SO_2 AND WINE: A REVIEW

OIV

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SCOPE

The group of experts « Food safety » of the OIV has worked extensively on the safety assessment of different compounds found in vitivinicultural products.
This document aims to gather more specific information on SO_2.
This document has been prepared taking into consideration the information provided during the different sessions of the group of experts "Food safety" and information provided by Member States.
Finally, this document, drafted and developed on the initiative of the OIV, is a collective expert report. This review is based on the help of scientific literature and technical works available until date of publishing.

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SO_2 AND WINE
FINAL REPORT OF THE EWG

INTRODUCTION

Sulfur dioxide (SO_2) and its salts have been added during winemaking since the 17th century. SO_2 and its sulfite salts, remain an essential winemaking additive as there is no one other additive that has the same dual properties of anti-oxidation and preservation. It remains a potentially adverse reaction causing and toxic product for wine consumers and winemakers in amounts greater than 10 mg/L, and that accordingly, should be handled with care. Moreover, sulfites are also used as biocide agent in disinfection for sanitation of barrels. This function is not detailed in this report.

SO_2 TECHNICAL DATA

Sulfur dioxide (INS 220) has a chemical formula - SO_2. It has a molecular weight of 64.06 g/mol, Chemical Abstracts Service (CAS) Registry Number 7446-09-5 and the European Inventory of Existing Commercial chemical Substances (EINECS) number is 231-195-2. Its structural formula is given in Figure 1.

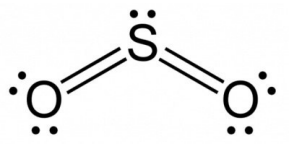


Figure 1: Structural formula of SO_2

The most commonly used synonyms for SO_2 are sulfurous acid anhydride and sulfurous oxide.

WHICH PROPERTIES DO SO_2 OR SULFITE SALTS HAVE IN WINE?

Sulfur dioxide and its salts have two main properties:

Anti-Oxidant

If oxygen is present, it will be 'captured' by SO_2 . A redox reaction to sulfite and further on to sulfate will take place. Other molecules such as aroma compounds are prevented from oxidation.

Preservative

Since the reaction of SO_2 with oxygen reduces the oxygen concentration, aerobic microorganisms cannot increase anymore e.g. in wine.

In winemaking, these properties are important for two reasons:

The anti-oxidant effect of SO_2 prevents the alteration of natural aromas of the grapes and wine due to the contact with oxygen.

The preservative effect of SO_2 helps inhibiting the development of 'indesirable bacteria' in the wine as well as sulfur dioxide does when used as disinfectant for sanitation of barrels; this latter function is not discussed further in this report.

The pH value plays an important role on the SO_2 concentration, with a low pH value in wine, you get a higher percentage of the molecular SO_2. If you have less acid, or a high pH value wine, you get a much lower percentage of the molecular SO_2.

SO_2 FREE, SO_2 TOTAL AND SO_2 ACTIVE

When SO_2 is incorporated into a must or a wine, a fraction of it will react with sugars, or aldehydes (ethanal) or ketones. The remaining fraction, called free, is the one with the most important properties.

SO_2 Total = SO_2 free + SO_2 reacted

The most active fraction of free SO_2 is called active SO_2 and is composed of molecular SO_2. During maturation and storage, concentrations of free SO_2 values of 25 mg/L on red wine and 30 mg /L on white wine are recommended. An active SO_2 concentration of 0.35 mg/L ensures a minimum protection, a value of 0.6 mg/L maximum protection.

AUTHORISATION AND LIMITS IN WINEMAKING

Approximately 20-200 mg/L of SO_2 may be added during winemaking (Ough 1986) and approximately 10-50 mg/L is formed by the yeast during fermentation, which is usually bound to acetaldehyde on formation. Therefore, when wine is analysed for the concentration of total SO_2, a small amount will always be measured regardless of whether sulfur dioxide was added or not during the course of winemaking.

Naturally occurring levels of SO_2 in wines are usually around 10-20 mg/L. In most wine consuming countries, wines containing sulfites greater than 10 mg/L must include a statement on the label making the consumer aware that sulfites are present.

Organisation	Wine type	Limit (mg/L)	Legal reference
OIV	Red < 4g/L White/Rosé < 4g/L Red/White/Rosé > 4g/L Sweet/Special wines	150 200 300 400	OIV Resolution OENO 09/1998
Codex Alimentarius		350 mg/kg	GSFA Provisions for Food Category 14.2.3 (Grapes wines)

Country	Wine type	Limit (mg/L)	Legal reference
Argentina	Red White Sweet red Sweet white/Rosé	130 180 180 210	Resolution INV N° 2/2018
Australia	< 35g/L sugars > 35g/L sugars	250 300	ANZFSC 4.5.1: Clause 5(5)(a)
Brazil	All	300	ANVISA, Resolution n° 123, 2016
Canada	All	350	Canadian Food & Drug Reg. B.02.100
EU	White/Rosé < 5g/L sugars Red < 5g/L sugars White/Rosé ≥ 5g/L sugars Red ≥ 5g/L sugars Specific sweet wines Specific sweet wines Specific sweet wines	200 150 250 200 300 350 400	Commission Delegated Regulation (EU) 2019/934
India	All	450	Prevention of Food Adulteration Act & Rules, Appendix C, Table 3
Japan	All	350	Japan's Specifications and Standards for Food Additives
New Zealand	< 35g/L sugars > 35g/L sugars	250 300	
South Africa	Red < 5g/L White < 5g/L All > 5 g/L Specific sweet wines	150 160 200 300	Liquor Products Act 60 of 1989 Regulations Regulation 32 (Table 8)
USA	All	350	27 CFR 4.22(b)(1)

POTENTIAL ADVERSE REACTION TO SO_2

An adverse reaction from ingestion of SO_2 is more commonly an intolerance rather than an allergic adverse reaction. Although the most common symptom is asthma, foods and food additives are not common triggers for asthma. Furthermore, adverse reactions to SO_2 in non-asthmatic and non-sensitive individuals are rare. Few clinical studies have, however, assessed the degree to which SO_2 additives contribute to wine-induced asthma. The results of these studies have been equivocal and hence direct evidence is limited. Furthermore, some individuals report reactions to red wines only, others to white wines only, some to both red and white wines and some to specific brands or types only. Allergists initially believed that 1-3 mg SO_2 released from wine and inhaled by a sulfite-sensitive individual may trigger an adverse reaction. It has since been clinically demonstrated, however, that SO_2 will generally only cause an adverse reaction in sulfite-sensitive asthmatics, which comprise approximately 1.7% of all asthmatics. Steroid-dependent asthmatics are most at risk of an adverse reaction. The threshold for an adverse reaction varies between 5 and 200 mg/L SO_2 where foods containing greater than 100 mg/L SO_2 may elicit no reaction in some sulfite-sensitive individuals. Usually the minimum threshold is considered to be 10 mg/L (Vally 2012).

