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Safety and efficacy of the feed additive 4-methyl-5-vinylthiazole [15.018] belonging to chemical group 29 for all animal species (FEFANA asbl)

EFSA Panel on Additives and Products or Substances used in Animal Feed (FEEDAP), Vasileios Bampidis, Giovanna Azimonti, Maria de Lourdes Bastos, Henrik Christensen, Mojca Durjava, Maryline Kouba, Marta López-Alonso, Secundino López Puente, Francesca Marcon, Baltasar Mayo, Alena Pechová, Mariana Petkova, Fernando Ramos, Yolanda Sanz, Roberto Edoardo Villa, Ruud Woutersen, Paul Brantom, Andrew Chesson, Johannes Westendorf, Paola Manini and Birgit Dusemund

Abstract

Following a request from the European Commission, EFSA was asked to deliver a scientific opinion on the safety and efficacy of 4-methyl-5-vinylthiazole [15.018] belonging to chemical group 29 (thiazoles, thiophene and thiazoline), when used as sensory additive (flavourings) in feed for all animal species. The FEEDAP Panel concluded that 4-methyl-5-vinylthiazole [15.018] was safe at the maximum proposed use level of 0.5 mg/kg complete feed for veal calves (milk replacer), dogs, salmonids and ornamental fish. For the other species, the calculated safe concentrations in complete feed are: 0.4 mg/kg for cattle for fattening, sheep/goat, horses and cats; 0.3 mg/kg for sows and dairy cows; 0.2 mg/kg for piglets, pigs for fattening, rabbits and laying hens; and 0.1 mg/kg for chickens for fattening and turkeys for fattening. These conclusions were extrapolated to other physiologically related species. For any other species, the additive was considered safe at 0.1 mg/kg complete feed. No safety concern would arise for the consumer from the use the additive up to the maximum proposed use level in feed. The additive should be considered as irritant to skin and eyes and the respiratory tract, and as dermal and respiratory sensitisers. The use of 4-methyl-5-vinylthiazole [15.018] as a flavour in animal feed was not expected to pose a risk to the environment. Since the compound under assessment is used in food as flavouring and its function in feed is essentially the same as that in food, no further demonstration of efficacy was considered necessary.

Keywords: sensory additives, feed flavourings, thiazoles, thiophene and thiazoline, 4-methyl-5-vinylthiazole, safety, efficacy

Requestor: European Commission

Question number: EFSA-Q-2016-00184

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1. Introduction

1.1. Background and terms of reference

Regulation (EC) No 1831/2003[1] establishes the rules governing the Community authorisation of additives for use in animal nutrition. In particular, Article 4(1) of that Regulation lays down that any person seeking authorisation for a feed additive or for a new use of feed additive shall submit an application in accordance with Article 7. In addition, Article 10(2) of that Regulation specifies that for existing products within the meaning of Article 10(1), an application shall be submitted in accordance with Article 7, within a maximum of seven years after the entry into force of this Regulation.

The European Commission received a request from Feed Flavourings Authorisation Consortium European Economic Interest Grouping (FFAC EEIG)[2] for authorisation of 12 substances (2,4,5-trimethylthiazole, 2-isobutylthiazole, 5-(2-hydroxyethyl)-4-methylthiazole, benzothiazole, 4-methyl-5-vinylthiazole, 2,4,5-trimethylthiazole, 2-acetylthiazole, 3-acetyl-2,5-dimethylthiophene, 2-isopropyl-4-methylthiazole, 2-ethyl-4-methylthiazole, 5,6-dihydro-2,4,6-trans(2-methylpropyl)4H-1,3,5-dithiazine and thiamine hydrochloride) belonging to chemical group (CG) 29, when used as a feed additive for all animal species (category: sensory additives; functional group: flavourings). CG 29 for flavouring substances is defined in Commission Regulation (EC) No 1565/2000[3] as "thiazoles, thiophene, thiazoline and thienyl derivatives." During the course of the assessment, this application was split and the present opinion covers one out of the 12 substances under application (see Section 1.2).

