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SCIENTIFIC OPINION

Safety and efficacy of a feed additive consisting of L-arginine produced with *Corynebacterium glutamicum* KCCM 80387 for all animal species (CJ Europe GmbH)

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The declarations of interest of all scientific experts active in EFSA's work are available at https://open.efsa.europa.eu/experts

Abstract

Following a request from the European Commission, EFSA was asked to deliver a scientific opinion on the safety and efficacy of L-arginine produced with *Corynebacterium glutamicum* KCCM 80387 as a nutritional feed additive for all animal species (category: nutritional additive; functional group: amino acids, their salts and analogues; and category: sensory additives; functional group: flavouring compounds). The production strain *C. glutamicum* KCCM 80387 is a genetically modified strain and raises no safety concerns. The FEEDAP Panel concluded that the additive does not pose any safety concern with regard to the production strain. The use of L-arginine produced by fermentation with *C. glutamicum* KCCM 80387 in feed as nutritional additive or as flavouring compound is safe for the target species. The FEEDAP Panel has concerns on the use of L-arginine in water for drinking. The use of L-arginine produced by fermentation with *C. glutamicum* KCCM 80387 in animal nutrition is considered safe for the consumers and for the environment. As regards the safety for the user, L-arginine produced with *C. glutamicum* KCCM 80387 is not irritant to skin, and not a dermal sensitiser but is irritant to the eyes and respiratory tract. The additive L-arginine produced by fermentation with *C. glutamicum* KCCM 80387 is regarded as an efficacious source of the essential amino acid L-arginine for non-ruminant nutrition. For the supplemental L-arginine to be as efficacious in ruminants as in non-ruminant species, it requires protection against degradation in the rumen. L-Arginine is also considered efficacious when used as a flavouring compound in animal nutrition.

KEYWORDS

amino acids, *Corynebacterium glutamicum* KCCM 80387, efficacy, nutritional additives, safety

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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.

The European Commission received a request from CJ Europe GmbH[2] for the authorisation of the additive consisting of L-arginine produced with *Corynebacterium glutamicum* KCCM 80387, when used as a feed additive for all animal species (category: nutritional additive; functional group: amino acids, their salts and analogues; and category: sensory additives; functional group: flavouring compounds).

According to Article 7(1) of Regulation (EC) No 1831/2003, the Commission forwarded the application to the European Food Safety Authority (EFSA) as an application under Article 4(1) (authorisation of a feed additive or new use of a feed additive). The dossier was received on 03 January 2024 and the general information and supporting documentation are available at https://open.efsa.europa.eu/questions/EFSA-Q-2024-00005. The particulars and documents in support of the application were considered valid by EFSA as of 18 April 2024.

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 L-arginine produced with *C. glutamicum* KCCM 80387, when used under the proposed conditions of use (see **Section 3.1.6**).

1.2 | Additional information

The additive L-arginine produced with *Corynebacterium glutamicum* KCCM 80387 has not been previously authorised as a feed additive in the European Union.

L-Arginine produced by fermentation with production strains different from the one mentioned in the paragraph above is currently authorised in the EU.[3]

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[4] in support of the authorisation request for the use of L-arginine produced with *C. glutamicum* KCCM 80387 as a feed additive.

In accordance with Article 38 of the Regulation (EC) No 178/2002[5] and taking into account the protection of confidential information and of personal data in accordance with Articles 39 to 39e of the same Regulation, and of the Decision of EFSA's Executive Director laying down practical arrangements concerning transparency and confidentiality,[6] a non-confidential version of the dossier has been published on Open.EFSA.

According to Article 32c(2) of Regulation (EC) No 178/2002 and to the Decision of EFSA's Executive Director laying down the practical arrangements on pre-submission phase and public consultations, EFSA carried out a public consultation on the non-confidential version of the technical dossier from 10 September to 1 October 2024 for which no comments were received.

The confidential version of the technical dossier was subject to a target consultation of the interested Member States from 24 April 2024 to 24 July 2024 for which the received comments were considered for the assessment.

The FEEDAP Panel used the data provided by the applicant together with data from other sources, such as previous risk assessments by EFSA, other scientific reports and experts' knowledge, to deliver the present output.