Safety assessment

Acceptable Daily Intake (ADI)

SO_2 and its sulfite salts are authorised as food additives in many countries for winemaking. In 1986, the Joint FAO/WHO Expert Committee on Food Additives (JECFA) allocated a group Acceptable Daily Intake (ADI) of 0–0.7 mg SO_2 equivalent/kg body weight (bw) per day for sulfur dioxide and sulfites. In 1994, the European Scientific Committee on Food (SCF) similarly allocated a group ADI of 0–0.7 mg SO_2 equivalent/kg bw per day based on pigs and rats studies. The group ADI allocated by JECFA and the SCF has in both cases been determined mainly based on irritating local effects and set under the assumption that results from all sulfiting substances can be compared when taking into consideration the amount of SO_2 being the theoretical result of dosing.

The results of the assessment of the dietary exposure to annatto, nitrites, tartaric acid and sulfites within the framework of the second French Total Diet Study (TDS) are reported in Food Additives & Contaminants Journal (Bemrah et al, 2012). The average concentration (medium bound) in the alcoholic beverages category stood at 46.4 mg/L but wine, taken individually, has a concentration of 92 mg/L. The average dietary exposure to sulphites varies from 0.16 mg/kg/day (lower bound assumption) to 0.17 mg/kg/day (upper bound assumption) in adults and from 0.031 mg/kg/day (lower bound assumption) to 0.04 mg/kg/day (upper bound assumption) in children. In the 95th percentile, exposure ranges from 0.59 mg/kg/day (LB assumption) to 0.60 mg/kg/day (UB assumption) among adults and from 0.12 mg/kg/ day (LB assumption) to 0.14 mg/kg/ day (UB assumption) among children.

The major contributors in the adult population are similar under both hypotheses (lower and upper bound), namely alcoholic drinks (wine, champagne and cider), which represent 77% of total exposure (lower bound) (73% for wine, 2% for champagne and 1% for cider) and 74% of total exposure (upper bound (70% for wine, 2% for champagne and 1% for cider), and secondly sugar, jams and confectionery, representing a contribution of 21% for both hypotheses[1].

JECFA evaluation in 1998

The Committee assessed the intake of SO_2 and related compounds, including the following: calcium, potassium and sodium hydrogen sulfite; calcium, potassium and sodium metabisulfite; calcium, potassium and sodium sulfite; and sodium thiosulfate. These substances are used as preservatives.

A group ADI of 0—0.7 mg/kg of body weight was allocated to sulfur dioxide and the group of related compounds at the fifthy first JECFA meeting (1998).

The evaluation of the proposed maximum limits for sulfites in the Codex Alimentarius General Standard for Food Additives, in conjunction with the data on food intake supplied by national governments, leads to the conclusion that certain foods can be identifled as major contributors to overall sulfite intake.

[1]N. Bemrah , K. Vin , V. Sirot , F. Aguilar , A.-C. Ladrat , C. Ducasse , J.-L. Gey , C. Rétho , A. Nougadere & J.-C. Leblanc (2012) Assessment of dietary exposure to annatto (E160b), nitrites (E249-250), sulphites (E220-228) and tartaric acid (E334) in the French population: the second French total diet study, Food Additives & Contaminants: Part A, 29:6, 875-885, DOI: 10.1080/19440049.2012.658525

Ingestion of a 100 g portion of any food containing sulfite at a concentration of 400 mg/kg or above would result in an intake of sulfite equal to or above the ADI. The consumption of certain solid foods and some beverages commonly leads to intakes above the ADI when the residual level of sulfites in the food approaches the maximum limit for these foods specified in the draft General Standard for Food Additives.

Such foods and beverages are included in the following categories: dried fruit (4.1.2.2); jams, jellies and marmelades (4.1.2.5); fruit preparations, including pulp and fruit toppings (4.1.2.8); dried vegetables (4.2.2.2); vegetable, nut and seed purees and spreads (4.2.2.5); white and semi-white sugar (sucrose or saccharose), fructose, glucose (dextrose), xylose, sugar solutions and syrups, and (partially) inverted sugars, including molasses, treacle and sugar toppings (11.1); concentrates (liquid or solid) for fruit juice (14.1.2.3); wines (14.2.3); and fruit wine (14.2.4).

EFSA evaluation 2016

Short-term toxicity studies in SO_2 - competent or -deficient rats indicated a no observed adverse effect level (NOAEL) of 70 mg SO_2 equivalent/kg bw per day. The critical effect was gastric lesions. In subchronic studies in pigs, a NOAEL of 72 mg SO_2 equivalent/kg bw per day was identified, and higher levels caused mucosal lesions in the stomach and the first part of the large intestine.

Based on the available genotoxicity data, the panel considered that the use of SO_2 and sulfites (sodium sulfite, sodium bisulfite, sodium metabisulfite, potassium metabisulfite, potassium bisulfite, calcium sulfite and calcium bisulfite) as food additives did not raise a concern with respect to genotoxicity.

Only old long-term studies, restricted to sodium and potassium bisulfites, were available. No carcinogenic potential was detected in these studies and a NOAEL of 70 mg SO_2 equivalent/kg bw per day was identified. The panel noted that a possible tumour promoting activity of sulfites in the pylorus of the glandular stomach was reported in two initiation–promotion studies in rats, which may be related to hyperplasia of the fundic glands induced by sodium metabisulfite.

Sulfite sensitivity occurs mostly in asthmatics people and may occur in a small number of non-asthmatic individuals. Numerous studies confirm that sensitivity to sulfites is prevalent and, after oral intake, may present as asthmatic attacks in people suffering from asthma, but also as urticaria and angiooedema in other individuals.

Most sulfite sensitivities are not true allergic reactions and the mechanisms of sulfite intolerance are unclear and likely due to various biological reactions, depending on the individual genetic background. The panel considered that the minimal dose able to elicit a reaction is variable and dependent upon the individual physiological characteristics.