According to Article 7(1) of Regulation (EC) No 1831/2003, the Commission forwarded the applications to the European Food Safety Authority (EFSA) as applications under Article 4(1) (authorisation of a feed additive or new use of a feed additive) and under Article 10(2) (re-evaluation of an authorised feed additive). During the assessment, the applicant withdrew the application for the use of chemically defined flavourings in water for drinking.[4] EFSA received directly from the applicant the technical dossier in support of this application. The particulars and documents in support of this application were considered valid by EFSA as of 18 November 2010.

According to Article 8 of Regulation (EC) No 1831/2003, EFSA, after verifying the particulars and documents submitted by the applicant, shall undertake an assessment in order to determine whether the feed additive complies with the conditions laid down in Article 5. EFSA shall deliver an opinion on the safety for the target animals, consumer, user and the environment and on the efficacy of the feed additive consisting of 4-methyl-5-vinylthiazole (EU Flavour Information System (FLAVIS) number) [15.018], when used under the proposed conditions of use (see Section 3.1.3).

1.2. Additional information

The initial application on CG 29 concerned 12 compounds, intended to be used as feed flavourings for all animal species. The EFSA Panel on Additives and Products or Substances used in Animal Feed (FEEDAP) has already delivered two opinions on 11 of the 12 compounds included in CG 29 (EFSA FEEDAP Panel, 2013, 2016).

One compound, 4-methyl-5-vinylthiazole [15.018] was excluded from the previous opinions because at that time the assessment for use in food as flavouring was not complete. The EFSA Panel on Food Contact Materials, Enzymes, Flavourings and Processing Aids (EFSA CEF Panel) had requested additional genotoxicity data to complete the assessment of 4-methyl-5-vinylthiazole [15.024] (EFSA CEF Panel, 2013).

The EFSA Panel on Food Additives and Flavourings (EFSA FAF Panel) has delivered an opinion in 2023 and concluded that the genotoxicity concerns for 4-methyl-5-vinylthiazole [15.018] could be ruled out and there was no safety concern at the estimated level of intake as a flavouring substance (EFSA FAF Panel, 2023).

[1] Regulation (EC) No 1831/2003 of the European Parliament and of the council of 22 September 2003 on the additives for use in animal nutrition. OJ L 268, 18.10.2003, p. 29.

[2] On 13/3/2013, EFSA was informed by the applicant that FFAC EEIG was liquidated on 19/12/2012 and their rights as applicant were transferred to FEFANA Asbl (EU Association of Specialty Feed Ingredients and their Mixtures), Avenue Louise 130A, Box 1, 1050 Brussels, Belgium.

[3] Commission Regulation (EC) No 1565/2000 of 18 July 2000 laying down the measures necessary for the adoption of an evaluation programme in application of Regulation (EC) No 2232/96 of the European Parliament and of the Council. OJ L 180, 19.7.2000, p. 8.

[4] On 10 March 2016, EFSA was informed by the European Commission on the withdrawal of the application for re-authorisation of chemically defined flavourings – use in water.

The compound under assessment, 4-methyl-5-vinylthiazole [15.018], is currently listed in the European Union database of flavouring substances[5] and in the European Union Register of Feed Additives,[6] respectively, and thus authorised for use in food and feed in the European Union.

2. Data and methodologies

2.1. Data

The present assessment is based on data submitted by the applicant in the form of a technical dossier[7] in support of the authorisation request for the use of the compounds belonging to chemical group 29 under assessment as feed additives. The dossier was received on 18 November 2010 and the general information and supporting documentation are available on Open.EFSA at https://open.efsa.europa.eu/questions/EFSA-Q-2016-00184.[8]

The FEEDAP Panel used the data provided by the applicant together with data from other sources, such as previous risk assessments by EFSA or other expert bodies, peer-reviewed scientific papers and experts' knowledge, to deliver the present output.