EFSA has verified the European Union Reference Laboratory (EURL) report as it relates to the methods used for the control of the L-arginine produced with *C. glutamicum* KCCM 80387 in animal feed.[7]

[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]CJ Europe GmbH. Unterschweinstiege 2–14. 60549. Frankfurt am Main. Germany.
[3]EU register of feed additives, available online: https://ec.europa.eu/food/food-feed-portal/screen/feed-additives/search.
[4]Dossier reference: FEED-2023-20151.
[5]Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. OJ L 31, 1.2.2002, p. 1–48.
[6]Decision available at: https://www.efsa.europa.eu/en/corporate-pubs/transparency-regulation-practical-arrangements.
[7]Evaluation report received on 3/7/2024 and available on the EU Science Hub https://joint-research-centre.ec.europa.eu/eurl-fa-eurl-feed-additives/eurl-fa-authorisation/eurl-fa-evaluation-reports_en.

2.2 | Methodologies

The approach followed by the FEEDAP Panel to assess the safety and the efficacy of L-arginine produced with *C. glutamicum* KCCM 80387 is in line with the principles laid down in Regulation (EC) No 429/2008[8] and the relevant guidance documents: Guidance on the assessment of the safety of feed additives for the consumer (EFSA FEEDAP Panel, 2017a), Guidance on the identity, characterisation and conditions of use of feed additives (EFSA FEEDAP Panel, 2017b), Guidance on the assessment of the safety of feed additives for the target species (EFSA FEEDAP Panel, 2017c), Guidance on the assessment of the efficacy of feed additives (EFSA FEEDAP Panel, 2024), Guidance on the characterisation of microorganisms used as feed additives or as production organisms (EFSA FEEDAP Panel, 2018), Guidance on the assessment of the safety of feed additives for the environment (EFSA FEEDAP Panel, 2019), EFSA statement on the requirements for whole genome sequence analysis of microorganisms intentionally used in the food chain (EFSA, 2021), and Guidance on the assessment of the safety of feed additives for the users (EFSA FEEDAP Panel, 2023).

3 | ASSESSMENT

The additive subject of this application is L-arginine (≥ 98%) produced by fermentation with a genetically modified strain of *C. glutamicum* (KCCM 80387). It is intended to be used as nutritional additive (functional group: amino acids, their salts and analogues) and as sensory additive (functional group: flavouring compounds) in feed and water for drinking for all animal species and categories.

3.1 | Characterisation

3.1.1 | Characterisation of the production microorganism

The production microorganism is a genetically modified strain of *C. glutamicum* that is deposited in the Korean Culture Collection of Microorganisms (KCCM) with accession number KCCM 80387.[9]

The taxonomic identification of the production strain KCCM 80387 as *C. glutamicum* was confirmed by bioinformatic analysis of the whole genome sequence (WGS) data.[10] [redacted].[11] [redacted].[12]

The susceptibility of the production strain to relevant antibiotics was tested against the list of antimicrobials described for '*Corynebacterium* and other Gram-positive' in the Guidance on the characterisation of microorganisms used as feed additives or as production organisms (EFSA FEEDAP Panel, 2018).[12] [redacted]. Therefore, the production strain is considered susceptible to all relevant antibiotics.

[redacted].

The WGS data of the production strain [redacted], was interrogated for the presence of antimicrobial resistance (AMR) genes [redacted].[13] [redacted] no acquired AMR genes were identified and the strain raises no concerns.

3.1.1.1 | *Information regarding the genetic modification*

The parental strain is [redacted] strain *C. glutamicum* [redacted]. This strain was genetically modified to increase L-arginine production.

[8]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.

[9]Annex 2.2.2. Certificate of strain deposition.pdf.

[10]Annex 2.2.3. WGS data_Confi_03May24.pdf.

[11]Annex 2.2.3. WGS data_Confi_03May24.pdf.

[12]Annex 2.2.4. Antimicrobial susceptibility.pdf.

[13]Annex 2.2.3. WGS data_Confi_03May24.pdf.