However, the panel noted that:

- the overall available database was limited;
- this database did not indicate any concern for genotoxicity and did not report effects in chronic, carcinogenicity and reproductive toxicity studies after oral exposure in the diet, by gavage, or in the drinking water. A NOAEL of 70 mg SO2 equivalent/kg bw per day was identified from a long-term toxicity study in rats;
- the Panel noted several uncertainties and limitations in the database and concluded that the current group acceptable daily intake (ADI) of 0.7 mg SO2 equivalent/kg bw per day (derived using a default uncertainty factor) would remain adequate but should be considered temporary while the database was improved;
- the EFSA Panel further concluded that exposure estimates to sulfur dioxide and sulfites were higher than the group ADI of 0.7 mg SO2 equivalent/kg bw per day for all population groups;
- although the majority of the available toxicological studies were performed using sodium or potassium metabisulfite, because exposure is predominantly to the sulfite ion irrespective of its source, read across of these data to other sulfites and SO2 is feasible.

According to the information provided by EFSA, the foods that contribute most to the total average exposure are:

Scenario 1): evaluation of exposure to the maximum level legislated.

Adults (18-64 years): Wine, Meat preparations (FCS 08.2)
Elderly (> 65 years): Wine, Meat preparations (FCS 08.2)

Scenario 2): refined exposure considering levels of concentration that do not exceed authorized maximum levels for the categories listed in Annex II of the Regulation 1333/2008 (additives) and Annex IB of Regulation 606/2009 (wines).

Adults (18-64 years): Wine, Meat preparations (FCS 08.2)
Elderly (> 65 years): Wine, Meat preparations (FCS 08.2)

Scenario 3): refined exposure assessment considering scenario 2) plus results analytical data for food categories that may contain sulfites by transfer and for food categories that have not authorized the use of sulfites and whose presence does not can be explained by the principle of transfer.

Adults (18-64 years): Wine, Meat, only chicken meat (FCS 08), Meat preparations (FCS 08.2)
Elderly (> 65 years): Wine, Meat, only chicken meat (FCS 08), Meat preparations (FCS 08.2)

Main food categories contributing to exposure to sulfur dioxide–sulfites (E 220–228) using the regulatory maximum level exposure assessment scenario. Finally in adults and elderly, the FCS 08.2 'Meat preparations as defined by Regulation (EC) No 853/2004' and 'Wine' represented the main food contributors.

The human sensitivity reactions towards sulfited wines, which cannot always be reproduced by exposure to sulfites alone (Linneberg et al., 2008), indicated that they may also be dependent on some co-exposure to either reactive products or other constituents, such as alcohol, biogenic amines or contaminants arising from the wine processing, as well as residual refining agents (egg white protein, casein). However, Vassilopoulou et al. (2011) reported that the amount of these allergens in the wines they studied was extremely low and concluded that current evidence indicates a very low risk for the allergic consumer from the wine-fining agents used in the wines they studied. The panel noted that some sensitivity reactions following ingestion of wine have also been reported as associated with the presence of other allergenic components such as hymenoptera venom from insects collected with the grapes (Armentia et al., 2007; Armentia, 2008).

OIV METHODS OF ANALYSIS

Many methods exist for the measurement of free, combined (bound) and total sulfites. Most methods are based on removing as much of the free sulfites and the reversibly bound sulfites as possible. Irreversibly bound sulfites cannot be estimated. The determination of free sulfites is important only for industry (wine, beverages, shrimps) to predict the durability of the final product.

The OIV method is based on methods:

Free Sulfur dioxide (titrimetry)	Type IV	OIV-MA-AS323-04A1
Total Sulfur dioxide (titrimetry)	Type II	OIV-MA-AS323-04A2
Sulfur dioxide (Iodometry)	Type IV	OIV-MA-AS323-04B
Sulfur dioxide (molecular method)	Type IV	OIV-MA-AS323-04C

SO_2 LEVELS IN WINES

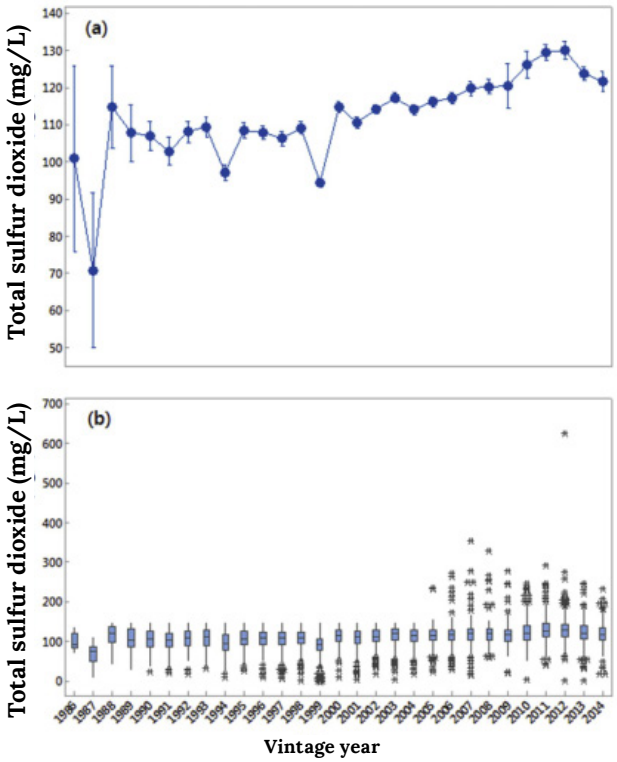
Argentina
Period of analysis: 2018

Red wines		
Total SO_2 mg/L	Nr. of samples	%
0 - 26	487	0.88%
26 - 52	6943	12.54%
52 - 78	17944	32.41%
78- 104	13856	25.03%
104 - 130	10740	19.40%
130 - 180	5391	9.74%
total	**55361**	

