <sup>16</sup>	Banned
New Zealand <sup>17</sup>	Banned
United States <sup>18</sup>	Not banned

Note: The list of countries is not exhaustive



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## WHY IS POTASSIUM IODATE NOT RECOMMENDED FOR TREATING FLOUR?

In 1965, the JECFA recommended that potassium iodate should not be used as a flour treatment agent due to the possibility of a higher intake of iodine as the chemical is considered a good source of it. The committee considered that “the use of a food additive for the treatment of a staple, such as flour, of a substance having such physiological significance and potency as iodine is highly undesirable”. Its use may result in a daily intake of iodine that is five or ten times than the usually recommended (100-200 µg). This intake is much different through iodate that is added at 10 ppm level to iodize salt which is consumed less.<sup>19</sup> Potassium iodate is not recommended to be used as a flour treatment agent in several parts of the world (see Table 5). It is not found in the approved list of food additives in these countries.

The European Food Safety Agency in its scientific opinion of 2014, mentions that various mechanisms can lead to thyroid disorders, and hypo- and hyper-thyroid status can be observed in cases of both insufficient and excessive iodine intake.<sup>20</sup> Referring to relevant studies, it mentions that chronic excessive iodine intakes may accelerate the development of sub-clinical thyroid disorders to overt hypothyroidism or hyperthyroidism, increase the incidence of autoimmune thyroiditis and increase the risk of thyroid cancer.

**Table 5: Regulatory status of potassium iodate as a flour treatment agent**

Country	Potassium iodate as an approved food additive
UK <sup>21</sup>	No
EU <sup>22</sup>	No
Australia <sup>23</sup>	No
New Zealand <sup>24</sup>	No

Note: The list of countries is not exhaustive

## INDIA ALLOWS USE OF POTASSIUM BROMATE AND POTASSIUM IODATE

India allows the use of potassium bromate and potassium iodate. As per the Food Safety and Standards (Food Product Standards and Additives) Regulations, 2011<sup>25</sup>:

- Maximum level of use of potassium bromate and/or iodate in bread is set at 50 ppm.
- Maximum level of use of potassium bromate in flour for bakery is set at 20 ppm.
- Maximum use limit of potassium bromate is set at 20 ppm in maida (refined wheat flour), if used for bakery.

While both chemicals are allowed, there are certain noteworthy issues in the existing regulation:

- Monitoring maximum level of use in bread may require onsite inspection to be able to ascertain the quantity of added chemical which would be difficult. On the other hand, in the absence of a set residue limit, presence of residues cannot be used to establish overuse. Therefore, when assumption of no residues in the end product was found to be failing in other countries, it was quite appropriate to completely prohibit use.

- There is limited clarity on clubbing potassium bromate and/or iodate, as one of the two (potassium bromate) is linked with cancer and is individually addressed otherwise, for example in flour for bakery. Clubbing the two anyways leaves a big range for bread makers to use potassium bromate.
- As potassium bromate is allowed in flour for bakery and/or maida for bakery, residues of it could be present in other bakery products not tested by the PML.

As per the current Food Safety and Standards (Packaging and Labelling) Regulation, 2011, for pre-packaged foods ‘flour treatment agent’ is the relevant class title to be labelled together with specific name or international numeric identifications for the food additives used for this purpose. With reference to labelling on flour for bakery, the existing laws do not require disclosure of the chemical(s) used. Instead, they merely require mentioning “wheat flour treated with improver/bleaching agents, to be used by bakers only”. This leaves another gap in knowing about the presence of potassium bromate or potassium iodate or other flour treatment agents/improvers at the level of bakers.

Bureau of Indian Standards (BIS) provides Standards for few bread variants. Potassium bromate and/or potassium iodate is allowed for use in white bread and wheat meal bread. For protein-fortified bread and milk bread potassium bromate is allowed. Effectively potassium bromate can be used at up to 50 ppm levels.

### WHY DOES INDUSTRY PREFER POTASSIUM BROMATE?

It is clear that potassium bromate is widely used and the main reason for preferring it over other alternatives is the quality of results it provides. It is an oxidizing agent which typically increases dough strength, leads to higher rising and uniform finish to baked products. It is a slow acting agent and can be used at any stage during baking. In comparison, ascorbic acid is considered a healthy alternative by experts, but it is a fast acting oxidizing agent and does not lead to comparable results. Glucose oxidase is another alternative known to perform similar functions and was approved by the FSSAI in November 2015. There are several other improvers and flour treatment agents approved by law such as ammonium persulphate, ammonium chloride and amylases.

