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SCIENTIFIC OPINION

# Safety and efficacy of a feed additive consisting of *Saccharomyces cerevisiae* NBRC 0203 and *Lacticaseibacillus rhamnosus* NBRC 3425 as a silage additive for all animal species (EM-Agriton B.V.)

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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 additive consisting of *Saccharomyces cerevisiae* NBRC 0203 and *Lacticaseibacillus rhamnosus* NBRC 3425 when used as a technological additive to improve ensiling of all fresh plant material for all animal species at a proposed minimum concentration of $4.0 \times 10^2$ and $3.2 \times 10^6$ colony forming units (CFU)/kg fresh plant material, respectively. The bacterial species *S. cerevisiae* and *L. rhamnosus* are considered by EFSA to be suitable for the qualified presumption of safety approach to safety assessment. The identity of the strains was established, the absence of resistance to antimycotics was confirmed for *S. cerevisiae* and no acquired antimicrobial resistance genes were detected in *L. rhamnosus*. Therefore, the FEEDAP Panel concluded that the use of both strains as a silage additive is considered safe for all the animal species, consumers and the environment. Regarding user safety, inhalation and dermal exposure are considered a risk. No conclusions can be drawn on the eye irritancy potential of the additive. The FEEDAP Panel concluded that the additive at a minimum level of $4.0 \times 10^2$ *S. cerevisiae* NBRC 0203 and $3.2 \times 10^6$ *L. rhamnosus* NBRC 3425 CFU/kg fresh plant material has the potential to improve the production and fermentation quality of silage made from easy and moderately difficult to ensile fresh plant material, with dry matter (DM) content ranging from 31% to 51%.

**KEYWORDS**

efficacy, *Lacticaseibacillus rhamnosus* NBRC 3425, QPS, *Saccharomyces cerevisiae* NBRC 0203, safety, silage additive, technological additive

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# CONTENTS

Abstract ..... 1
1. Introduction ..... 3
    1.1. Background and Terms of Reference ..... 3
    1.2. Additional information ..... 3
2. Data and Methodologies ..... 3
    2.1. Data ..... 3
    2.2. Methodologies ..... 3
3. Assessment ..... 4
    3.1. Characterisation ..... 4
        3.1.1. Characterisation of the active agents ..... 4
            3.1.1.1. Saccharomyces cerevisiae NBRC 0203 ..... 4
            3.1.1.2. Lacticaseibacillus rhamnosus NBRC 3425 ..... 4
        3.1.2. Characterisation of the additive ..... 5
        3.1.3. Conditions of use ..... 6
    3.2. Safety ..... 6
        3.2.1. Safety for the target species, consumers and environment ..... 6
        3.2.2. Safety for the user ..... 6
    3.3. Efficacy ..... 7
        3.3.1. Conclusions on efficacy ..... 8
4. Conclusions ..... 8
Abbreviations ..... 8
Acknowledgements ..... 8
Requestor ..... 8
Question number ..... 8
Copyright for non-EFSA content ..... 8
Panel members ..... 8
Legal notice ..... 8
References ..... 8

# 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 EM-Agriton B.V.[2] for the authorisation of the additive consisting of *Saccharomyces cerevisiae* NBRC 0203 and *Lacticaseibacillus rhamnosus* NBRC 3425, when used as a feed additive for target species (category: technological additives; functional group: silage additives).

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 06 November 2023 and the general information and supporting documentation are available at https://open.efsa.europa.eu/questions/EFSA-Q-2023-00715. The particulars and documents in support of the application were considered valid by EFSA as of 24 June 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 *S. cerevisiae* NBRC 0203 and *L. rhamnosus* NBRC 3425 when used under the proposed conditions of use (see **Section 3.1.3**).

## 1.2 | Additional information

The additive is a preparation containing *S. cerevisiae* NBRC 0203 and *L. rhamnosus* NBRC 3425. It has not been previously authorised as a feed additive 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[3] in support of the authorisation request for the use of *S. cerevisiae* NBRC 0203 and *L. rhamnosus* NBRC 3425 as a feed additive.

In accordance with Article 38 of the Regulation (EC) No 178/2002[4] 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,[5] 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 2024 to 01 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 28 June 2024 to 28 September 2024; the comments received were considered for the assessment.