Description of the genetic modification

[redacted]

3.1.2 | Manufacturing process

L-arginine is produced by fermentation with *C. glutamicum* KCCM 80387.[14] [redacted].

The applicant stated that no antimicrobial substances are used in the manufacturing process.[15]

3.1.3 | Characterisation of the active substance/additive

L-arginine (International Union of Pure and Applied Chemistry (IUPAC) name: (S)-2-Amino-5-guanidinopentanoic acid), is a compound identified with the Chemical Abstracts Service (CAS) No 74-79-3, and the European Inventory of Existing Commercial chemical Substances (EINECS) No 200–811-1. It has a molecular mass of 174.2 Da. The molecular formula of L-arginine is $C_6H_{14}N_4O_2$. The structural formula is given in Figure 1.

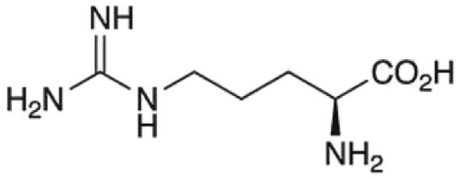

FIGURE 1 Molecular structure of L-arginine.

The additive is specified to contain ≥ 98% L-arginine on DM basis and ≤ 0.5% water.

Compliance with the specification was shown in five batches in which L-arginine was on average 99.7% on DM basis (range 99.4%–100.0%).[16] Water content was on average 0.26% (range 0.2%–0.3%). Crude ash was also analysed and resulted in values < 0.4% in all five batches.

The specific optical rotation (three batches analysed) ranged from +27.4 to +27.6°.[17] These values are within the reference range specified in the European Pharmacopoeia monograph for this substance (+25.5 to +28.5°)[18] and confirm the L-enantiomer of arginine in the additive.

3.1.3.1 | *Impurities*

Three batches of the additive were analysed for impurities. Cadmium, lead, mercury and arsenic were all below the limit of quantification (LOQ) of the analytical method in all three batches.[19]

Polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and dioxin-like polychlorinated biphenyls (DL-PCBs) were analysed in three batches. All values were below the corresponding LOQ. The calculated upper bound (UB) concentration was 0.05683 ng WHO-PCDD/F-TEQ/kg for the sum of PCDD/Fs, and 0.11605 ng WHO-PCDD/F-PCB-TEQ/kg the sum of PCDD/Fs and DL-PCBs. The UB for the sum of non-DL-PCBs was 0.53 µg/kg (all values are expressed based on 88% dry matter).[20]

Mycotoxins, including aflatoxins (B1, G1, B2, G2), ochratoxin A, deoxynivalenol (DON), zearalenone, T-2 toxin, HT-2 Toxin and fumonisins (B1 + B2 + B3) were below their corresponding LOQ.[21]

Microbiological contamination was analysed by determination of *Enterobacteriaceae*, *E. coli, Salmonella* spp., yeasts and filamentous fungi. *Enterobacteriaceae*, yeast and filamentous fungi were below the limit of determination (LOD) of the analytical method in all cases.[22] *Salmonella* spp. was not detected in 25 g samples. *E. coli* was not detected in the same batches analysed.

[14]Annex 2.3.1. Manufacturing process_20240318.

[15]Annex 2.3.3. Declaration letter.

[16]Annex 2.1.3. Batch to batch analysis. Analytical method to determine L-arginine in the additive according to Regulation (EC) No 152/2009 Annex III-F.

[17]Annex 2.1.2. Optical rotation. European pharmacopoeia method 2.2.7.

[18]Arginine Monograph 01/2017:0806, European pharmacopoeia 11th Edition, 2025.

[19]Annex 2.1.4b. Purity (contaminants). LOQ in mg/kg was 0.015 for lead, 0.01 for cadmium and for mercury and 0.04 for arsenic.

[20]Annex 2.1.4b. Purity (contaminants) Upper bound concentrations are calculated on the assumption that all values of the different congeners below the limit of quantification are equal to the limit of quantification. TEQ = toxic equivalency factors for PCDD/Fs and DL-PCBs established by WHO in 2005 (van den Berg et al., 2006).

