Series of Clinical and Medical Case Reports and Reviews

Research Article

Public Knowledge, Attitude, and Practice Towards the Use of Potassium Bromate in Bakeries in Benghazi, Libya

Houssein N*[1], El-mani S[2], El adouli L[3], Amari M[4], Boaisha OB[5], Tarhuni A[5], Eltuhami A[2] and Belkhair A[4]

[1]Department of Epidemiology, Faculty of Public Health, University of Benghazi, Libya
[2]Department of Nutrition, Faculty of Public Health, University of Benghazi, Libya
[3]Department of Health Services Management, Faculty of Public Health, University of Benghazi, Libya
[4]Department of Health Education, Faculty of Public Health, University of Benghazi, Libya
[5]Department of Environmental Health, Faculty of Public Health, University of Benghazi, Libya

***Corresponding author:** Naeima Houssein, Department of Epidemiology, Faculty of Public Health, University of Benghazi, Libya

Received: 28 March 2023
Accepted: 10 May 2023
Published: 15 May 2023

Abstract

Background: Over the last few years, the use of potassium bromate in bread has been the subject of many scientific arguments in Libya. The Food and Drug Control Center in Libya banned the use of potassium bromate in bread on account of its deleterious effect and carcinogenicity in humans. However, the current research presents conflicting results on its use in bread.

Aim: This study aimed to examine the knowledge and increase awareness among the population about the use of this substance in bread. In addition, it looked at some aspects of bread making in bakeries.

Methods: A cross-sectional study was conducted on the general population during the period from Feb 2021 to May 2021. An electronic questionnaire was designed using Google Forms and distributed through social media.

Results: A total of 500 participants responded to the electronic survey and were included in this study. 79% females and 21% males with an age range from 20–30 years. The majority of participants were from Benghazi (92%) and Libyan nationality (97%). 76% did not have any health problems, whereas 24% had some diseases. 50% of them consumed bread twice a day. Only 12% of participants had awareness about the Libyan standard for bread making, while half of them (51%) did have any knowledge, and about 38% of them did not know any information about these standards. Most of the participants (71%) did have any information about potassium bromate as a food additive. Only 31% of participants reported that potassium bromate is a banned substance, whereas around half of them (52%) did not know that. Most of the participants (65%) did not know the effects of potassium bromate on their health. The majority of them suggested that the health inspection office, municipal guard, and the Ministry of Economy have the responsibility of monitoring the use of food additives in the bakery.

Conclusion: This study highlights the low level of knowledge of respondents regarding food additives, especially potassium bromate. Education programs to increase awareness among people are highly recommended. Further scientific investigations are needed.

Keywords: potassium bromate, bread, Libya, public knowledge, health effects

1. Introduction

Potassium bromate ($KBrO_3$) is used in bread as a promoted substance (an oxidizer). It preserves the flavor and improves the taste and appearance of bread in addition to other commercial advantages [1, 2]. However, a growing body of literate indicates the harmful effects of this substance on human health [3]. It is considered a cancer inducer and may lead to hepatic, renal, and central nervous system diseases [4, 5]. Despite that its use in the food industry was banned by the World Health Organization (WHO) in 1992, in addition to other agencies, it is still used in some developed countries [6, 7]. In 2005, Food and

Drug Control Center in Libya banned the use of potassium bromate in bread on account of its deleterious effect and carcinogenicity in humans [8]. However, the compliance to stop using potassium bromate in bread after the ban is unknown in light of poor surveillance of baking makers. Reports from the Libyan Advanced Centre for Chemical Analysis, which is part of the state Libyan Authority for Scientific Research, indicate that potassium bromate was being used as an additive in unsafe proportions in the Libyan bread and pastry industry in general [9].