EFSA has verified the EURL report as it relates to the methods used for the control of flavourings from CG 29 – thiazoles, thiazolines and thienyl derivatives – in animal feed.[9]

2.2. Methodologies

The approach followed by the FEEDAP Panel to assess the safety and the efficacy of the 4-methyl-5-vinylthiazole [15.018] belonging to chemical group 29 is in line with the principles laid down in Regulation (EC) No 429/2008[10] and the relevant guidance documents: Guidance for the preparation of dossiers for sensory additives (EFSA FEEDAP Panel, 2012a), Guidance on studies concerning the safety of use of the additive for users/workers (EFSA FEEDAP Panel, 2012b), Guidance on the identity, characterisation and conditions of use of feed additives (EFSA FEEDAP Panel, 2017a), Guidance on the safety of feed additives for the target species (EFSA FEEDAP Panel, 2017b), Guidance on the assessment of the safety of feed additives for the consumer (EFSA FEEDAP Panel, 2017c), Guidance on the assessment of the safety of feed additives for the environment (EFSA FEEDAP Panel, 2019) and Guidance on the assessment of the efficacy of feed additives (EFSA FEEDAP Panel, 2018).

3. Assessment

The additive under assessment, 4-methyl-5-vinylthiazole [15.018], belongs to CG 29 'thiazoles, thiophene, thiazoline and thienyl derivatives.' It is intended to be used as a sensory additive (functional group: flavouring compounds) in feed for all animal species.

[5] Commission Implementing Regulation (EU) No 872/2012 of 1 October 2012 adopting the list of flavouring substances provided for by Regulation (EC) No 2232/96 of the European Parliament and of the Council, introducing it in Annex I to Regulation (EC) No 1334/2008 of the European Parliament and of the Council and repealing Commission Regulation (EC) No 1565/2000 and Commission Decision 1999/217/EC. OJ L 267, 2.10.2012, p. 1.

[6] European Union Register of Feed Additives pursuant to Regulation (EC) No 1831/2003. Available online: https://joint-research-centre.ec.europa.eu/publications/fad-2010-0116_en

[7] FEED dossier reference: FAD-2010-0415.

[8] The original application EFSA-Q-2010-011180 was split on 12 June 2013 and a new question was generated. The initial EFSA-Q-2010-01180 was assigned to 3-acetyl-2,5-dimethylthiophene [15.024] and the new EFSA-Q-2013-00569 to the remaining 11 compounds. On 2 March 2016, the EFSA-Q-2013-00569 was further split and a new EFSA-Q-2016-00184 was assigned to the compound 4-methyl-5-vinylthiazole [15.018].

[9] The full report is available on the EURL website: https://ec.europa.eu/jrc/sites/default/files/FinRep-FAD-2010-0118.pdf

[10] Commission Regulation (EC) No 429/2008 of 25 April 2008 on detailed rules for the implementation of Regulation (EC) No 1831/2003 of the European Parliament and of the Council as regards the preparation and the presentation of applications and the assessment and the authorisation of feed additives. OJ L 133, 22.5.2008, p. 1.

3.1. Characterisation

3.1.1. Characterisation of the flavouring substance

The chemical structure of the flavouring additive under application is shown in Figure 1 and its physico-chemical characteristics in Table 1.

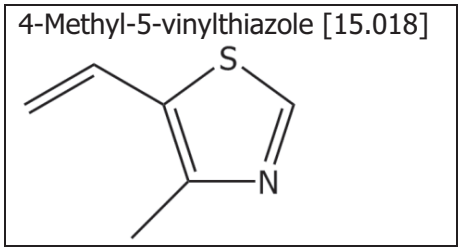

Figure 1: Chemical structure, EU register name and [FLAVIS numbers] of the flavouring compound under assessment

Table 1: Chemical abstracts service (CAS) and FLAVIS numbers and some characteristics of the chemically defined flavouring under assessment

EU Register name	CAS no	FLAVIS no	Molecular formula	Molecular weight	Physical state	Log K_{ow} [(a)]
4-Methyl-5-vinylthiazole	1759-28-0	15.018	C_6H_7NS	125.19	Liquid	1.38

EU: European Union; CAS no: Chemical Abstract Service number; FLAVIS No: EU Flavour Information System number.
(a): Logarithm of octanol–water partition coefficient.