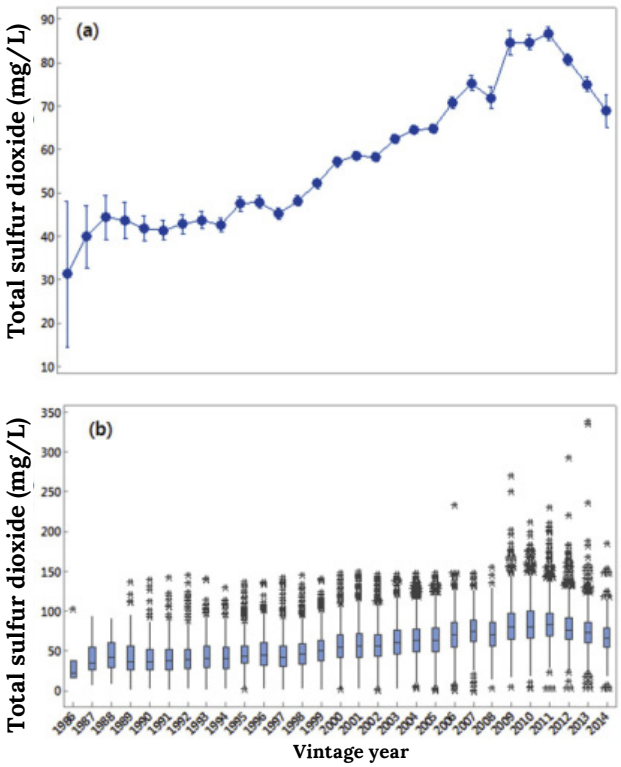
White/Rosé wines		
Total SO_2 mg/L	Nr. of samples	%
0 - 30	39	0.19%
30 - 60	577	2.86%
60 - 90	4348	21.56%
90 - 120	8119	40.26%
120 - 150	4931	24.45%
150 - 180	1784	8.85%
180 - 210	366	1.82%
total	**20164**	

Australia

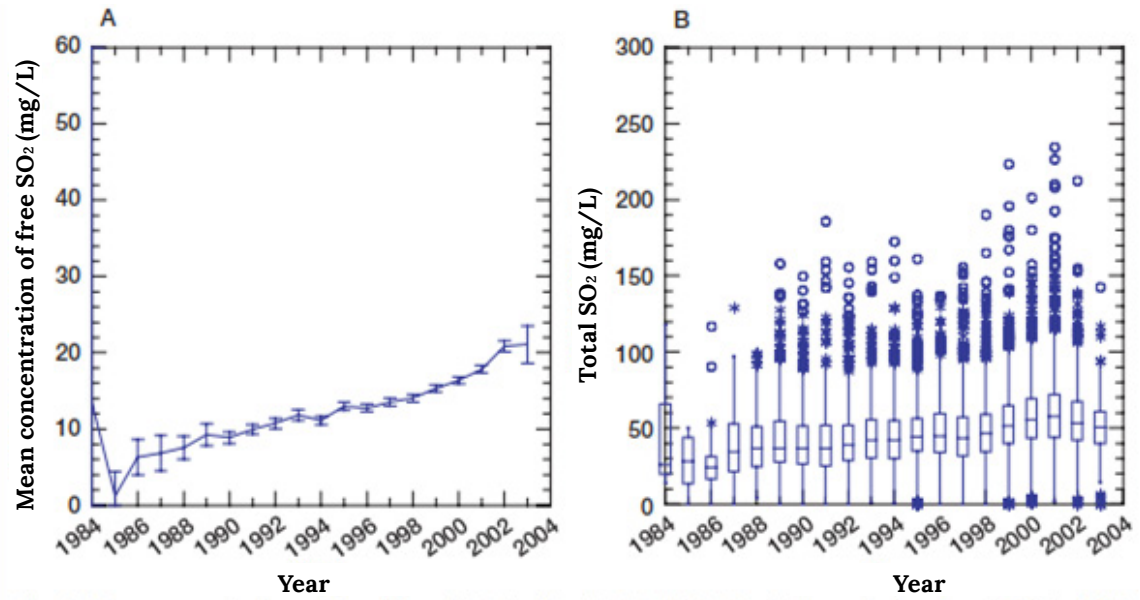
The mean concentration of total SO_2 observed in 9477 white wines and 18,421 red wines analysed at The Australian Wine Research Institute from 1990 to 2001 was 121 mg/L and 33.5 mg/L, respectively (AWRI, unpublished data). In 2004, the mean concentration of total SO_2 in red wine was approximately 55 mg/L; it increased steadily from 40 mg/L in 1987 to 58 mg/L in 2001 and has subsequently stabilised. In 2013 however, the median concentration of total SO_2 in Australian wines was 73 mg/L for red wine and 123 mg/L for white wine (AWRI unpublished data).



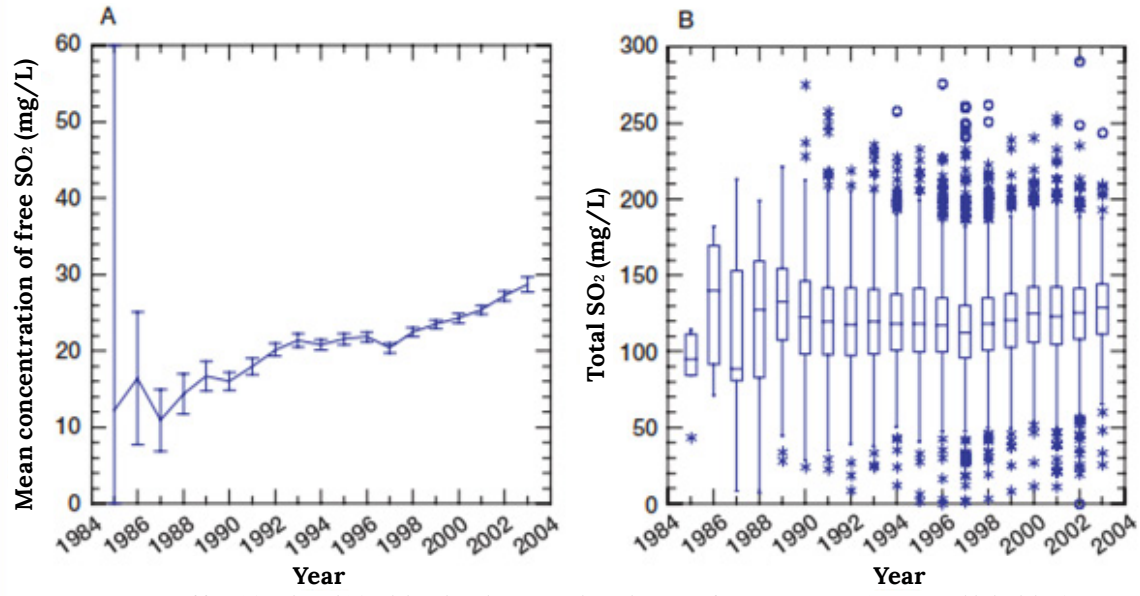
(a) Mean total SO_2 concentration and (b) median (horizontal line in the centre of the box) and distribution of total SO_2 concentration in white and rosé wines of all cultivars for the vintages 1988-2014 (rosé wines included from 2004 vintage onwards).