Over the last few years, the use of potassium bromate in bread has been the subject of many scientific arguments in Libya. The current research presents conflicting results. Some findings reported a high level of potassium bromate than the permissible level set by the American Food and Drug Administration (FDA) [10]. A study from Tajoura city in the west of Libya tested 25 randomly purchased bread samples from 25 different bakeries [11]. The results revealed that all samples showed high levels of potassium bromate (300–1333). Likewise, a study from Benghazi city in the East of Libya conducted on different bakeries examined 29 samples of bread and different bakery product samples, including croissants, toast, and cakes [12]. The results indicated a higher level of residual potassium bromate than the permitted level in the analyzed bread and baked samples, ranging from 0.6138 µg/g to 1.558 µg/g, with a mean concentration equal to 0.9641 ± 0.4 µg/g. In contrast, another study from Benghazi was conducted on a larger sample of 60 different types of bread samples that were randomly collected from 60 different bakeries [13]. This study found negative potassium bromate levels (0.00 ppm) in 60 bread and flour samples. Similarly, the Food and Drug Control Center took samples from 50 Libyan cities from January 2021 to January 2022, concluding that the bread was free of potassium bromate [14]. These comparable findings may be explained by using a different methodology, or different times of data collection and geographical areas and compliance with the ban law. In light of inconclusive results and passive national surveillance of bakeries, further investigations are required.

Having current controversial reports and conflicting research results, it is crucial for public health to rise this concern across social media and increase public awareness regarding the possible health effects of this material and food additives in general, in addition to the continued monitoring of its use in bakeries and scientific research. This study tried to examine the knowledge and awareness of the population about the use of this substance in bread as a daily consuming food. In addition, it looks at some aspects of bread making in bakeries.

2. Methods

A cross-sectional study was conducted on the general population during the period from Feb 2021 to May 2021. An electronic questionnaire was designed using Google Forms and distributed through social media. The questionnaire was divided into four sections. The first section asked about the demographics of the participants. The second section was about the sources and types of bread consumption. The next section included knowledge of participants about potassium bromate as used during bread making and its effects on humans. The fourth section contained questions about the attitude of participants toward potassium bromate. Descriptive statistics were used to analyze data that included frequency and percentage. Participation in this survey was voluntary, anonymously.

3. Results

As **Table 1** summarizes, the study consisted of 500 participants (79% females and 21% males) with an age range from 20–30 years. The majority of participants were from Benghazi (92%) and Libyan nationality (97%). 93% had a university level of education, and more than half of them had medium socioeconomic status (67%). The social status of respondents were married or single, 48% and 49%, respectively. The majority of the participants were doctors, students, officers, and university academic staff whereas the least of them were housewives and teachers with the same percentage (5%), and 12% of them did not have jobs.

Characteristics	N	%
City		
Benghazi	460	92%
Outside Benghazi	38	8%
Sex		
Male	103	21%
Female	397	79%
Age		
< 20	22	4%
20–30	224	46%
31–40	167	34%
41–50	48	10%
> 50	29	6%

Nationality		
Libyan	473	97%
Non-Libyan	14	3%
Education level		
Primary	4	1%
Secondary	31	6%
University and above	459	93%
Income		
Good	119	24%
Medium	325	67%
Excellent	42	9%
Social status		
Single	245	49%
Married	237	48%
Divorced	10	2%
Widower	4	1%
Occupation		
Doctor	154	33%
Officer	49	10%
Teacher	25	5%
Free business	11	2%
Student	93	20%
University academic staff	39	8%
Housewife	21	5%
Others	21	5%
Do not have job	54	12%

Table 1: Demographical characteristics of participants.

3.1 Medical history of participants

Regarding the medical history of participants **(Table 2)**, most of them (76%) did not have any health problems, whereas 24% had some diseases. The most distributed diseases among participants were heart diseases, respiratory diseases, digestive diseases, and diabetes (18%, 16%, 14%, and 13%, respectively).

	N	%
Health problems		
Yes	119	24%
No	377	76%
Type of disease		
Diabetes	15	13%
Heart diseases	21	18%
Respiratory diseases	19	16%
Eye problems	3	3%
Bone and cartilage problems	7	6%
Glands problems	9	8%
Digestive problems	16	14%
Urinary tract problems	8	7%
Others	17	15%

Table 2: Health status and disease distribution among participants.

3.2 Bread types, sources, and consumption among participants

Figure 1 shows that there was variation in bread consumption among participants. Around half of them consumed bread twice a day, whereas the least of participants consumed bread once a day and three times per day (21% and 19%, respectively). Only 7% of participants consumed bread more than three times per day.