The compound under assessment is produced by chemical synthesis and the typical routes of synthesis are described in the technical dossier.[11]

Data were provided on the batch-to-batch variation in five batches of 4-methyl-5-vinylthiazole [15.018].[12] The content of the active substance (Table 2) exceeded in all batches the minimum content reported in the specifications set by the Joint FAO/WHO Expert Committee on Food Add (JECFA) (FAO, 2006).

Table 2: Identity of the substance and data on batch-to-batch variation

EU Register name	FLAVIS no	JECFA specification minimum % [(1)]	Assay %	
			Average	Range
4-Methyl-5-vinylthiazole	13.019	97	99.9	99.5–100

(1): FAO (2006).

The applicant states that potential contaminants are considered as part of the product specification and are monitored as part of the Hazard Analysis and Critical Control Point (HACCP) procedure. The parameters considered include residual solvents, mercury, cadmium, lead and arsenic and other undesirable substances. However, no evidence of compliance was provided for these parameters.

3.1.2. Shelf-life

The minimum shelf-life of 4-methyl-5-vinylthiazole [15.018] is claimed to be 12 months, when stored in closed containers under recommended conditions.[13] However, no data supporting this statement were provided.

[11] Technical dossier FAD-2010-0415.
[12] Technical dossier FAD-2010-0415/Section II/Annex 2.1 and Supplementary information July 2011.
[13] Technical dossier FAD-2010-0415/Supplementary information July 2011.

3.1.3. Conditions of use

The applicant proposes the use of 4-methyl-5-vinylthiazole [15.018] in feed for all animal species without withdrawal period at a maximum use level of 0.5 mg/kg complete feed.

3.2. Safety

The assessment of safety of 4-methyl-5-vinylthiazole [15.018] is based on the maximum use level proposed by the applicant (0.5 mg/kg complete feed).

The compound under assessment has been recently evaluated by EFSA as a food flavouring (EFSA FAF Panel, 2023), and no safety concerns were identified for the consumer.

3.2.1. Safety for the target species

The concerns for the genotoxicity of 4-methyl-5-vinylthiazole [15.018] previously identified (EFSA CEF Panel, 2013) have been resolved (EFSA FAF Panel, 2023) and the compound is not considered genotoxic.

In line with the FEEDAP Panel guidance on the safety for the target species (EFSA FEEDAP Panel, 2017a,b,c), the safety for target animals can be derived from toxicological studies with oral administration of the compound(s) under assessment in laboratory animals. In the assessment of 4-methyl-5-vinylthiazole [15.018] as a food flavour, the EFSA FAF Panel derived a no observed adverse effect level (NOAEL) of 0.92 mg/kg body weight (bw) per day from a 90-day oral toxicity study in rats with 2,4-dimethyl-5-vinylthiazole [15.005], a substance which is structurally related to 4-methyl-5-vinylthiazole [15.018] (Posternak et al., 1969). The FEEDAP Panel agrees with the read-across made by the FAF Panel and considered that the NOAEL of 0.92 mg/kg bw per day for 2,4-dimethyl-5-vinylthiazole [15.005] can be used as the reference point for 4-methyl-5-vinylthiazole [15.018]. Applying an uncertainty factor (UF) of 100 to the NOAEL, the safe daily dose of 4-methyl-5-vinylthiazole [15.018] for the target species is derived following the EFSA Guidance on the safety of feed additives for the target species (EFSA FEEDAP Panel, 2017b), and thus, the maximum safe feed concentration of 4-methyl-5-vinylthiazole [15.018] is calculated (Table 3).