(a) Mean total SO_2 concentration and (b) median (horizontal line in the centre of the box) and distribution of total SO_2 concentration in red wines of all cultivars for the vintages 1984-2014.



Mean concentration of free (A) and total sulphur dioxide (B) in Australian red wine from 1984 to 2004 (AWRI unpublished data).



Mean concentration of free (A) and total (B) sulphur dioxide in Australian white wine from 1984 to 2004 (AWRI unpublished data).

Austria
Analyses carried out by the Federal Office for Viticulture
SO_2 Total: 37813 samples
Period of analysis: 2018

			Total SO_2 mg /L		
Type of wine	Colour	Nr. of samples	Mean	Min.	Max.
Auslese	RS*	1	127	127	127
Auslese	RT**	3	115	59	195
Auslese	WE***	166	187.38	74	413
Beerenauslese	WE	152	226.55	29	482
Beerenauslese	RS	3	250.67	189	287
Beerenauslese	RT	4	234	218	240
DAC	RS	18	127.89	57	214
DAC	RT	334	73.44	20	148
DAC	WE	4062	112.6	26	341
Eiswein	RS	5	195.6	134	238
Eiswein	RT	5	167.2	141	192
Eiswein	WE	42	246.57	53	411
Eiswein	GP****	2	236	182	290
Kabinett	RT	8	78	16	114
Kabinett	RS	20	108.55	75	163
Kabinett	WE	384	116.09	46	246
Qualitätswein	WE	22308	115.64	9	344
Qualitätswein	RT	7821	82.4	9	530
Qualitätswein	RS	1785	111.32	10	215
Qualitätswein	GP	100	113.53	48	196
Ruster Ausbruch	RT	1	412	412	412
Ruster Ausbruch	WE	9	284.44	199	341
Spätlese	RT	64	127.84	61	252
Spätlese	RS	16	149.94	119	187
Spätlese	WE	365	168.4	58	314
Strohwein	WE	5	198.4	134	373
Strohwein	RT	3	215	130	360
Trockenbeerenauslese	WE	120	228.57	50	382
Trockenbeerenauslese	RT	5	174.4	123	277
Trockenbeerenauslese	RS	2	225	164	286
RS* - rosé, RT**- red, WE*** - white, GP**** - pressed immediately					

Brazil
Total SO_2 - period: 2010-2018

Product	N. of samples	Mean (mg/L)	Std Dev (mg/L)	Minimum (mg/L)	Maximum (mg/L)
Red wine - dry	1113	82.89	32.61	8	241
Red wine - sweet	19	89.95	44.11	36	200
White wine - dry	423	118.88	37.59	20	290
White wine - sweet	11	77.45	38.33	36	150
Rosé wine - dry	31	105.61	39.65	36	170
Rosé wine - sweet	5	42.20	8.17	36	53
Sparkling wine	306	120.68	34.03	10	250
Moscatel sparkling wine	70	137.33	41.01	36	220
Total Samples	**1908**				

France

Results from independent laboratories
(18246 wines analysed) from 2011 to 2018 vintages.

		SO_2Free			SO_2T		
All type of wines (n = 18246 wines)	**Min - Max**	0.0	-	245.0	1.0	-	404.0
	Mean ± Std Dev	22.4	±	12.5	69.5	±	34.1
Red wine (n = 12320)	**Min - Max**	0.0	-	188.0	1.0	-	378.0
	Mean ± Std Dev	23.2	±	12.1	57.7	±	27.8
Rosé wine (n = 2498)	**Min - Max**	0.0	-	240.0	1.0	-	345.0
	Mean ± Std Dev	21.8	±	12.5	94.4	±	28.6
White wine (n = 3428)	**Min - Max**	0.0	-	245.0	1.0	-	404.0
	Mean ± Std Dev	19.9	±	13.7	93.8	±	35.4
Vintage 2011 (n = 13)	**Min - Max**	0.0	-	24.0	4.0	-	94.0
	Mean ± Std Dev	6.8	±	6.2	58.4	±	21.0
Vintage 2012 (n = 4)	**Min - Max**	14.0	-	31.0	50.0	-	97.0
	Mean ± Std Dev	24.3	±	7.4	80.3	±	21.0
Vintage 2013 (n = 35)	**Min - Max**	3.0	-	37.0	35.0	-	134.0
	Mean ± Std Dev	24.0	±	8.6	77.0	±	20.5
Vintage 2014 (n = 1390)	**Min - Max**	0.0	-	76.0	1.0	-	206.0
	Mean ± Std Dev	25.6	±	10.6	72.0	±	30.3
Vintage 2015 (n = 1536)	**Min - Max**	0.0	-	168.0	1.0	-	378.0
	Mean ± Std Dev	25.5	±	11.9	72.2	±	32.4
Vintage 2016 (n = 1282)	**Min - Max**	0.0	-	112.0	1.0	-	203.0
	Mean ± Std Dev	24.9	±	11.9	70.2	±	30.1
Vintage 2017 (n = 1233)	**Min - Max**	0.0	-	98.0	1.0	-	180.0
	Mean ± Std Dev	24.7	±	11.6	70.8	±	30.6
Vintage 2018 (n = 570)	**Min - Max**	0.0	-	56.0	1.0	-	237.0
	Mean ± Std Dev	14.1	±	12.0	46.6	±	36.9

	SO_2T	Number	%
All type of wines (n = 18246 wines)	0 - 30 mg/L	1982	10.9
	31 - 60 mg/L	5685	31.2
	61 - 90 mg/L	5989	32.8
	91 - 120 mg/L	3257	17.9
	121 - 150 mg/L	1073	5.9
	151 - 180 mg/L	177	1.0
	181 - 210 mg/L	48	0.3
	> 210 mg/L	27	0.1
Red wine (n = 12320)	0 - 30 mg/L	1744	14.2
	31 - 60 mg/L	5199	42.2
	61 - 90 mg/L	4120	33.4
	91 - 120 mg/L	961	7.8
	121 - 150 mg/L	217	1.8
	151 - 180 mg/L	45	0.4
	181 - 210 mg/L	13	0.1
	> 210 mg/L	5	0.0
Rosé wine (n = 2498)	0 - 30 mg/L	64	2.6
	31 - 60 mg/L	164	6.6
	61 - 90 mg/L	875	35.0
	91 - 120 mg/L	998	40.0
	121 - 150 mg/L	336	13.5
	151 - 180 mg/L	43	1.7
	181 - 210 mg/L	13	0.5
	> 210 mg/L	4	0.2
White wine (n = 3428)	0 - 30 mg/L	172	5.0
	31 - 60 mg/L	320	9.3
	61 - 90 mg/L	990	28.9
	91 - 120 mg/L	1297	37.8
	121 - 150 mg/L	519	15.1
	151 - 180 mg/L	89	2.6
	181 - 210 mg/L	22	0.6
	> 210 mg/L	18	0.5