In regard to the type of bread consumed, approximately all participants (98%) consumed wheat bread, 72%, and 83% of them consumed barely bread and Shami bread, respectively. More than half of the participants (65%) reported that they consumed other types of bread, that include toast, burger bread, and brioche. Approximately all the participants (99%) also reported that they bought bread from bakers, while 87% of them bought bread from the supermarket, and 77% consumed homemade bread **(Table 3)**.

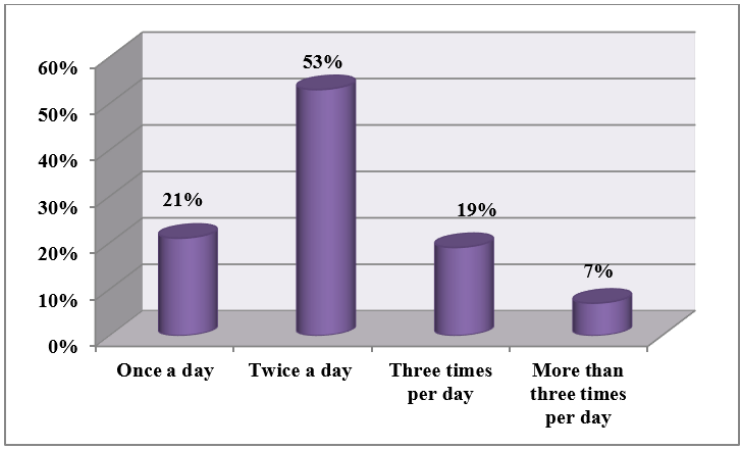

Figure 1: Frequency of bread consumption among participants.

Type of bread consumption		**N**	**%**
Wheat bread	Yes	442	98%
	No	10	2%
Barely bread	Yes	128	72%
	No	49	28%
Shami bread	Yes	190	83%
	No	40	17%
Other bread	Yes	91	65%
	No	49	35%
Sources of bread consumption		**N**	**%**
Supermarkets	Yes	159	87%
	No	23	13%
Homemade	Yes	96	77%
	No	28	23%
Bakery	Yes	446	99%
	No	4	1%

Table 3: Distribution of types and sources of bread consumption among participants.

Figure 2 indicates that bakery cleaning (99%) and type of bread (98%) were the most dependent criteria for choosing bread by participants. Bread shape and bread size were the following criteria as reported by participants, 94% and 81%, respectively. Only 60% of participants focused on the presence of food additives in the bread before consuming it.

Regarding standards of bread making, only 12% of participants had awareness about the Libyan standard for bread making while half of them (51%) did have any knowledge and about 38% of them did not know any information about these standards **(Figure 3)**.

3.3 Knowledge of participants about potassium bromate

Awareness of participants about potassium bromate was limited **(Table 4)**. Most of the participants (71%) did have any information about potassium bromate as a food additive. Only 31% of participants reported that potassium bromate is a banned substance, whereas around half of them (52%) did not know that. Most of the participants (65%) did not know the effects of potassium bromate on their health, 32% of them said that potassium bromate has a healthy effect while only 3% of them reported unhealthy effects. The majority of respondents did not identify the diseases that could be caused by potassium bromate (that include kidney diseases, infertility diseases, and cancer), 76%, 90%, and 47% of participants did not know these diseases, respectively.

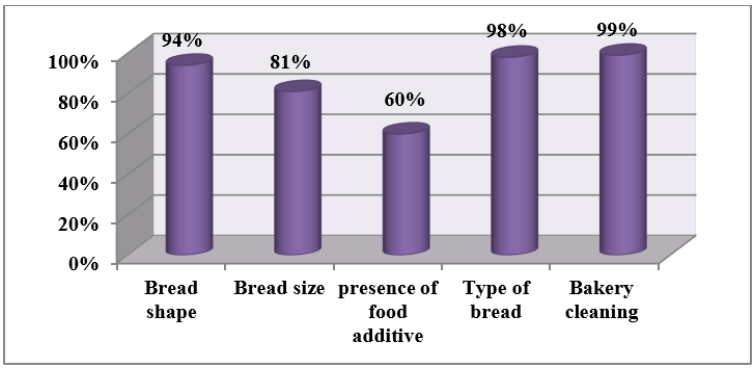

Figure 2: Criteria for choosing bread by participants.

