

AN OUTBREAK OF FOOD-POISONING DUE TO A FLOUR IMPROVER, POTASSIUM BROMATE*

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The Food, Drugs and Disinfectants Act,¹ No. 13 of 1929, has as its object 'to consolidate and amend the laws for regulating the labelling and preventing the importation or sale of food and drugs which are unwholesome or adulterated or incorrectly or falsely described and for regulating the labelling and preventing the importation or sale of disinfectants which are incorrectly or falsely described'. This Bill was passed by Parliament in 1928 and became law in 1929. The Act was needed as it had become necessary to protect the public from adulteration and sophistication of articles of food. The Minister of Health and his department were made responsible for its administration.

Unlike the earlier Public Health Act, which is concerned with the fitness of food for human consumption due to bacterial contamination, the Food, Drugs and Disinfectants Act aims primarily at the prevention of fraud and misrepresentation and the prevention of harmful adulteration of food of a chemical nature.

Amendments to parliamentary legislation are often difficult and cumbersome to negotiate. This is taken care of by regulations which may be promulgated in terms of the Act, a step which must be taken before the introduction of anything new in the food processing industry. Had this been done, the accident due to the overdosing of a batch of bread with a flour improver, potassium bromate, might have been prevented.

As reported in the Annual Report of the Wheat Industry Control Board² for 1966, the bread-making industry in South Africa used 551,477 tons of wheat for bread-making in that year. In an industrial undertaking of this magnitude the use of flour improvers is approved by the Minister of Health 'provided he authorises it' (Section 13(3)(a) of the Food, Drugs and Disinfectants Act).

TABLE I. BREAD MADE IN 1966

Type	Weight in lb.
White	1,031,860,533
Brown	450,998,028
Wholewheat	49,981,456
'Compound'	77,014,034
Total	1,609,854,051 (804,927 tons)

Various improvers in the bread-making industry have been so authorized: †

12(1) Flour.

(a) No person shall import into the Union any flour to which any foreign substance, other than a substance mentioned or referred to in clause (2) hereof, has been added, or which has been subjected to any artificial bleaching process, and no person shall import into the Union, have in his possession, or sell any chemical bleaching agent or so-called 'improver' intended for the treatment of or mixing with flour.

(b) Before importing into the Union any consignment of

flour intended for sale or use in the Union, the importer or his agent shall produce to the collector of customs at the port of entry, a certificate by the head of the department of agriculture or other responsible officer of the Government of the exporting country stating that the flour is entirely free from any foreign substance, other than a substance mentioned or referred to in clause (2) hereof, and has not been subjected to any artificial bleaching process. Samples of the flour may also be taken and transmitted to an analyst.

(c) No person shall add to any flour any foreign substance, other than a substance mentioned or referred to in clause (2) hereof, or similar substance or shall subject any flour either during or after milling to any artificial bleaching process, save that flour milled in the Union may during milling be treated with peroxide of nitrogen generated by electricity, the treatment being regulated and restricted so that the total nitrites (calculated as sodium nitrite) in the treated flour shall not exceed six parts per million.

(2) Self-raising flour is flour to which baking powder or other leavening substances have been added. The label of every package containing flour to which acid phosphate has been added shall state, in type H, 'Prepared with acid phosphate baking powder'.

(8) Wholesome natural substances of animal or vegetable origin may be added to meal or flour or maize meal for the purpose of increasing its nutritional value. The addition of synthetic vitamins is prohibited. The addition of 14 ounces calcium acetate to 200 lb. meal to prevent the formation of rope is permitted.

(9) Meal or flour or maize meal to which wholesome substances have been added as permitted by sub-regulation (8) hereof, and bread made from such meal or flour shall be labelled in type G with the word 'enriched' and the name and business address of the manufacturer.

13(1) Baking powder is the leavening agent produced by mixing an acid-reacting material, with sodium bicarbonate, with or without starch. It shall contain not more than 1.5 per cent of sulphates calculated as calcium sulphate (CaSO₄), or more than 0.1 per cent of aluminium compounds calculated as alumina (Al₂O₃), and shall yield not less than 10 per cent by weight, of carbon dioxide, and shall not contain fluorine.

(2) Cream of tartar shall contain not less than 95 per cent of acid tartrates calculated as potassium acid tartrate (KHC₄H₄O₆) and not more than 2 per cent of sulphates calculated as calcium sulphate (CaSO₄).

