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A scientific study of genotoxic-carcinogenic impacts of Potassium Bromate as food additive on human health

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Abstract

The research study aims to substantially explain the lethal and negative impacts of Potassium Bromate being widely used as a food additive mostly in the baking food items, thereby deteriorating the human health to a greater extent. 'It is a probable human carcinogen, though its effects have only been evaluated in lab rats and mice'- as stated by ***The U.S. Environmental Protection Agency(2001)*** *. Potassium bromate also conceives the potential to disrupt the genetic material within human cells. On entering the human body, potassium bromate readily transformed into molecules called oxides and radicals. These highly reactive molecules cause damage to DNA and leads to the development of cancer. Various scientific researches observed severe damage in human liver and intestine cells, where exposure to potassium bromate resulted in breaking of DNA strands and chromosomal damage. Potassium bromate is mostly used as food additive in the formation & baking of bread. It possess a powerful oxidizing chemical property which results into the fermentation of bread flour at a faster rate. Potassium bromate bleaches the dough thereby enhancing its elasticity by strengthening its molecular bridges. This forms tiny thin-walled bubbles in the dough thus making it fluffy, voluminous and unnaturally ivory white in color. As a result of these findings, the use of Potassium bromate as food additive in baking items around the world has been banned. Therefore, the study reveals the fact that Potassium Bromate is an unnecessary and potentially harmful food additive which should be strictly avoided.*

Keywords: ***Bromated flour, carcinogenic, food additive, genotoxic, potassium bromate ($KBrO_3$), potassium iodate(KIO_3)***

1. INTRODUCTION

The potent question arises as to what is the reason behind the carcinogenic nature of Potassium bromate, that makes it lethal to use as food additive for the human beings. The chemical composition of Potassium Bromate is being exhibited as a bromate of potassium found in the form of white crystals or powder. Further, this harmful additive can be chemically prepared by passing bromine into a solution of potassium hydroxide. Potassium(K), is a metallic element of S-block is prepared in which a solution of potassium hydroxide and bromine a non-metallic element of P-block is passed through the solution to form potassium bromate. Potassium bromate is a chemical additive mixed in flour to improve the action of gluten. Gluten is a protein found in wheat flour which makes the dough of the bread elasticity during kneading and thereby ferment the dough by trapping gases produces by yeast. By strengthening the gluten, potassium bromate causes the bread to rise in volume and hold its shape. Hence, potassium bromate is a flour enhancer which makes dough stronger, softer and

allows for better oven spring, higher rising,voluminous and has faster mixing properties. When it is used within prescribed limits of 15-30ppm, it gets cooked up during the baking process and leaves no trace in the end product. However, if the mixture consist of higher amounts of potassium bromate, or if you don't bake the bread at sufficiently high temperature or for long enough, then residual amounts of potassium bromate will be found in the bread.

1.1 USES OF POTASSIUM BROMATE

In spite potassium bromate is banned for use in foods by many countries,in USA potassium bromate is typically used as flour improver (E924). It has the property to strengthen the dough and to make it voluminous in quantity. Potassium bromate is an oxidizing agent which is commonly used in baking the bread. Potassium bromate is also used in the production of malt barley yet ***U.S Food and Drug Administration (FDA)*** declared the prescribed and safe limits of its usage. It is known as a very powerful oxidizer in comparison to potassium permanganate too. ***(Entezam .A et.al, 2010).*** Brominated flour may also be found in grocery store and is still widely used in restaurants, bakeries and is found in many baking food items as fast food rolls, buns, pizza dough etc. A number of countries have banned the use of potassium bromate in food manufacturing viz. The European Union, UK, China, Canada and Brazil etc.

A report by ***Centre for Science and Environment (CSE)*** revealed that about 84% of 38 commonly available brands of pre-packaged breads, pav and buns were tested positive for potassium bromate and potassium iodate. According to CSE, potassium bromate typically increases dough strength, leads to higher rising and uniform finish to the baked products, whereas potassium iodate is a flour-treatment agent. Hence, report by CSE claims that potassium bromate is a chemical of category 2B carcinogen. CSE quoted the prescribed level of usage by ***Food Safety and Standards (Food Product Standards and Additives) Regulations 2011,*** which is set at 50 ppm for the use of potassium bromate/ iodate in bread. The maximum limit of using this chemical in wheat flour or refined wheat flour for baking is 20ppm. ***(Fisher, N. et al,1979)***