EFSA has verified the European Union Reference Laboratory (EURL) report as it relates to the methods used for the control of the *S. cerevisiae* NBRC 0203 and *L. rhamnosus* NBRC 3425 in animal feed.[6]

## 2.2 | Methodologies

The approach followed by the FEEDAP Panel to assess the safety and efficacy of *S. cerevisiae* NBRC 0203 and *L. rhamnosus* NBRC 3425 is in line with the principles laid down in Regulation (EC) No 429/2008[7] and the relevant guidance documents:

[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]EM-Agriton B.V., Molenstraat 10-1 Noordwolde, Netherlands.

[3]Dossier reference: FEED-2023-18730.

[4]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.

[5]Decision available at: https://www.efsa.europa.eu/en/corporate-pubs/transparency-regulation-practical-arrangements.

[6]Evaluation report received on 25/09/2024 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.

[7]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.

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 characterisation of micro-organisms 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), Guidance on the assessment of the safety of feed additives for the users (EFSA FEEDAP Panel, 2023), Guidance on the assessment of the efficacy of feed additives (EFSA FEEDAP Panel, 2024) and EFSA statement on the requirements for whole genome sequence analysis of microorganisms intentionally used in the food chain (EFSA, 2024).

## 3 | ASSESSMENT

The additive under assessment is a preparation of viable cells of *S. cerevisiae* NBRC 0203 and *L. rhamnosus* NBRC 3425 intended to be added to fresh plant material to promote ensiling (category: technological additives; functional group: silage additives) with the eventual use of the silage for all animal species.

### 3.1 | Characterisation

#### 3.1.1 | Characterisation of the active agents

##### 3.1.1.1 | *Saccharomyces cerevisiae NBRC 0203*

The applicant declares that the *S. cerevisiae* strain was originally isolated from the 'natural environment', without further details, and that it has not been genetically modified.[8] The *S. cerevisiae* strain is deposited in the Biological Resource Center of National Institute of Technology and Evaluation (NBRC) with the accession number NBRC 0203.[9]

A bioinformatic analysis of the whole genome sequence (WGS) data of the strain NRBC 0203 confirmed its identity as *S. cerevisiae*.[10] [redacted]

An antimycotic susceptibility test was performed using a commercial kit based on a colorimetric microdilution assay.[11] The minimum inhibitory concentration (MIC) values obtained for the antimycotics tested after 24 h [including anidulafungin (0.12 µg/mL), micafungin (2 µg/mL), capsofungin (0.25–0.5 µg/mL), 5-flucytosine (≤ 0.06 µg/mL), posaconazole (0.25 µg/mL), voriconazole (0.03 µg/mL), itraconazole (0.12 µg/mL), fluconazole (2 µg/mL) and amphotericin B (0.25–0.5 µg/mL)] were considered low.

##### 3.1.1.2 | *Lacticaseibacillus rhamnosus NBRC 3425*

The applicant declares that the *L. rhamnosus* strain was originally isolated from the 'natural environment,' without further details, and that it has not been genetically modified.[12] The *L. rhamnosus* strain is deposited in the NBRC with the accession number NBRC 3425.[13]

The taxonomic identification of NBRC 3425 was achieved by a bioinformatic analysis using the WGS data.[14] The taxonomic assignment to the *L. rhamnosus* species was based on [redacted].

The antimicrobial susceptibility of the strain NBRC 3425 was tested against the battery of antibiotics recommended by the FEEDAP Panel (EFSA FEEDAP Panel, 2018) for *L. rhamnosus*.[15] All the MIC values were equal to or fell below the corresponding cut-off values. Therefore, the strain is considered susceptible to all the relevant antibiotics.

[8] 2.2.2.2.j Origin of the strains.
[9] 2.2.2.2.i Certificate of deposition.
[10] 2.2.2.2.d Bioinformatics 131597_S.cerevisiae NBRC 0203 Consolidated 241107.
[11] 2.2.2.2.b Susceptibility S.c. antimycotic T1302R1111_2021.
[12] 2.2.2.2.j Origin of the strains.
[13] 2.2.2.2.i Certificate of deposition.
[14] 2.2.2.2.c Bioinformatics 131597_L.rhamnosus NBRC 3425 Consolidated 241107.
[15] 2.2.2.2.a MIC Susceptibility T1302R1118.2_Consolidated 241010.