(3) 'Acid phosphate' powder is an acid phosphate which, with or without starch or other wholesome farinaceous substance, may be used to replace cream of tartar in the preparation of chemical leaven for baking purposes. It shall not contain more than 2 per cent of sulphates calculated as calcium sulphate (CaSO₄), nor more than 0.3 per cent of any compound of aluminium calculated as alumina (Al₂O₃). Every package containing acid phosphate for use in food, or containing any baking powder of which acid phosphate is an ingredient, shall be labelled with the words 'acid phosphate', in type E. The words 'cream of tartar' or any lettering suggesting cream of tartar or tartaric acid shall not appear on any such label.

The bread-making industry is highly competitive and sales acceptance depends on many factors—whiteness, lightness, freshness and keeping quality, among others. Freshly milled flour is always under-oxidized, and to ensure the desired dough-handling characteristics and to obtain baked products with the best volume, grain and texture, it is common practice for millers and bakers to add oxidizing agents to flour and dough. For many years yeast 'foods' containing potassium bromate, ammonium

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chloride and calcium sulphate³ have been in use. Recently potassium iodate was added to this list. These chemicals, singly or in combination, are used in many countries to improve bread quality. There is a rapid 'proofing' of dough, especially when ferment-yeasts are used; gas-retention in the dough is increased, giving a 'nice light texture'. There is also a great saving in space that would otherwise be necessary for slow proofing of dough.

With the increase in bread sales, interest in quick processes for dough maturation has become widespread and many bakers are now using these processes regularly, some for whole and others for part of their daily production. Conditions which may influence quality range widely in different bakeries, and new processes introduced may overtake legislation in this regard.

In the baking process bromate is reduced to bromide and therefore any direct toxicity can be based on the bromide content. At normal 40 p.p.m. there is no interference with the nutritional quality of the bread.⁴

THE OUTBREAK

At 2.30 p.m. on 15 August 1968, a report was received at the City Health Department that 3 cases of vomiting and abdominal pain had been seen following the eating of bread purchased that day. These cases, plus 4 others which had occurred since the report was received, were visited.

The history was the same: the eating of bread purchased that day, followed within a few hours by abdominal pain and vomiting. Questioning revealed that the bread eaten had not smelt or tasted 'too good'.

Clinically the patients, both adults and children, were not very ill. There was no pyrexia, pulses were slow and strong, no vomiting occurred during physical examination, and there was only a mild degree of epigastric tenderness. Bread which had apparently caused the trouble was retrieved. This had a peculiar dryish smell which was not identified, and a greyish look. The loaf was rather blown and friable.

A hospital where 3 further adult cases had been admitted was visited. Here the story was the same: the eating of bread, followed within an hour or two by abdominal pain and vomiting. One man, in no distress, stated that he had vomited clots of blood. (All bed letters of cases which were subsequently admitted to various hospitals in the city were later perused; a few mentioned the vomiting of blood before admission, but there was no confirmation that vomiting of blood had occurred in hospital.)

A common factor had been determined, the eating of bread supplied by a specific bakery. The Managing Director stated that an excess of an ingredient had been accidentally added to a batch of 288 loaves which were later delivered to 5 dealers in the western part of the city. As soon as the error was noted, the bakery concerned had retrieved all the unsold loaves. With this assurance, no further action was taken that evening.

By 16 August 1968 an epidemic of abdominal pain, vomiting and diarrhoea had broken out in the suburbs supplied by bread from the 5 bread retailers concerned. Cases started flooding into 2 regional hospitals and a special message was broadcast not to eat any bread originating in Johannesburg the day before.

A sample of bread contained 1.1% by weight of potassium bromate. The bakery concerned was revisited and an acknowledgement obtained that a single batch of dough had been accidentally grossly overdosed with a flour improver, potassium bromate (40 p.p.m. is apparently the usual amount used where it is the practice to use potassium bromate as a flour improver).⁵

All hospitals in the Johannesburg area were notified that the poisoning was due to potassium bromate and a further bulletin was broadcast to the effect that bread produced in Johannesburg was once again safe and that only one small batch produced by one bakery on 14 August 1968 had been involved in the food-poisoning outbreak.