1.2 Long-term Risks and Health impacts of potassium bromate in humans

The ***International Agency for Research on Cancer (IARC),*** a research organization associated with the World Health Organization. Its task is to categorize the substances that may cause cancer, or are carcinogenic: Class 1 substances re known to be human carcinogens and Class 2A includes substances those are probable carcinogens. Class 2B classifies those substances that have caused cancer in laboratory animals (or lab tested animals), which includes Potassium bromate and indicates that it is a possible human carcinogen.***The U.S Environment Protection Agency (EPA),2001*** states that potassium bromate is a probable human carcinogen, but though its effects have only been observed in lab rats and mice hence, we can't ignore the probable vulnerability of humans against this additive. ***The International Agency for Research on Cancer (1999)*** determined that potassium bromate is a possible human carcinogen. Its use is banned as a food additive in a number of countries, including the United Kingdom, Canada, Argentina, Nigeria, South Korea, Brazil and European Union etc. It was banned in Sri Lanka in 2001 and China in 2005. The exposure of potassium bromate tested on lab animals, increased the incidence of benign and malignant tumors in the thyroid and peritoneum- the membrane outlines the abdominal cavity. Potassium bromate also has the potential to disrupt the genetic material within cells. Various scientists have observed damage in human liver and intestinal cells, due to the exposure of potassium bromate breaks in DNA

strands and chromosomes occurs. ***(Spassova MA, Miller DJ, Eastmond DA, et al, 2013).*** Though, the use of Potassium bromate has not been banned in the United States of America. The FDA sanctioned the use of bromate before the ***Delaney clause of the Food, Drug and Cosmetic Act-*** which legally bans potential carcinogenic substances, it came into effect by 1958. Since then, from 1991 the FDA has urged bakers to voluntarily stop using it. In California, a warning label is required when bromated flour is used. According to ***The National Institute of Health,*** the toxicity and carcinogenicity of Potassium bromate is stated as follows: It proves to be a carcinogenic agent and nephrotoxic in both rats and humans. $KBrO_3$ (Potassium bromate) also proves to induce renal cell tumors, mesotheliomas of the peritoneum and follicular cell tumors of the thyroid. Many scientific experiments and researchers aimed at elucidating the mode of carcinogenic action reveals that $KBrO_3$ is a potent carcinogen, possessing both initiating and promoting symptoms for rat renal tumorigenesis. (***Fonnum F, Mariussen E.,2009)***

The ***Environmental Working Group (EWG)*** report finds that dozens of many baked food items and confectionery products contain potassium bromate, remarked as a potentially cancer-inducing food additives- as told by ***Jose Aguayo, EWG Database Analyst*** and co-author of the report. He further states that in various research studies carried out on human cell cultures, potassium bromate is said to have genotoxic effect i.e. it causes damage to DNA of human cells. Also, long-term carcinogenicity studies and invivo and in-vitro mutagenicity studies showed that potassium bromate was a 'genotoxic carcinogen' or a chemical agent that could damage genetic structures, causing mutations. ***(Ishidate, M., Sofuni, J. & Yoshikawa, K.,1981)***

2. Regulatory steps needs to be taken:

It is necessary and a relevant fact after the discovery of the report that potassium bromate and potassium iodate such food additives could pose a major threat to the health and life of human beings,the need to regulate their judicious use and restrict their illegal usage. In the wake of this reality and on an ethical submissive notion, the foreign countries like California, solely the first state to put potassium bromate on its proposition 65 List of carcinogenic chemicals under ***Safe and Drinking Water and Toxic Enforcement Act,*** which regulates the products containing bromated flour to carry a warning label. The EWG consider Potassium bromate among one of the *'dirty dozen'* food additives to avoid eating, considering that both the chemicals can cause cancer, CSE recommended FSSAI should prohibit the use of potassium bromate and potassium iodate in the manufacturing of bread and bakery products. In lieu of precautionary action, the Centers for Disease Control indicates the long-term effects of using bromated flour and thereby to eliminate the risk, many companies have removed it from their products. ***(Kujore A & Serret JM.,2010)***

3. Conclusion

So, in the end the research study and varied scientific studies showed the fact that use of potassium bromate as food additive in the manufacturing of bread is proven to be hazardous for the human health. It has to be avoided from consumption as some of the dangers it poses are: disruption of thyroid function, it slows neural and cognitive development, causes skin disorders, DNA damage, proves to be toxic to kidneys, is potentially carcinogenic, also contributes to mental illness etc. Hence, strict regulation on the incessant and illegal use of this lethal chemical agent is mandatory by the support of Health and Food Safety committees; also there is a dire need to make people aware about the potential harm caused by this additive and a ban is needed on its usage.

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