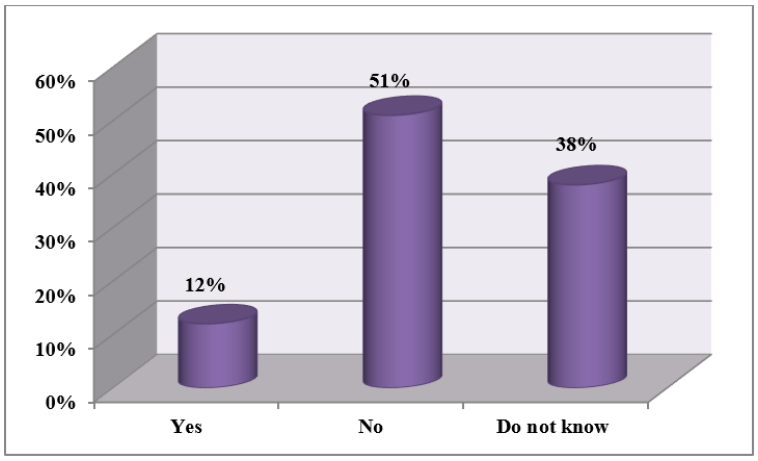

Figure 3: The participants' knowledge of Libyan standards for bread making.

Knowledge about potassium bromate		N	%
Potassium bromate	Yes	144	29%
	No	351	71%
Effect of potassium bromate	Healthy effect	160	32%
	Unhealthy effect	16	3%
	Did not know	322	65%
Banned substance	Yes	153	31%
	No	82	17%
	Did not know	258	52%
Caused kidney diseases	Yes	89	23%
	No	3	1%
	Did not know	297	76%
Caused infertility diseases	Yes	25	8%
	No	6	2%
	Did not know	297	90%
Caused cancer diseases	Yes	183	42%
	No	2	1%
	Did not know	249	47%

Table 4: Awareness of participants regarding potassium bromate.

3.4 The attitude of participants about food additives during bread making

Figure 4 shows the attitude of participants about the ways of raising people's awareness. The majority of participants suggested that social media, local media, and seminars and conferences are the best way to provide messages about potassium bromate to the people, 96%, 88%, 88%, respectively. Around half of them (52%) chose newspapers as educational media.

Figure 5 indicates that most of the participants agreed that all the sectors have responsibility for monitoring food additives during bread making. The majority of them, 98%, 97%, and 80%, suggested that the health inspection office, municipal guard, and the Ministry of Economy have the responsibility of monitoring the use of food additives in the bakery.

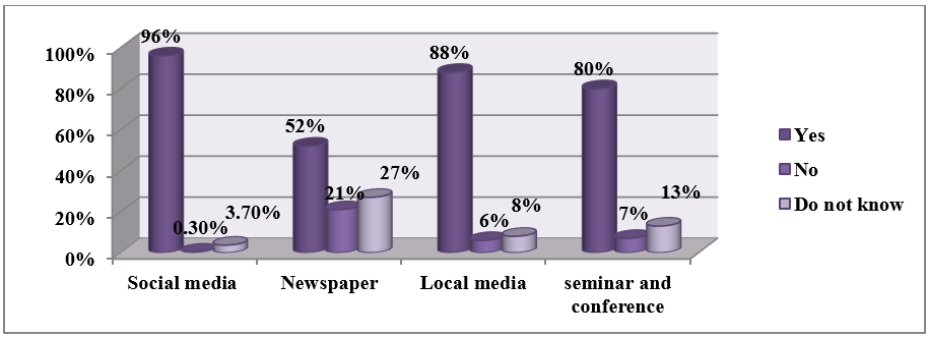

Figure 4: Attitude of participants about ways of raising people's awareness.