Table 3: Maximum safe concentration in feed of 4-methyl-5-vinylthiazole [15.018] for target animal species and categories calculated using the NOAEL of 0.92 mg/kg bw per day identified for 2,4-dimethyl-5-vinylthiazole [15.005]

	Body weight (kg)	Feed intake (g DM/day)	Daily feed intake (g DM/kg bw)	Maximum safe concentration (mg/kg feed)(1)
Chicken for fattening	2	158	79	0.1
Laying hen	2	106	53	0.2
Turkey for fattening	3	176	59	0.1
Piglet	20	880	44	0.2
Pig for fattening	60	2,200	37	0.2
Sow lactating	175	5,280	30	0.3
Veal calf (milk replacer)	100	1,890	19	0.5
Cattle for fattening	400	8,000	20	0.4
Dairy cow	650	20,000	31	0.3
Sheep/goat	60	1,200	20	0.4
Horse	400	8,000	20	0.4
Rabbit	2	100	50	0.2
Salmon	0.12	2.1	18	0.5
Dog	15	250	17	0.5
Cat	3	60	20	0.4
Ornamental fish	0.012	0.054	5	1.8

DM: dry matter.
(1): Complete feed containing 88% DM, milk replacer 94.5% DM.

Therefore, the FEEDAP Panel concludes that 4-methyl-5-vinylthiazole [15.018] is safe at the maximum proposed use level (0.5 mg/kg complete feed) for veal calves (milk replacer), dogs, salmonids and minor fin fish and ornamental fish. For the other species, the calculated safe concentrations in complete feed are 0.4 mg/kg for sheep/goats, cattle for fattening and other ruminants for fattening or reared for milk production/reproduction and camelids at the same physiological stage, horses and other Equidae, and cats; 0.3 mg/kg for sows and all pigs (Suidae) for reproduction, dairy cows, other ruminants and camelids for milk production or reproduction; 0.2 mg/kg for all pigs (Suidae) for meat production or reared for reproduction, rabbits and laying hens and other laying/reproductive birds; and 0.1 mg/kg for chickens for fattening, other poultry for fattening or reared for laying/reproduction, ornamental birds and other avian species at the same physiological stage. For other species not covered above, the additive is considered safe at 0.1 mg/kg complete feed.

3.2.2. Safety for the consumer

The safety for the consumer of 4-methyl-5-vinylthiazole [15.018] used as a food flavour has been recently assessed by EFSA (EFSA FAF Panel, 2023) and no safety concerns were identified. The compound is currently authorised in the EU as a food flavouring without limitations.[14]

In the previous opinion on CG 29 compounds (EFSA FEEDAP Panel, 2016), the FEEDAP Panel reviewed the available literature on the absorption, distribution, metabolism and excretion (ADME) of thiazole derivatives. These compounds are metabolised primarily by side chain oxidation or oxidation of the ring sulfur or nitrogen atoms. The major metabolites are then readily excreted in the urine either free or as glutathione conjugates (WHO, 2003). Other routes of metabolism, involving ring cleavage, are also possible.

Although no metabolic and residue studies in target species could be found for CG 29 compounds, including for 4-methyl-5-vinylthiazole, the enzymes involved in the biotransformation pathways of CG 29 compounds (cytochrome P450 monooxygenase families, glucuronide-, sulfate- and glutathione transferases) have been detected in many species, including mammals, birds and fish, and are assumed to be present in all the target species. Therefore, the Panel considered that it is expected that the target species are able to metabolise 4-methyl-5-vinylthiazole and no appreciable residues are expected to remain in the food products that would increase the consumers' exposure to the compound (EFSA FEEDAP Panel, 2016).

No safety concern would arise for the consumer from the use of 4-methyl-5-vinylthiazole [15.018] as a feed flavouring up to the maximum proposed use level in feed.

3.2.3. Safety for the user

No specific data on the safety for the user were provided. In the safety data sheet,[15] hazards for skin and eye contact and respiratory exposure are recognised for 4-methyl-5-vinylthiazole [15.018].

The compound should be considered as an irritant to skin and eyes and the respiratory tract, and as a dermal and respiratory sensitiser.

