Content is avaliable at SCOPUS

Meat Technology — Special Issue 64/2

www.meatcon.rs ▪ www.journalmeattechnology.com

UDK: 637.521.238.4

ID: 126487817

https://doi.org/10.18485/meattech.2023.64.2.48

Original scientific paper

Monitoring of sulfites in kebabs and grilled meat

Jasna Kureljušić[a], Nikola Roković[a], Marija Pavlović[a], Aleksandra Tasić[a], Jelena Maletić[a], Dragana Ljubojević-Pelić[b] and Tanja Bijelić[a]*

[a] *Scientific Institute of Veterinary Medicine of Serbia, 11107, Janisa Janulisa, 14, Belgrade, Serbia*
[b] *Scientific Veterinary Institute "Novi Sad", Rumenacki put 20, 21113 Novi Sad*

ARTICLE INFO

Keywords:
Sulfites
Kebabs
Meat for grilling

ABSTRACT

Food additives are substances of known chemical composition, which are not consumed as food, nor are they a typical ingredient of food, regardless of nutritional value, but are added to food with the purpose of improving technological performance and retaining certain sensory properties. Additives widely used in the food industry include sulfur dioxide (SO_2) and sulfites (E 220 – E 228). Sulfur dioxide and its derivatives are added to food with the purpose of inhibiting and controlling the growth of microorganisms, preventing non-enzymatic browning, inhibiting reactions catalyzed by enzymes, and as antioxidants and reducing agents. The harmful effects of sulfur dioxide and sulfites are most often associated with allergic reactions from food, so it is necessary to provide consumers with information about their presence in food, even when they are found in very small amounts, because even then the possibility of an allergic reaction is not excluded. This research was conducted with the aim of determining the amount of sulfites in meat products in the period from 2019 to 2022. Altogether, 128 meat product samples were analyzed of which 53 were kebabs and 75 were meat for grilling. After testing, the mean levels of sulfur dioxide and sulfites in positive samples expressed in mg/kg were 210.0 mg/kg in kebabs and 110.6 mg/kg in meat for grilling. In conclusion, in most of the tested meat products, the sulfite concentration was below the established maximum permissible values according to national and European regulations.

1. Introduction

Sulfur dioxide and sulfites (SO_2) are additives that have been used for their disinfecting and purifying capabilities for at least 2,000 years. Sulfites are used in various technologies as preservatives, bleaching agents, antioxidants and flour treatment agents. They are allowed in many different foods, including wine, desserts, dried fruits and vegetables. They are employed in the food business to preserve the product's color, increase shelf life, and stop the development of bacteria. The majority of the time, they are added as additives during the production, processing, and storage of food products. However, they can also be naturally occurring components of foods, byproducts of the fungal metabolism in fermented beverages (beer, wine), or breakdown products of secondary metabolites containing sulfur (*Konić-Ristić and Šobajić*, 2005).

Different types of sulfites are used as additives. Because they are efficient antibacterial agents in acidic or acidified foods, inhibiting lactate dehydrogenase and other bacterial dehydrogenases, they are most frequently utilized as preservatives. Sulfites are additionally used as browning inhibitors since they

***Corresponding author:** Jasna Kureljušić, *jasnakureljusic@yahoo.com*

Paper received May 10th 2023. Paper accepted May 18th 2023.
Published by Institute of Meat Hygiene and Technology — Belgrade, Serbia

prevent both enzymatic and non-enzymatic browning. Sulfite stabilizes vitamins A and C in food by its facile oxidation to sulfate anion, which underlies its antioxidant activity. In the past, they were also employed to stop fresh food from browning, but most nations now forbid this practice. Sulfites have been used as additives for a very long time; records of their use extend back to the time of ancient Greece and Rome (*Queensland Government*, 2021).

Sulfites have negative impacts despite being crucial to the production of food. Since only 1% of people are sensitive to sulfites, the US Food and Drug Administration (FDA) mandates that sulfites be disclosed if they are used as a food ingredient, a processing aid, or a component of an ingredient used in food. Sulfites can lead to allergic reactions, which most frequently manifest as asthma symptoms in people who already have the allergic condition, occasionally as allergic rhinitis-like reactions, infrequently as urticaria (hives), and extremely rarely as anaphylaxis (severe allergic reaction) (*Leclercq et al*., 2000; *Warner et al*., 1986). Since SO_2 gas irritates, one possibility is that inhaling it causes the airways to reflexively contract. This mechanism might account for the symptoms' sudden onset. The enzyme sulfite oxidase, which aids in the breakdown of SO_2, is partially deficient in some asthmatics that react to sulfites. Skin tests for sulfite allergies rarely reveal real allergies in persons. The degree of exposure to SO_2 or sulfites from all sources determines a person's susceptibility to sulfites in food. Although the biochemical mechanisms underlying the onset and progression of adverse reactions to sulfites are poorly understood, it is unlikely that these reactions would be allergic, immune-mediated, or result in anaphylactic shock (*EFSA* 2004).