	SO_2T	Number	%
Vintage 2011 (n = 13)	0 - 30 mg/L	1	7.7
	31 - 60 mg/L	4	30.8
	61 - 90 mg/L	7	53.8
	91 - 120 mg/L	1	7.7
	121 - 150 mg/L	0	0.0
	151 - 180 mg/L	0	0.0
	181 - 210 mg/L	0	0.0
	> 210 mg/L	0	0.0
Vintage 2012 (n = 4)	0 - 30 mg/L	0	0.0
	31 - 60 mg/L	1	25.0
	61 - 90 mg/L	1	25.0
	91 - 120 mg/L	2	50.0
	121 - 150 mg/L	0	0.0
	151 - 180 mg/L	0	0.0
	181 - 210 mg/L	0	0.0
	> 210 mg/L	0	0.0
Vintage 2013 (n = 35)	0 - 30 mg/L	0	0.0
	31 - 60 mg/L	7	20.0
	61 - 90 mg/L	20	57.1
	91 - 120 mg/L	7	20.0
	121 - 150 mg/L	1	2.9
	151 - 180 mg/L	0	0.0
	181 - 210 mg/L	0	0.0
	> 210 mg/L	0	0.0
Vintage 2014 (n = 1390)	0 - 30 mg/L	81	5.8
	31 - 60 mg/L	447	32.2
	61 - 90 mg/L	532	38.3
	91 - 120 mg/L	221	15.9
	121 - 150 mg/L	100	7.2
	151 - 180 mg/L	7	0.5
	181 - 210 mg/L	2	0.1
	> 210 mg/L	0	0.0

	SO_2T	Number	%
Vintage 2015 (n = 1536)	0 - 30 mg/L	103	6.7
	31 - 60 mg/L	484	31.5
	61 - 90 mg/L	551	35.9
	91 - 120 mg/L	278	18.1
	121 - 150 mg/L	103	6.7
	151 - 180 mg/L	10	0.7
	181 - 210 mg/L	4	0.3
	> 210 mg/L	3	0.2
Vintage 2016 (n = 1282)	0 - 30 mg/L	90	7.0
	31 - 60 mg/L	429	33.5
	61 - 90 mg/L	457	35.6
	91 - 120 mg/L	241	18.8
	121 - 150 mg/L	51	4.0
	151 - 180 mg/L	9	0.7
	181 - 210 mg/L	5	0.4
	> 210 mg/L	0	0.0
Vintage 2017 (n = 1233)	0 - 30 mg/L	103	8.4
	31 - 60 mg/L	381	30.9
	61 - 90 mg/L	400	32.4
	91 - 120 mg/L	281	22.8
	121 - 150 mg/L	58	4.7
	151 - 180 mg/L	4	0.3
	181 - 210 mg/L	0	0.0
	> 210 mg/L	0	0.0
Vintage 2018 (n = 570)	0 - 30 mg/L	220	38.6
	31 - 60 mg/L	168	29.5
	61 - 90 mg/L	106	18.6
	91 - 120 mg/L	50	8.8
	121 - 150 mg/L	22	3.9
	151 - 180 mg/L	3	0.5
	181 - 210 mg/L	0	0.0
	> 210 mg/L	1	0.2

Italy

The data on Italian wines, shown below, derive from laboratories that perform analyses on behalf of producers. Wines containing sulphites above the limits were not marketed.

Total SO_2 - period: 2011-2013

Product	Number of samples	Means mg/L	Std Deviation	Min	Max
Sparkling Aromat Qualita White	56	162.64	20.26	69	200
Sparkling Aromat Qualita Rosé	9	137.33	35.43	81	179
Sparkling Aromat Qualita Red	15	149.2	35.98	69	185
Aromatised Wine	126	115.5	35.64	10	180
Wine White	6034	99.57	29.36	5	438
Wine White Sparkling	534	133.18	25.6	73	220
Wine White fotified	16	98.78	25.45	71	150
Wine Rosé	561	92.87	27.91	14	170
Wine Rosé Sparkling	74	132.68	27.59	65	172
Wine Red	15275	89.09	30.11	5	525
Wine Red Sparkling	1644	104.92	25.72	36	160
Wine Sparkling White	206	136.72	39.54	5	213
Wine Sparkling Qualita White	22	98.86	34.12	20	159
Wine Sparkling Qualita Rosé	18	133.94	47.63	49	191
Wine Sparkling Qualita Red	1	151		151	151
Wine Sparkling Rosé	55	125.62	32.54	58	216
Wine Sparkling Red	8	100.88	38.42	35	160
vsqprd aromatised White	144	145.99	21.46	79	202
vsqprd aromatised Red	9	116.89	13.02	92	131
vsqprd White	618	106.46	21.07	43	147
vsqprd Rosé	74	109.19	18.47	78	160
Total samples	**25499**	**95.18**	**32**	**5**	**525**

Total SO_2 - period: 2019 - data from Veneto

2019	n.	Mean mg/L	Max mg/L	0-50 mg/L	50-100 mg/L	100-150 mg/L	150-200 mg/L	200-250 mg/L	250-300 mg/L
White	1597	107	256	115	508	830	129	14	1
Rosé	207	102	206	24	67	86	29	1	0
Sweet white	18	143	204	1	1	8	7	1	0
Red	3504	104	220	224	1345	1669	263	3	0
Sweet red	48	117	196	3	15	20	10	0	0
Sparkling	571	127	208	28	141	181	219	2	0
Organic White	113	72	158	33	49	30	1	0	0
Organic Rosé	9	64	126	4	3	2	0	0	0
Organic Red	97	66	169	34	45	16	2	0	0
Organic Sparkling	12	117	144	0	1	11	0	0	0

Total SO_2 - period: 2019 – data from Abruzzo

2019	n	Mean mg/L	Max mg/L	0-50 mg/L	50-100 mg/L	100-150 mg/L	150-200 mg/L	200-250 mg/L	250-300 mg/L
White	857	100	195	73	370	350	64	0	0
Rosé	502	96	189	37	263	183	19	0	0
Sweet white	37	64	156	9	25	2	1	0	0
Red	1603	77	194	281	1021	272	29	0	0
Sparkling	33	122	244	1	4	24	3	1	0
Organic Rosé	6	62	132	2	4	0	0	0	0
Organic Red	15	36	84	11	4	0	0	0	0