3.2.4. Safety for the environment

The addition of naturally occurring substances that will not result in a substantial increase of the concentration in the environment are exempt from further assessment. Examination of the published literature shows that 4-methyl-5-vinylthiazole [15.018] occurs in the environment at levels well above the application rate of 0.5 mg/kg complete feed.[16,17]

[14] Commission Implementing Regulation (EU) No 872/2012 of 1 October 2012 adopting the list of flavouring substances provided for by Regulation (EC) No 2232/96 of the European Parliament and of the Council, introducing it in Annex I to Regulation (EC) No 1334/2008 of the European Parliament and of the Council and repealing Commission Regulation (EC) No 1565/2000 and Commission Decision 1999/217/EC. OJ L 267, 2.10.2012, p. 1.

[15] Technical dossier FAD-2010-0415/Section II/Annex_II_3 and supplementary information April 2023/Annex_2_CG29_15_018 _SDS: Harmful if swallowed (H302), causes skin irritation (H315), causes serious eye irritation (H319), and may cause respiratory irritation (H335).

[16] Technical dossier FAD-2010-0415/Supplementary information July 2011. Data taken from the Netherlands Organisation for Applied Scientific Research (TNO) database Volatile Compounds in Food ver. 14.1; Burdock, 2003.

[17] Technical dossier/Supplementary information April 2023/Annex_5_CG 29_Duke_2023. Natural occurrence: up to 0.74 mg/kg in *Allium sativum* var. sativum.

Therefore, no environmental risk is foreseen from the use of 4-methyl-5-vinylthiazole [15.018] up to the maximum proposed use level in feed.

3.3. Efficacy

Since the compound under assessment is used in food as a flavouring, and its function in feed is essentially the same as that in food, no further demonstration of efficacy is necessary.

4. Conclusions

4-Methyl-5-vinylthiazole [15.018] is safe at the maximum proposed use level of 0.5 mg/kg complete feed for veal calves (milk replacer), dogs, salmonids and minor fin fish, and ornamental fish. For the other species, the calculated safe concentrations in complete feed are: 0.4 mg/kg for sheep/goats, cattle for fattening and other ruminants for fattening or reared for milk production/reproduction and camelids at the same physiological stage, horses and other Equidae, and cats; 0.3 mg/kg for sows and all pigs (Suidae) for reproduction, dairy cows, other ruminants and camelids for milk production or reproduction; 0.2 mg/kg for all pigs (Suidae) for meat production or reared for reproduction, rabbits and laying hens and other laying/reproductive birds; and 0.1 mg/kg for chickens for fattening, other poultry for fattening or reared for laying/reproduction, ornamental birds and other avian species at the same physiological stage. For other species not covered above, the additive is considered safe at 0.1 mg/kg complete feed.

No safety concern would arise for the consumer from the use of 4-methyl-5-vinylthiazole [15.018] up to the maximum proposed use level in feed.

The compound should be considered as an irritant to skin and eyes and the respiratory tract, and as a dermal and respiratory sensitiser.

No environmental risk is foreseen from the use of 4-methyl-5-vinylthiazole [15.018] up to the maximum proposed use level in feed.

Since the compound under assessment is used in food as flavouring and its function in feeds is essentially the same as that in food, no further demonstration of efficacy is necessary.