Although the threshold for sensitive reactions may be considerably lower, the European Union mandates the labeling of goods containing sulfites at concentrations of 10 mg/kg or greater. Depending on the kind of food, sulfur dioxide (SO_2) concentrations are given in mg/kg or mg/L and relate to the total amount from all sources in various foods. Where total SO_2 concentration is equal to or higher than 10 mg/kg (ppm), this is applicable. Given that this is the detection threshold, sulfites below this level are regarded as inconsequential and the food as sulfite-free.

In order to rationalize the range of additives that are already in use and to make the identification of additives as easy as possible, the E-numbering system (so-called E-numbers) was introduced in the EU. The prefix E indicates that these are additives that are applicable in Europe, which is shown in Table 1 (*Commission Decision*, 2021; *Rulebook of the Republic of Serbia*, 2018). This study's objective was to establish the levels of sulfites present in Serbian kebabs and grilled meat at stores.

Table 1. E-numbers for sulfites

Sulfites	E number
Sulfur dioxide	E220
Sodium sulfite	E221
Sodium hydrogen sulfite	E222
Sodium metabisulfite	E223
Potassium metabisulfite	E224
Calcium sulphite	E226
Calcium hydrogen sulphite	E227
Potassium hydrogen sulphite	E228

2. Materials and methods

2.1. Materials

The tested samples were sampled in Serbia in the period from 2019 to 2022. The meat products examined were kebabs and meat for grilling. The samples were sampled in plastic bags in amounts of 0.5 kg per sample. Following the cold chain, they were delivered to the laboratory and stored at a temperature of 2°C to 8°C in a refrigerator until the start of the analysis. Before analysis, they were taken out of the refrigerator and homogenized.

2.2. Method

To determine sulfites in kebabs and meat for grilling, the *AOAC* (2005) method was used. The method measures in food free sulfites and the fraction of bound sulfites, such as carbonyl addition products. Each test sample was heated under reflux with HCl (approximately 4 M) to convert the sulfites to SO_2. The stream of nitrogen introduced below the surface of the refluxed solution pushes SO_2 through the water-cooled condenser and through the drain

connected to the condenser into a 3% H_2O_2 solution, where SO_2 was oxidized to H_2SO_4. The sulfite content is directly related to the H_2SO_4 content, which was determined by titration with a standard NaOH solution. For verification, sulfates can be determined gravimetrically as $BaSO_4$ (*AOAC*, 2005).

3. Results and discussion

In the period from 2019 to 2022, the sulfite concentrations were determined in 53 samples of kebabs and 75 samples of meat for grilling, as shown in Table 2.

Within the group of 14 kebabs examined in 2019, sulfites were found in two of them. In 2020, 8 kebab samples were analyzed, of which sulfites were found in three. One of the seven samples tested in 2021 was positive for sulfites. In 2022, 24 samples were analyzed, three of which were found to contain sulfites, as shown in Figure 1.

Within 22 samples of meat for grilling inspected in 2019, sulfites were found in two of them. In 2020, 26 samples were analyzed, of which sulfites were found in four. Two of the 11 samples tested in 2021 tested positive for sulfites. In 2022, 16 samples were analyzed, one of which was found to contain sulfites, as shown in Figure 2.

In Serbia, the Rulebook on the quality of chopped meat, semi-finished products and meat products (*Official Gazette of the Republic of Serbia*, 2019; 2023) that contain nitrites and nitrates, sulfur dioxide, sulfites and phosphates cannot be used in the production of semi-finished meat products.

Table 2. Average sulfite level (mg/kg) in positive samples of kebabs and meat for grilling in the period from 2019 to 2022.