CLINICAL FINDINGS

In all, 68 cases were admitted to hospital and 481 cases were seen as outpatients. At 2 Coloured schools, a further 290 children were seen by a medical team sent from Transvaal Memorial Hospital for Children. Of these, 31 children were removed to hospital by ambulance and 8 were admitted. Ages varied from under 1 year to 48 years.

TABLE II. ANALYSIS OF PATIENTS

Race	Outpatients		Inpatients		Total
	Adults	Children	Adults	Children	
Coloured	40	638	9	40	727
Bantu	5				5
White	2	63	2	17	84
					816

These patients presented with the following clinical signs and symptoms: abdominal pain, vomiting, diarrhoea, headache, dryness of mouth, weakness and dizziness.

The abdominal pain varied from mild epigastric discomfort to severe stabbing pains. The time of onset of this pain after eating the bread depended on the amount swallowed—which was seldom more than a mouthful, due to the bad taste—and it varied from about 2 hours to 6 hours or longer.

Vomiting was invariable and ranged from mild nausea to copious vomiting. Several patients stated that they had actually vomited blood but no blood was reported in vomitus of any of the cases hospitalized.

Diarrhoea was not invariable and, when it occurred, varied from 1 to 5 watery stools. In only one case was dehydration severe enough to warrant intravenous fluid therapy, and in one case only was there a report of dark red blood in the stool.

Ingested bromate may cause methaemoglobinaemia with consequent cyanosis and central nervous system and kidney damage. No cases in this series showed these sequelae. Full blood counts on 10 children admitted to Transvaal Memorial Hospital for Children were done. These were normal in all but 4, who showed mild eosinophilia. Three out of 10 urine specimens submitted showed albumin. This proteinuria cleared up within 48 hours. No cyanosis was noted in any of the cases seen either as outpatients or in the wards.

Physical examination revealed little except mild epigastric tenderness. Pulse rates, temperature, respiration,

blood pressure, etc., were normal. (Hypotension has been reported in potassium bromate poisoning.)

The duration of hospital admission in 90% of cases was 24 hours only and varied from a few hours' observation to 5 days. There were no fatalities and no sequelae have been reported. Treatment was purely symptomatic. A few children at Transvaal Memorial Hospital for Children had stomach wash-outs performed and in these cases 5-20 G of sodium thiosulphate, depending on age, was given by mouth.

POTASSIUM BROMATE POISONING

When potassium bromate is brought into contact with an acid, such as gastric hydrochloric acid, hydrogen bromate is released.

A fatal dose has been estimated at 60 G, and 10 fatalities have been reported in the medical literature due to the ingestion of potassium bromate in hair cold-wave neutralizing solutions. No other potassium bromate fatalities from any other source have been recorded.

Ingestion is followed by nausea, vomiting, severe abdominal pain and diarrhoea. The patient becomes apathetic but irritable, and there is central nervous depression with loss of tendon reflexes and even loss of consciousness; however, convulsions may occur. Kidney damage with albuminuria and subsequent anuria may arise. Respiration becomes shallow and rapid, pulse rate increases and there is a fall in blood pressure. Body temperature is lowered. Hepatitis, pulmonary oedema and toxic myocarditis have been reported.⁶

As potassium bromate is an oxidizing agent, the ferrous iron of the haemoglobin may be oxidized to ferric iron which may lead to methaemoglobinaemia, cyanosis and kidney damage.⁷

In the blood, bromate is reduced to bromide within

a few hours.⁸ The normal blood bromide level on the Witwatersrand is very low, usually less than 1 mg./100 ml. In 5 cases in this series blood bromides were done on outpatients who had certainly ingested some bromate and were exhibiting symptoms of an acute gastritis. The method used was that described by Barbour *et al.*⁹ The serum bromide levels of these 5 patients were 3.0, 3.0, 3.1, 3.4 and 3.6 mg./100 ml., respectively. These low findings suggest that the amount of bromate ingested was very small or that most of the bromate ingested was lost by vomiting.

SUMMARY

An outbreak of food-poisoning due to a chemical flour improver, potassium bromate, is reported. This chemical was accidentally added in an excess amount to a batch of dough and resulted in 816 persons seeking medical attention; 68 persons, mainly children, were admitted to hospital. Fortunately the resulting illness was not serious and no sequelae have been reported or are expected.

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