5. Documentation provided to EFSA/chronology

Date	Event
10/09/2010	Dossier received by EFSA. Chemically defined flavourings from Chemical Group 29 - Thiazoles, thiophene, thiazoline and thienyl derivatives for all animal species and categories. CDG 29). Submitted by FEFANA Asbl/Feed Flavourings Authorisation Consortium European Economic Interest Grouping (FFAC EEIG)
05/10/2010	Reception mandate from the European Commission
18/11/2010	Application validated by EFSA – Start of the scientific assessment
06/01/2011	Request of supplementary information to the applicant in line with Article 8(1)(2) of Regulation (EC) No 1831/2003 – Scientific assessment suspended. *Issues: characterisation, safety for target species, safety for the consumer, safety for the user and efficacy*
21/02/2011	Comments received from Member States
18/03/2011	Reception of the Evaluation report of the European Union Reference Laboratory for Feed Additives
07/07/2011	Reception of supplementary information from the applicant - Scientific assessment remained suspended
11/11/2011	Request of supplementary information to the applicant in line with Article 8(1)(2) of Regulation (EC) No 1831/2003 (addendum) – Scientific assessment suspended. *Issues: safety for the consumer*
10/04/2012	Reception of supplementary information from the applicant - Scientific assessment remained suspended
22/05/2012	Request of supplementary information to the applicant in line with Article 8(1)(2) of Regulation (EC) No 1831/2003 (addendum) – Scientific assessment suspended. *Issues: safety for the consumer*
16/07/2012	Reception of supplementary information from the applicant - Scientific assessment remained suspended

Date	Event
12/06/2013	The applicant was informed that the application was split into two separate questions. The initial EFSA-Q-2010-01180 was assigned to 3-acetyl-2,5-dimethylthiophene [15.024], the second EFSA-Q-2013-00569 to the remaining 11 compounds.
02/03/2016	The applicant was informed that the application was further split. The EFSA-Q-2013-00569 was assigned to the 10 compounds for which EFSA has completed the evaluation as food flavours, 2,4,5-trimethylthiazole [15.019], 2-acetylthiazole [15.020], 2-ethyl-4-methylthiazole [15.033], 2-isobutylthiazole [15.013], 2-isopropyl-4-methylthiazole [15.026], 4,5-dihydrothiophen-3(2H)-one [15.012], 5,6-dihydro-2,4,6-trans(2-methylpropyl)4H-1,3,5-dithiazine [15.113], 5-(2-hydroxyethyl)-4-methylthiazole [15.014], benzothiazole [15.016] and thiamine hydrochloride [16.027]. The new EFSA-Q-2016-00184 was assigned to the compound 4-methyl-5-vinylthiazole [15.018]
10/03/2016	Partial withdrawal from EC: use in water (Art. (4))
14/04/2023	Reception of supplementary information from the applicant - Scientific assessment re-started
12/05/2023	Opinion adopted by the FEEDAP Panel. End of the Scientific assessment

References

EFSA CEF Panel (EFSA Panel on Food Contact Materials, Enzymes, Flavourings and Processing Aids), 2013. Scientific Opinion on Flavouring Group Evaluation 76, Revision 1 (FGE.76Rev1): consideration of sulphur-containing heterocyclic compounds evaluated by JECFA (59th meeting) structurally related to thiazoles, thiophene, thiazoline and thienyl derivatives from chemical group 29 and miscellaneous substances from chemical group 30 evaluated by EFSA in FGE.21Rev3. EFSA Journal 2013;11(11):3455, 52 pp. https://doi.org/10.2903/j.efsa.2013.3455

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Abbreviations

BW	body weight
CAS	Chemical Abstracts Service
CDG	chemically defined group
CEF	EFSA Scientific Panel on Food Contact Materials, Enzymes, Flavourings and Processing Aids
CG	chemical group
DM	dry matter
EEIG	European Economic Interest Grouping
EURL	European Union Reference Laboratory
FAF	EFSA Panel on Food Additives and Flavourings
FAO	Food Agricultural Organisation
FEEDAP	EFSA Scientific Panel on Additives and Products or Substances used in Animal Feed
FFAC	Feed Flavourings authorisation Consortium of FEFANA (EU Association of Specialty Feed Ingredients and their Mixtures)
FGE	food group evaluation
FLAVIS	The EU Flavour Information System
HACCP	Hazard Analysis and Critical Control Point
JECFA	The Joint FAO/WHO Expert Committee on Food Additives
Log K_{ow}	logarithm of octanol–water partition coefficient
NOAEL	no observed adverse effect level
UF	uncertainty factor
WHO	World Health Organization