The WGS of the strain NBRC 3425 was interrogated for the presence of antimicrobial resistance (AMR) genes against [redacted] databases.[16] [redacted] Therefore, the strain NBRC 3425 does not harbour acquired AMR genes.

The WGS was also interrogated for the presence of genes coding for virulence factors [redacted] no hits exceeding the thresholds recommended by EFSA (EFSA, 2024) were identified.[17]

### 3.1.2 | Characterisation of the additive

[redacted].[18] The applicant states that no antimicrobial substances are used during the manufacturing processes.[19]

The additive is in a liquid form and it is specified to contain a minimum of $5 \times 10^3$ colony forming units (CFU) of *S. cerevisiae* NBRC 0203 and $4 \times 10^7$ CFU of *L. rhamnosus* NBRC 3425 per mL.[20]

The data provided by the applicant on the batch-to-batch variation,[21] impurities[22] and physico-chemical properties[23] of the additive are reported in Table 1.

**TABLE 1** Data on the batch-to-batch variation, impurities and physical properties of the additive consisting of *S. cerevisiae* NBRC 0203 and *L. rhamnosus* NBRC 3425.

| | | Analysis | | |
|---|---|---|---|---|
| **Parameter** | **Specification** | **Average** | **Range** | **No. of batches** |
| **Batch-to-batch variation (CFU/mL)** | | | | 5 |
| *S. cerevisiae* NBRC 0203 | $5.0 \times 10^3$ | $1.9 \times 10^5$ | $6.2 \times 10^3$–$5.9 \times 10^5$ | |
| *L. rhamnosus* NBRC 3425 | $4.0 \times 10^7$ | $2.3 \times 10^8$ | $4.6 \times 10^7$–$3.4 \times 10^8$ | |
| **Impurities** | | | | 3 |
| Lead (mg/kg) | | | < 0.01–0.012 | |
| Mercury (mg/kg) | | | < 0.002 | |
| Cadmium (mg/kg) | | | < 0.002 | |
| Arsenic (mg/kg) | | | < 0.01 | |
| **Dioxins and furans (upper bound)**[1] | | | | 3 |
| PCDD/Fs (ng $WHO_{2005}$-TEQ/kg) | | | 0.137 | |
| PCB-TEQ/kg (ng $WHO_{2005}$-TEQ/kg) | | | 0.132 | |
| WHO-PCDD/F-PCB (ng TEQ/kg) | | | 0.269 | |
| **Mycotoxins** (μg/kg) | | | | 3 |
| Aflatoxins | | | 1.16–1.54 | |
| Ochratoxin A | | | < 5.0 | |
| Fumonisins B1 + B2 + B3 | | | < 25.0 | |
| Zearalenone | | | < 17 | |
| Deoxynivalenol | | | < 134–200 | |
| Citrinin | | | 34.1–46.2 | |
| **Microbial contamination** | | | | 3 |
| *Salmonella* spp. (in 25 g) | | | Not detected | |
| Total counts of aerobic and facultative anaerobic bacteria (CFU/g) | | | < 10 | |
| Yeasts (CFU/g)[2] | | | $3.50$–$7 \times 10^6$ | |
| Moulds (CFU/g) | | | < 10 | |

(Continues)

[16] 2.2.2.2.c Bioinformatics 131597_L.rhamnosus NBRC 3425 Consolidated 241107.

[17] 2.2.2.2.c Bioinformatics 131597_L.rhamnosus NBRC 3425 Consolidated 241107.

[18] 2.3.1.a Description of production and flowchart EM Silage 2.0 consolidated 250206 and 2.3.1.b Composition raw material.

[19] Sect_2.1–2.2_Consolidated 250207.

[20] Sect_2.1–2.2_Consolidated 250613.

[21] 2.1.3 Batch to batch variation CoAs and Sect_2.1–2.2_Consolidated 250613.

[22] 2.1.4.a Impurities 137762, 2.1.4.b Dioxins, 2.1.4.a2 Impurities B. cereus 143445 and Sect_2.6_Consolidated 250729.