Moldavia
Analyses carried out by the National Center for Quality Control of Vitivinicultural Products

SO_2 Total: 10.767 samples
Period of analysis: 01.01. 2017 - 01.06.2019

Product	Number of samples	Mean mg/L	SD mg/L	Min.	Max.
Dry white wines, sugars <4 g / L	1323	132.8	31.02	12	303
Rosés wine , sugars <4 g / L	271	115.76	29.14	17	199
Red wines, sugars <4 g / L	2070	96.79	29.14	20	185
White, Rosés, Red semi dry wines, maximum sugars 18 g / L	1497	133.53	35.48	31	250
White, Rosés, Red semi sweet wines, maximum sugars 45 g / L	4048	143.77	38.53	5	250
White, Rosés, Red sweet wines sugars > 45 g/L	376	130.65	43.91	46	300
White, Rosés, Red special wines sugars > 120 g/L	415	76.2	39.17	17	200
White, Rosés, Red sparkling wines (brut, extra brut, sec, demisec, doux)	767	144.04	32.25	40	300

Romania

Analysis carried out by USAMV Bucharest and Central Laboratories for Quality and Hygiene Control of Wine Focsani, Valea Calugareasca, Basarabi, Blaj, and Craiova
SO_2 Total: 729 samples

Period of analysis: 2018 and 2019

Type	No. of samples	Total SO_2, mg/L				
		Mean	Std Dev	Min.	Median	Max.
White	351	114.67	35.77	11.07	111.83	273.32
Red	275	86.76	34.15	18.6	84.36	194.39
Rose	103	124.81	51.17	28.97	118.3	422.08
	729					

Sugar content	No. of samples	Total SO_2, mg/L				
		Mean	Std Dev	Min.	Median	Max.
dry	549	98.32	34.56	11.07	99.92	247.47
half-dry	107	120.76	45.01	42.93	114.3	350
half-sweet	60	132.39	54.1	58.9	127.45	422.08
sweet	13	163.62	37.17	108.6	164.41	235.83
	729					

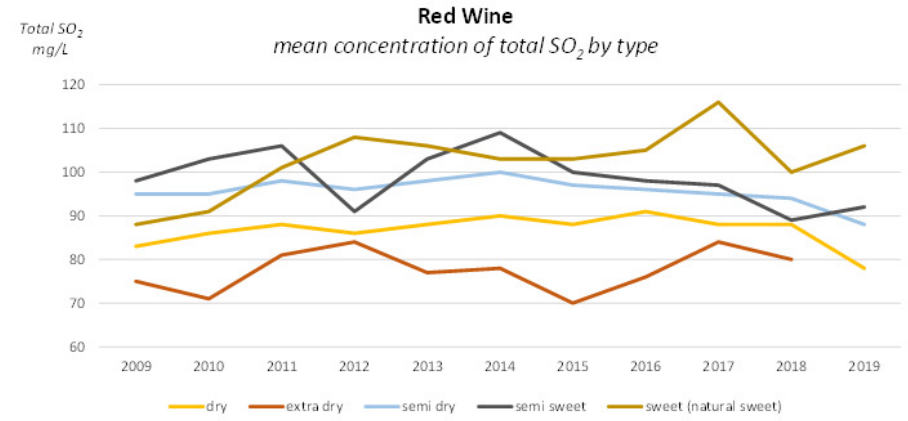
Type	Sugar content	No. of samples	Total SO_2, mg/L				
			Mean	Std Dev	Min.	Med.	Max.
White	**dry**	256	107.13	31.52	11.07	106.23	247.47
	half-dry	54	132.12	39.48	50	127.27	273.32
	half-sweet	33	133.23	35.94	75	131.1	225.48
	sweet	8	162.91	36.66	119.7	157.18	235.83
Red	**dry**	221	83.84	33.55	18.6	81.9	187.5
	half-dry	36	91.76	29.01	42.93	95.55	152.86
	half-sweet	14	101.21	34.81	58.9	92.985	158.62
	sweet	4	152.1	36.31	108.6	152.7	194.39
Rosé	**dry**	72	111.48	32.47	28.97	115.03	179.92
	half-dry	17	146.08	58.38	97.4	142	350
	half-sweet	13	163.82	86.19	96.1	133	422.08
	sweet	1	215.42	--	215.42	215.42	215.42
		729					

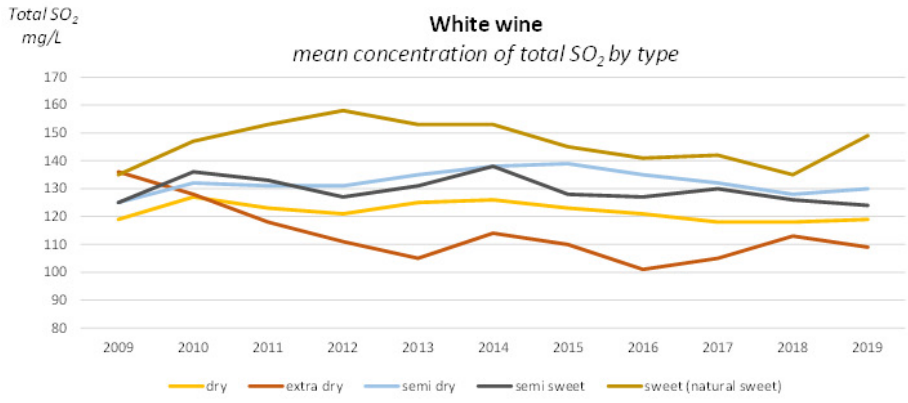
Year	No. of samples	Total SO_2, mg/L				
		Mean	Std Dev	Min.	Median	Max.
2019	353	106.12	43.37	12.47	103.45	422.08
2018	376	105.08	37.82	11.07	107.15	241.99