		Kebabs	Meat for grilling
2019	No. of samples	14	22
	No. of positive samples	2	2
	Average sulfite concentration in positive samples	101.95	87.90
2020	No. of samples	8	26
	No. of positive samples	3	4
	Average sulfite concentration in positive samples	265.20	232.73
2021	No. of samples	7	11
	No. of positive samples	1	2
	Average sulfite concentration in positive samples.	196.70	56.65
2022	No. of samples	24	16
	No. of positive samples	3	1
	Average sulfite concentration in positive samples	276.07	65.10

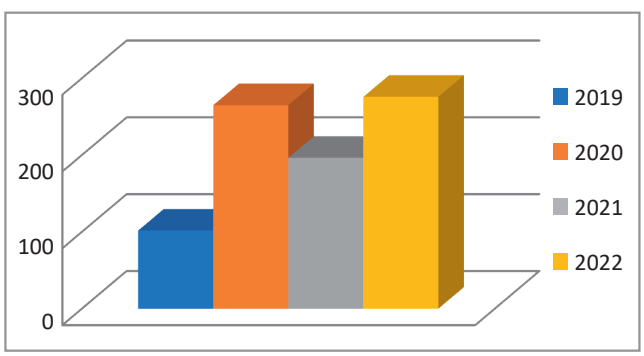

Figure 1. Mean values of sulfites mg/kg in kebabs in the period from 2019 to 2022

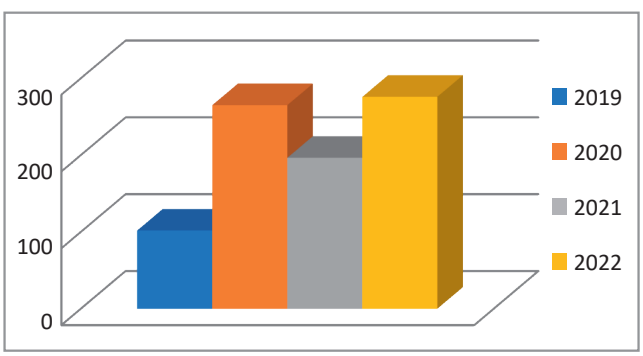

Figure 2. Mean values of sulfites (mg/kg) in meat for grilling in the period from 2019 to 2022

4. Conclusion

As a result of control activities carried out by an accredited laboratory to determine levels of sulphites in meat products, 128 meat product samples were analysed. A non-negligible percentage (14%) of these meat products contained sulphites, which confirmed that control of sulphite addition in meat preparations is still an important task for the food safety authorities. In particular, 18 samples resulted positive at a screening test. In any case, the mandatory labelling for sulfite concentrations higher than 10 mg/kg was established by the Regulation (EC) N. 1169/2011; *European Commission*, 2011). Also, as early as 1986, the US Food and Drug Administration (FDA) began to require that all sulfites be declared on the label of each product in which the concentration exceeded 10 mg/kg (ppm) (measured as sulfur dioxide (SO_2)), and that no sulphites are added to any food product intended for serving raw or presented as fresh food. Finally, even small amounts of sulfites can trigger food allergies in sensitive people, which is why the declaration is mandatory.

Disclosure statement: No potential conflict of interest was reported by the authors.

Funding: The study was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract 451-03-47/2023-01/200030).

References

AOAC, (2005). AOAC Official Method 990.28 — Sulfites in Foods — Optimized Monier-Williams Method.

Commission Decision, (EU) 2021/741, (2021). *Official Journal of the European Union*, 159.

European Commission, (2011). Council Regulation of 25 October 2011 on the provision of food information to consumers, amending Regulations (EC) No 1924/2006 and (EC) No 1925/2006 of the European Parliament and of the Council, and repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC and Commission Regulation (EC) No 608/2004, 1169/2011/EC. In: Official Journal, L 304/18, 22.11.2011.

European Food Safety Authority, (2004). Opinion of the Scientific Panel on dietetic products, nutrition and allergies on a request from the Commission relating to the evaluation of allergenic foods for labelling purposes. *EFSA Journal*, 32, 1–197.

Konić-Ristić, A. & Šobajić, S. (2005). Rezidualni sumpor-dioksid u uzorcima suvog voća sa beogradskog tržišta. Institut za bromatologiju, 46(3–4), 51–55.

Leclercq, C., Molinaro, M. G., Piccinelli, R., Baldini, M., Arcella, D. & Stacchini P. (2000). Dietary intake exposure to sulphites in Italy-analytical determination of sulphite-containing foods and their combination into standard meals for adults and children. *Food Additives & Contaminants*, 17, 979–989.

Queensland Government, (2021). Sulphur dioxide in meat from https://www.qld.gov.au/health/staying-healthy/food-pantry/food-safety-for-consumers/food-warnings-and-advice/sulphur-dioxide-in-meat.

Rulebook of the Republic of Serbia, (2018). Known as the Rulebook on Food Additives, Official Gazette of the RS No. 53/18.

Warner, C. R., Daniels, D. H., Joe, F. L. & Fazio T., (1986). Reevaluation of Monier-Williams method for determining sulfite in food. *Journal Association of Official Analytical Chemists*, 69, 3–5.