[21]Annex 2.1.4b. Purity (contaminants). LOQ in µg/kg were 0.2 for aflatoxins, 0.5 for ochratoxin A, 10 for DON, 5 for zearalenone, 2 for T-2 and HT-2 Toxins and 50 for fumonisins.

[22]Annex 2.1.4a. Purity (microbiology). LOD in cfu/g was 10 for *Enterobacteriaceae*, and 100 for yeasts and filamentous fungi. It was MPN/g in the case of *E. coli*.

The FEEDAP Panel considers that the microbial contamination and the amounts of the detected impurities do not raise safety concerns.

The presence of viable cells of the production strain was investigated in three batches of the additive [redacted].[23] [redacted]

The presence of DNA from the production strain was analysed using a PCR-based method in three batches of the additive [redacted].[24] [redacted]

3.1.4 | Physical properties of the additive

L-arginine is a white to off-white crystal or crystalline powder showing a solubility in water of 148 g/L at 20°C. The bulk density was measured in three batches and ranged from 597 to 613 kg/m^3. The dusting potential of three batches of the additive was determined using the Stauber-Heubach method and showed values that ranged from 25 to 90 mg/m^3.[25] The particle size distribution of the dust was analysed by laser-diffraction method; the results showed that on average (v/v) the fractions of particles having a diameter < 100 μm, < 50 μm, < 10 μm ranged 23.7%–25.7%, 6.8%–7.3% and 1.4%–1.5%, respectively.[26]

3.1.5 | Stability and homogeneity

The shelf life of the additive (three batches) was studied when stored at 25°C/60% relative humidity (RH) and at 45°C/75% RH in paper bags, for 6 months. Losses at the end of the storage period were negligible in both scenarios.[27]

The stability of the additive (three batches) in a vitamin premixture for chickens for fattening, containing a coccidiostat and calcium carbonate as carrier, was studied when supplemented at 100,000 mg/kg and stored at 25°C in aluminium bags, for 6 months. No losses of L-arginine were detected at the end of the storage period.[28]

The stability of the additive (three batches) in a complete feed (mash and pelleted form) for chickens for fattening (based on wheat, maize and soybean meal) was studied when supplemented at 3000 mg/kg. The mash feed was pelleted at 70–75°C. Pelleting process caused no loss of L-arginine except in one batch, where the loss of L-arginine observed was 15%. After pelleting, the mash and pelleted feed were stored at 25°C in aluminium bags for 3 months. At the end of the storage the losses observed were up to 5% in both mash and pelleted feed.[29]

The stability of the additive (three batches) in water for drinking was studied when supplemented at 0.5 mg/mL. Samples were stored at room temperature (15–25°C) in aluminium bags for 48 h. No losses of L-arginine were detected at the end of the storage period.[30]

The capacity of the additive to distribute homogeneously in premixtures was studied in 10 subsamples. The coefficient of variation was 3%. The capacity for homogeneous distribution of the additive was studied in 10 subsamples of mash feed and pelleted feed described above. Total arginine was analysed, and the background concentration of arginine in feed was subtracted. The resulting coefficient of variation was 9% mash feed and 6% pelleted feed.[31]

3.1.6 | Conditions of use

L-arginine is proposed to be used in feeds as a nutritional additive to achieve the adequate amino acid profile and meet the requirements on L-arginine for all animal species. It can be added via premixture or directly into feedingstuffs (including complete feed and complementary feed), or via water for drinking without maximum or minimum levels and without withdrawal period. No inclusion levels are proposed, as the requirements in quantitative terms depend on the species,

[23] Annex 2.2.5. Absence viable cells_Conf.pdf.
[24] Annex 2.2.6. DNA absence_Confi_20240221.pdf.
[25] Annex 2.1.5. Physical state.
[26] Annex 2.1.5. Physical state.
[27] Annex 2.4.1. Storage stability.
[28] Annex 2.4.1. Storage stability.
[29] Annex 2.4.2. Stability and homogeneity in feeds.
[30] Annex 2.4.3. Stability in water and Q5. Annex 2.4.3. Stability in water.
[31] Annex 2.4.2. Stability and homogeneity in feeds.

the physiological state of the animal, the performance level and the environmental conditions, as well as the amino acid composition of the unsupplemented diet.