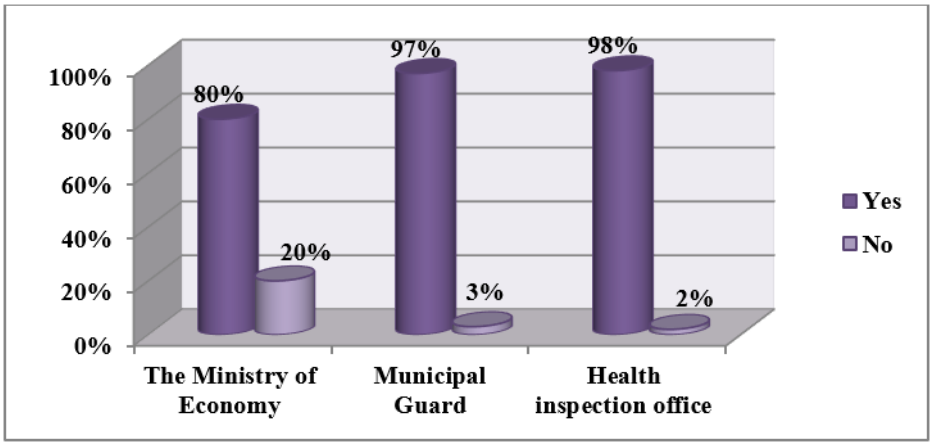

Figure 5: Attitude of participants regarding the responsibility of monitoring food additives in the bakery.

4. Discussion

The scope of this study was to assess the level of knowledge and practice of the Libyan population regarding the use of potassium bromate in bread as a promoted substance (an oxidizer). To the best of our knowledge, this is the first study that focuses on public awareness regarding this health issue. At the national level, previous studies have examined the presence of potassium bromate in bread [11, 12]. Some of these studies found different concentrations of potassium bromate in bread that exceeded the maximum acceptable limits recommended by Food and Drug Administration which is below 75 mg/kg or 50 mg/kg [10]. On the other hand, other investigations denied these results [13, 14]. Regardless of the current controversial dilemma in the Libyan scientific society of food chemistry regarding the actual presence of this material in the bread and methods of evaluation, these findings have arisen alarm about the significance of this health issue. This survey was conducted to increase public awareness about potassium bromate as one of the flour improvers used in bread and its harmful effect on health, as proven in the literature.

In general, our findings indicate a low knowledge level, as the vast majority of responders did not know the answers to the knowledge section. Despite the higher percentage of participants with higher educational occupational levels in our sample, 33% were doctors and 93% were university level and above, as reported in **Table 1**, only 29% of them know the use of potassium bromate as a food additive for flour improvement. This result may imply a low level of awareness about this health issue among Libyans in general.

Regarding the Libyan standards for bread, the results show a low level of knowledge as well with a higher percentage of participants who did not know. Therefore, more national efforts are required to increase public awareness of different educational and occupational levels.

This study looked at some different aspects of the practice of participants regarding the consumption of

bread. Findings show that wheat bread is the preferred type by the majority of participants. Furthermore, most of the participants choose bread based on its type and shape regardless of the presence of food additives. More importantly, 50% of participants think that food additives are not useful **(Figure 6)**, although they do not know the health effect of potassium bromate.

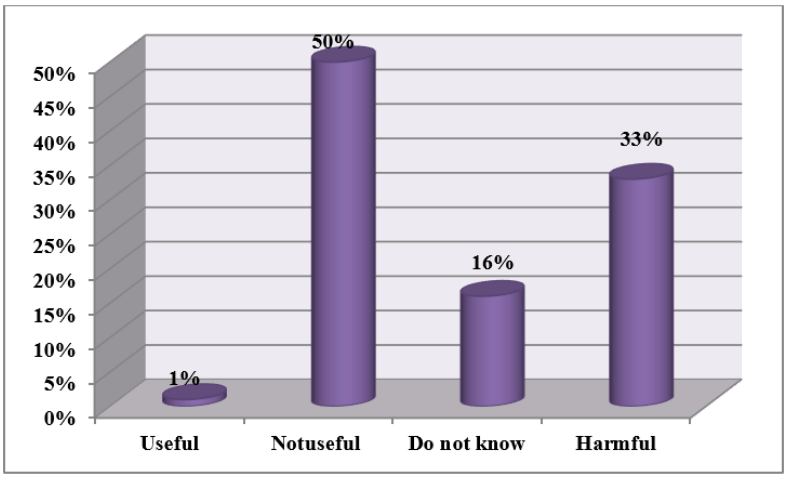

Figure 6: Attitude of participants about food additives.