Bread is a low-value, low-margin and high volume business which is growing at about 9 per cent per annum, with an estimated turnover of Rs 33 billion in 2015. However, the cost of adopting safer alternative is insignificant (*see Box: Economics of alternatives*).



### Economics of alternatives

At an approximate per kg price of Rs 330 for potassium bromate, Rs 450 for ascorbic acid and Rs 6,500 for glucose oxidase, the cost of solely using potassium bromate is less than one-sixth of using ascorbic acid and less than one-eighth of using glucose oxidase alone. These costs are calculated as per 50 ppm and 200 ppm, i.e. the maximum level of use for potassium bromate and ascorbic acid as per the law and at 20 ppm of glucose oxidase as an average recommended dose. **However, in absolute terms, an increase in cost to use these alternatives is insignificant.** For a 400 gm loaf of bread, it is less than 1.5 paise for ascorbic acid and 2 paise for glucose oxidase.

## ONLY A FEW COMPANIES DENIED USE OF POTASSIUM BROMATE/IODATE

When CSE approached 12 companies whose samples were positive for potassium bromate/iodate, to confirm if they use potassium bromate and/or potassium iodate, the response was limited. Only six of them came forward to categorically deny use of these additives. Perfect Bread labels potassium bromate suggesting its use by big bread makers (*see Table 6*).

**Table 6: Response by companies whose products were found to contain potassium bromate/iodate by the PML**

Company	Response
Harvest Gold Industries Pvt. Ltd.	No response so far
LR Foods Pvt. Ltd. (makers of Perfect Bread)	No response so far; labelled – potassium bromate
Mrs Bector's Food Specialties Ltd. (makers of English Oven Bread)	No response so far
Le Marche	Not aware about flour treatment agent in improver mix
Britannia Industries Ltd.	Denied use of potassium bromate or potassium iodate
Nirula's Corner House Pvt. Ltd.	No response so far
Pizza Hut (part of Yum chain of restaurants)	Denied use of potassium bromate or potassium iodate
Jubilant FoodWorks Ltd (for Domino's)	No response so far
Green House & Hestsoft Foods Pvt. Ltd. (for Slice of Italy)	Denied use of potassium bromate or potassium iodate
Hardcastle Restaurants Pvt. Ltd. (for McDonald's)	Denied use of potassium bromate or potassium iodate
Subway Systems India Pvt. Ltd.	Denied use of potassium bromate or potassium iodate
KFC (part of Yum chain of restaurants)	Denied use of potassium bromate or potassium iodate

*Note: Companies were approached through email and/or hard copy letters addressed to company head and/or senior representatives from the concerned departments. Follow up mails, telephonic calls were also made in most cases.*

## CSE RECOMMENDS

It is clear that potassium bromate is used in making bread and its residues are present in the end-product. It could well be understood that there are no safe levels of potassium bromate. In order to limit entry of this chemical into human food supply, these are our suggestions:

- **The FSSAI should prohibit use of potassium bromate in making bread and bakery products with immediate effect.** Considering that it can cause cancer, is banned in most parts of the world, and presence of healthy alternatives, there is no reason why this chemical should be allowed, specifically when residues are found to be present in end-product. Effectively, this means that potassium bromate should not be allowed to be added directly and not allowed in improver mix and as part of maida or flour for bakery. A complete prohibition would also



take care of presence of this chemical in ready to eat burger bread and ready to eat pizza bread which otherwise are proprietary foods and not well labelled and regulated. It would also then not find use in several other bakery products.

- **The FSSAI should set and ensure appropriate labelling for flour treatment agents in pre-packaged breads, bakery products, improvers and flour for bakery.** This would add another layer of check on those who may knowingly or unknowingly are using potassium bromate or potassium iodate. The FSSAI should also conduct inspections and test for use and presence of potassium bromate and take necessary action against those who are currently flouting labelling norms by not mentioning it.
- **BIS should amend relevant available standards.** This should ensure that both potassium bromate and potassium iodate are not allowed as improver/flour treatment agents in bread and bakery products.

**Also, the use of potassium iodate as a flour treatment agent in breads should not be allowed by the FSSAI.** It is not recommended as a flour treatment agent in several countries due to possible higher intake of iodine which can potentially affect the functioning of thyroid.



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