When used as feed flavouring, L-arginine is proposed to be used at a maximum recommended level of inclusion of 25 mg/kg feed.[32]

3.2 | Safety

3.2.1 | Safety of the production microorganism

The production strain *C. glutamicum* KCCM 80387 was developed to increase the production of L-arginine. The production strain belongs to a species, *C. glutamicum*, that is suitable for the qualified presumption of safety (QPS) approach to safety assessment when used for production purposes (EFSA BIOHAZ Panel, 2023a). The taxonomic identification of the production strain was unequivocally established, strain KCCM 80387 does not carry acquired antimicrobial resistance genes and the genetic modification does not raise safety concerns. The production strain and its DNA were not detected in the final products. Therefore, the final products do not pose any safety concern as regards the genetically modified production strain.

3.2.2 | Safety for the target species, the consumer and the environment

The L-arginine requirements of the target animal species and the safety of this essential amino acid in non-ruminant and ruminant nutrition are well-known by feed formulators and available in general publications on animal nutrition.

The additive is highly purified (≥ 98% arginine and about 99.7% identified material on a dry matter basis) and is produced by fermentation using a strain that is considered safe. Concerns on the use of the additive would not derive from the L-arginine, which is considered safe, but may arise from residues of the fermentation process/production strain remaining in the final product.

The production strain qualifies for the QPS safety assessment approach, the genetic modifications performed are considered safe, and no viable cells and DNA of the production strain were found in the final product. L-Arginine produced with *C. glutamicum* KCCM 80387 is safe for the target species when used to supplement the diet in appropriate amounts to satisfy the animal requirements.

Since the levels proposed for the use of L-arginine as flavouring compound (25 mg/kg complete feed) are substantially lower than the animal requirements, the FEEDAP Panel considers that L-arginine produced by fermentation with *C. glutamicum* KCCM 80387 is safe for the target species when used as a flavouring compound.

However, due to the risk of nutritional imbalances and hygienic reasons associated to the use of amino acids via water for drinking (EFSA FEEDAP Panel, 2010), the FEEDAP Panel has concerns on the safety of the simultaneous oral administration of amino acid-containing additives via feed and water for drinking.

The absorption and metabolic fate of L-arginine in the animals is well-known. The amino acid L-arginine, supplemented to feed, will be incorporated into proteins of tissues and/or products of animal origin and any of its potential excess will be metabolised and excreted. Therefore, the protein composition of tissues and products of animal origin will not be affected using L-arginine in animal nutrition.

Neither the production strain, nor its recombinant DNA was detected in the final product. The final product does not pose any environmental safety concern associated with the genetic modification.

The amino acid L-arginine is a physiological and natural component of animals and plants. It is not excreted as such, but as urea/uric acid and carbon dioxide. The use of the product L-arginine in animal nutrition would not lead to any localised increase in the concentration in the environment. The use of the additive in water for drinking, when given in addition to complete diets with a well-balanced amino acid profile, would disturb the nitrogen balance and increase nitrogen excretion via urine. It is concluded that the use of the product L-arginine produced by fermentation with *C. glutamicum* KCCM 80387 as a feed additive does not represent a risk to the environment.

3.2.2.1 | *Conclusions on safety for the target species, consumers and the environment*

The use of L-arginine produced with *C. glutamicum* KCCM 80387 in animal nutrition under the proposed conditions of use is safe for the target species, consumers and the environment. The FEEDAP Panel has concerns on the use of L-arginine in water for drinking.

[32] Q6. Section 2.5. Conditions of use_24Sep24.pdf.

3.2.3 | Safety for the user

The applicant submitted a study on acute inhalation toxicity in rat, a study on in vitro skin irritation, a study on in vitro eye irritation and a study on skin sensitisation in mice, all of them performed with the additive under assessment.

3.2.3.1 | *Effects on respiratory system*

The highest dusting potential measured was 90 mg/m^3. Therefore, exposure by inhalation is likely.