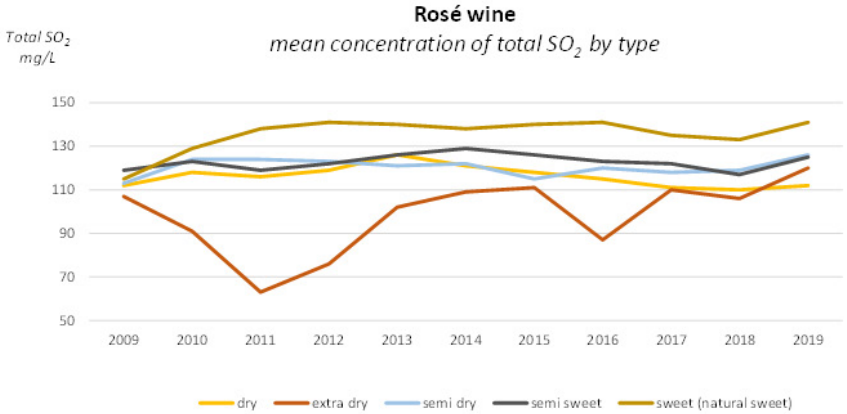
Spain
SO_2 Total: 1124 samples

Type of wine	N. of samples	Mean mg/L	Std Deviation	Median	Max.	Min.
Red wine	547	92.1	28.9	89.0	218.0	1.8
White wine	241	107.2	36.7	100.0	226.0	22.0
Rosé wine	56	117.3	32.7	113.0	198.0	52.0
Sparkling wine	14	88.6	36.9	79.0	171.0	46.0
Vermouth	6	99.0	33.6	92.0	141.0	48.0

South Africa
Evolution of total SO_2 levels per type of wines from 2009 to 2019.







Sweden
Total SO_2, mg/L

Type of Wine	Number of samples	Min.	Max.	Median	Mean	Std deviation
Red wine in bottle	4720	<20	248	72	76	28
Red wine NOT in bottle	653	<20	202	85	84	29
White wine in bottle	2424	<20	280	103	105	29
White wine NOT in bottle	516	51	229	118	118	26
Rosé wine in bottle	444	20	227	97	100	31
Rosé wine NOT in bottle	237	<20	211	119	123	35
Champagne	329	20	165	54	53	15
Sparkling wine	487	<20	208	107	106	36
Sweet wines	438	<20	403	83	110	93

CONCLUSIONS

Based on data received from several Member States the mean concentration of total SO_2 observed according to the different types of wine are well below the OIV limit:

Red < 4g/L sugars: 60-96 mg/L
White/Rosé < 4g/L sugars: 100-132 mg/L
Red/White/Rosé > 4g/L sugars: 80-130 mg/L
Sweet/Special wines: 110-180 mg/L

Based on the risk assessment, it appears that wine, sparkling wines and cider are major contributors of exposure of SO_2 in the adult population, which represent approximately 75% of total exposure when this beverages are included in the diet.

There are risk management measures applicable to food additives that could have a fairly immediate effect in terms of reducing exposure, in particular the reduction of authorized maximum levels.

To carry out this review, it is necessary to know in advance the possibilities of making this reduction and to what level, maintaining the technological need at an acceptable level, and knowing the alternatives that may exist to the use of sulfites that allow to suppress uses or substitute them by others alternatives, mainly in the food categories that contribute most to the exhibition.

The production of wines with reduction of SO_2 concentrations need to be explored and should be managed with recommendations at all steps of the winemaking process – from the grapes to the bottle – without compromising wine quality in terms of organoleptic characteristics and microbiological stability. This complementary approach should be considered in function of the various wines types specifities and taking into account the resolution OIV-OENO 631-2020: "Review of practices for the reduction of SO_2 doses used in winemaking".

REFERENCES

Allen, R.G; L. S. Pereira; D. Raes and M. Smith (1998). Crop evapotranspiration - Armentia A, Pineda F and Fernández S, 2007. Wine-induced anaphylaxis and sensitization to hymenoptera venom. The New England Journal of Medicine 357, 719–720. Armentia A, 2008. Adverse reactions to wine: think outside the bottle. Current Opinion in Allergy and Clinical Immunology, 8, 266–269.

EFSA, 2016. Scientific Opinion on the re-evaluation of sulfur dioxide (E 220), sodium sulfite (E 221), sodium bisulfite (E 222), sodium metabisulfite (E 223), potassium metabisulfite (E 224), calcium sulfite (E 226), calcium bisulfite (E 227) and potassium bisulfite (E 228) as food additives. EFSA Journal 2016;14(4):4438.

Hassan Vally, Neil LA Misso, Adverse reactions to the sulphite additives Gastroenterol Hepatol Bed Bench. 2012 Winter; 5(1): 16–23.

JECFA, 1986, Evaluation of certain food additives and contaminants. 29th report of the Joint FAO/WHO Expert Committee on Food Additives. WHO, Technical Report Series, (Geneva), No. 733, and corrigendum

JECFA, 2001, Evaluation of national assessments of intake of Sulfites. Prepared by the 51st meeting of the Joint FAO/WHO Expert Committee on Food Additives. WHO, Safety Evaluation of Certain Food Additives. WHO, Food Additives Series (Geneva), No. 42

JECFA, 2009, Safety evaluation of certain food additives. Prepared by the 69th meeting of the Joint FAO/WHO Expert Committee on Food Additives. WHO, Food additives series, (Geneva), No. 60

JECFA, 2009, Evaluation of certain food additives. 69th report of the Joint FAO/WHO Expert Committee on Food Additives. WHO, Technical Report Series, (Geneva) No. 952

Linneberg A, Berg ND, Gonzalez-Quintela A, Vidal C and Elberling J, 2008. Prevalence of selfreported hypersensitivity symptoms following intake of alcoholic drinks. Clinical And Experimental Allergy 38, 145–151.

N. Bemrah, K. Vin, V. Sirot, F. Aguilar, A.-C. Ladrat, C. Ducasse, J.-L. Gey, C. Rétho, A. Nougadere & J.-C. Leblanc (2012) Assessment of dietary exposure to annatto (E160b), nitrites (E249-250), sulphites (E220-228) and tartaric acid (E334) in the French population: the second French total diet study, Food Additives & Contaminants: Part A, 29:6, 875-885, DOI: 10.1080/19440049.2012.658525.

OIV, (2020). Resolution OIV-OENO 631-2020. "Review of practices for the reduction of SO_2 doses used in winemaking".

Ough CS, Determination of sulfur dioxide in grapes and wines. J Assoc Off Anal Chem. 1986 Jan-Feb;69(1):5-7.

Vassilopoulou E, Karathanos A, Siragakis G, Giavi S, Sinaniotis A, Douladiris N, Fernandes-Rivas M, Clausen M and Papadopoulos NG, 2011. Risk of allergic reactions to wine, in milk, egg and fishallergic patients. Clinical and Translational Allergy 1, 10.

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