Regarding participants' attitude, social media is the preferred source of information that they think help to raise people's awareness of health issues. They also agree that health inspection offices are responsible for monitoring the quality of bread. These suggestions need to be considered in public health education campaigns in this endeavor that may lead to effective health promotion.

However, this study has several limitations. First, being a cross-sectional survey may contain a recall bias, as data presented in this study were self-reported depending on participants' honesty. Second, the study tool was transmitted through the internet, which is not accessible to all Libyans, therefore, results cannot be generalized on the national level as most of the residents are from Benghazi city. Further mass surveys estimating the population's awareness of potassium bromate are required. Third, laboratory analysis of random samples of bread across the country is needed.

Parallel to this online survey, the authors conducted another observational and questionnaire-based study directed to the workers in the bakeries in Benghazi city as an effort to the Faculty of Public Health to reach the responsible persons and bakers and educate them regarding this material and its occupational hazards if used above the standards [15]. However, the response rate was low, and the sample size was not adequate yet. Government support is needed in this endeavor.

5. Conclusion

This study highlights the low level of knowledge of respondents regarding food additives, especially potassium bromate, and the Libyan standards for bread making. In addition, there was variation in types and sources of bread consumption among participants. Education programs to increase awareness among people are highly recommended. Further scientific investigations are needed.

References

1. Ati-Hellal ME, Doggui R, Krifa Y, et al. Potassium bromate as a food additive: a case study of Tunisian breads. Environ Sci Pollut Res Int. 2018;25(3):2702-2706.

2. Lukman AA, Maxwell MN, Bassey II, et al. Determination of Potassium Bromate content in Selected Bread Samples in Gwagwalada, Abuja-Nigeria. Int J Health Nutr. 2013;4(1):15-20.

3. Watson Y. Material safety data sheet: potassium bromate (Mallinckrodt Baker Inc). New Jersey. 2000.

4. Altoom NG, Ajarem J, Allam AA, et al. Deleterious effects of potassium bromate administration on renal and hepatic tissues of Swiss mice. Saudi J Biol Sci. 2018;25(2):278-284.

5. Ajarem J, Altoom NG, Allam AA, et al. Oral administration of potassium bromate induces neurobehavioral changes, alters cerebral neurotransmitters level and impairs brain tissue of swiss mice. Behav Brain Funct. 2016;12(1):14.

6. FAO/WHO JECFA. Joint Expert Committee on Food Additives: Evaluation of Certain Food Additives and Contaminants. Geneva, 1992, pp. 25-33.

7. Nehal FAM, Abbo MA, Omer AMG. Measurement of Bromate Residues in Some Popular Baked Products Produced in Sudan by X-Ray Fluorescence (XRF). Int J Recent Sci Res. 2015;6(12):7715-7717.

8. Libyan National Center for Standardization and Metrology (LNCSM), Ministry of Economic and Commerce. Libyan Standard Legislation Concerning Bread Improvers Requirements. 2015;822:1-5.

9. Zaptia S. Attorney General to investigate bakery use of banned potassium bromate in Bread. Libya Herald. 2022.

10. Shanmugavel V, Santhi KK, Kurup AH, et al. Potassium bromate: Effects on bread components, health, environment and method of analysis: A review. Food Chem. 2020; 311:125964.

11. Alhanash HB, Edriss NA, Ksheid SM, et al. Residual Bromate Assessment in Bread Samples from Tajoura city bakeries, Libya. Acad J Res Sci Pub. 2020;2(13):1-9.

12. Busaadia MAS, Ahmida NHS, Towier NH, et al. Bromate Residual Contents in Some Brands of Bread and Bakery Products Collected from Benghazi`s Bakeries, Libya. LCCA. 2021;1(1)28-33.

13. Buzgeia MH, Buhagar S, Elfagi S, et al. Detection of Potassium Bromate as an Improver in Breads Produced in Some Bakeries in Benghazi, Libya. GSJ. 2022;(10)5:2178-2188.

14. Assad AK. Libyan Food and Drug Control Center denies "potassium bromate" presence in bread. The Libya Observer. 2022.

15. Ncheuveu NT, Fon TP, Navti LK. Health Risk Assessment and Symptoms of Potassium Bromate Toxicity Amongst Bakers in Bamenda, North West Region of Cameroon. SSRN. 2022;1-27.

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