An acute inhalation study (nose only exposure) was performed following the OECD TG 403 (2009).[33] The inhalation LC_{50}, 4 h value of L-arginine in Wistar Han rats was established to exceed the maximum attainable concentration of 2.7 mg/L.

3.2.3.2 | *Effects on skin and eyes*

The skin irritation potential of L-arginine was investigated in an in vitro skin irritation study according to OECD TG 439.[34] The results of the study showed that the test item additive is not irritant to skin (UN GHS 'No Category').

The eye irritation potential of the additive was investigated in an in vitro eye irritation study according to OECD TG 437.[35] The results of the study showed that the additive is irritant to eyes (UN GHS 'Category 1').

The skin sensitisation potential of L-arginine was tested using the local lymph node assay in mice following the OECD TG 429.[36] Based on the results obtained, the additive should not be considered a dermal sensitiser.

3.2.3.3 | *Conclusions on the safety for the user*

Based on the results of the studies submitted, L-arginine produced with *C. glutamicum* KCCM 80387 is not irritant to skin, and not a dermal sensitiser but is irritant to the eyes and respiratory tract.

3.3 | Efficacy

Efficacy studies are not required for amino acids that occur naturally in plant and animal proteins. The nutritional role of the amino acid L-arginine is well established in the scientific literature. For the supplemental L-arginine to be as efficacious in ruminants as in non-ruminant species, it requires protection against degradation in the rumen.

As L-arginine is used in food as flavouring compound, it is expected that it can provide a similar function in feed and no further demonstration of efficacy is necessary.

3.4 | Post-market monitoring

The FEEDAP Panel considers that there is no need for specific requirements for a post-market monitoring plan other than those established in the Feed Hygiene Regulation[37] and Good Manufacturing Practice.

4 | CONCLUSIONS

The production strain *C. glutamicum* KCCM 80387 is genetically modified and raises no safety concerns. No viable cells or DNA of the production strain were detected in the final product. Therefore, the FEEDAP Panel concludes that the additive does not pose any safety concern with regard to the production strain.

The use of L-arginine produced by fermentation with *C. glutamicum* KCCM 80387 in feed as nutritional additive or as flavouring compound is safe for the target species. The FEEDAP Panel has concerns on the use of L-arginine in water for drinking.

The use of L-arginine produced by fermentation with *C. glutamicum* KCCM 80387 in animal nutrition is considered safe for the consumers and for the environment.

As regards the safety for the user, L-arginine produced with *C. glutamicum* KCCM 80387 is not irritant to skin, and not a dermal sensitiser but is irritant to the eyes and respiratory tract.

L-arginine produced by fermentation with *C. glutamicum* KCCM 80387 is regarded as an effective source of the amino acid L-arginine for all non-ruminant species. In order to be as efficacious in ruminants as in non-ruminants, it should be

[33] Annex 3.3.1 Acute inhalation.
[34] Annex 3.3.2 Skin irritation.
[35] Annex 3.3.3 Eye irritation.
[36] Annex 3.3.4. Skin sensitisation.
[37] Regulation (EC) No 183/2005 of the European Parliament and of the Council of 12 January 2005 laying down requirements for feed hygiene. OJ L 35, 8.2.2005, p. 1.

protected from ruminal degradation. L-Arginine is considered efficacious when used as a flavouring compound in animal nutrition.

ABBREVIATIONS

CAS	Chemical Abstracts Service
CFU	colony forming unit
CV	coefficient of variation
DM	dry matter
EINECS	European Inventory of Existing Chemical Substances
EURL	European Union Reference Laboratory
FEEDAP	EFSA Scientific Panel on Additives and Products or Substances used in Animal Feed
FLAVIS	The EU Flavour Information System
GC–MS	gas chromatography–mass spectrometry
HACCP	hazard analysis and critical control points
IUPAC	International Union of Pure and Applied Chemistry
JECFA	The Joint FAO/WHO Expert Committee on Food Additives
LOD	limit of detection
LOQ	limit of quantification
MIC	minimum inhibitory concentration
OECD	Organisation for Economic Co-operation and Development
RH	relative humidity
SCAN	Scientific Committee on Animal Nutrition

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