[23] Sect_2.1–2.2_Consolidated 250613, 2.1.5 Viscosity vapour pressure, 2.4.1.f pH batch no. production date Consolidated 250214, Sect_2.4_Consolidated 250729, 2.4.1.n Answer to Question 11 of RFI 250113, 2.4.1.o1 Stability in water and 2.4.1.o2 CoAs.

**TABLE 1** (Continued)

| Parameter | Specification | Analysis | | |
|---|---|---|---|---|
| | | Average | Range | No. of batches |
| *Escherichia coli* (in 25 g) | | | Not detected | |
| *Bacillus cereus* (CFU/g) | | | < 100 | |
| **Physical properties** | | | | |
| Physical form | | | Liquid | |
| Density (kg/m$^3$) | | | 1000 | |
| Kinematic Viscosity (20°C) (mm$^2$/s) | | | 1.21–1.23 | 3 |
| Vapour Pressure (kPa) | | | 7.5–9.5 | 3 |
| pH | | | 3.18–3.44 | 5 |
| **Shelf-life (losses)** | | | | |
| Room temperature, 200 days | | | ≤ 1 log[3] | 5 |
| **Stability in water (losses)** | | | | |
| Room temperature, 48 h | | | ≤ 1 log[3] | 3 |

Abbreviations: <, Means below the limit of detection, except for lead, mercury, cadmium and arsenic that means limit of quantification; CFU, colony forming unit; PCBs, polychlorinated biphenyls; PCDDs, polychlorinated dibenzo-*p*-dioxins; PCDFs, polychlorinated dibenzofurans; TEQ, toxic equivalent factors for dioxins, furans and dioxin-like PCBs established by WHO in 2005 (Van den Berg et al., 2006); WHO, World Health Organization.

[1]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. Values are expressed per kg of additive with 88% dry matter content.

[2]Including the active agent *S. cerevisiae* NBRC 0203.

[3]Viability losses for both active agents were considered as not biologically relevant.

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

### 3.1.3 | Conditions of use

The additive is intended for use with all fresh plant material and for all animal species at a proposed minimum concentration of $4.0 \times 10^2$ *S. cerevisiae* NBRC 0203 and $3.2 \times 10^6$ *L. rhamnosus* NBRC 3425 CFU/kg fresh plant material. It is to be applied as a dilution in water.[24]

## 3.2 | Safety

### 3.2.1 | Safety for the target species, consumers and environment

The species *S. cerevisiae* and *L. rhamnosus* are considered by EFSA to be suitable for the qualified presumption of safety (QPS) approach to safety assessment (EFSA BIOHAZ Panel, 2023). This approach requires the identity of the strains to be conclusively established, evidence of the absence of resistance to antimycotics used for medical treatment of yeast infections in cases where viable cells are added to the food or feed chain for *S. cerevisiae* and evidence that they do not carry acquired resistance to antibiotics of human and veterinary importance for *L. rhamnosus*. In the view of the FEEDAP Panel, the identity of the strains has been established as *S. cerevisiae* and *L. rhamnosus*, respectively, the antimycotic resistance qualification met for *S. cerevisiae* and the antibiotic resistance qualification met for *L. rhamnosus*. Consequently, the active agents *S. cerevisiae* NBRC 0203 and *L. rhamnosus* NBRC 3425 are considered safe for the target species, consumers and the environment. Since no other substances are included in the additive, the final additive is also considered safe for the target species, consumers and the environment.

### 3.2.2 | Safety for the user

No specific information was submitted.[25] The additive contains microorganisms and therefore should be considered as a skin and respiratory sensitiser. In the absence of data, the FEEDAP Panel is not in the position to conclude on the potential of the additive to be an eye irritant. Any exposure through the skin and respiratory tract is considered a risk.

[24]Sect_2.5_Consolidated and Sect_2.1–2.2_Consolidated 250602.

[25]Sect_3.3_Consolidated and 2.5.2 MSDS_EM Silage 2.0.

## 3.3 | Efficacy

The additive is intended to support ensiling of all types of fresh plant material at a proposed minimum concentration of $4.0\times10^2$ *S. cerevisiae* NBRC 0203 and $3.2\times10^6$ *L. rhamnosus* NBRC 3425 CFU/kg fresh material. The applicant provided four laboratory experiments made with fresh plant material samples. However, only two types of forages were represented: materials easy to ensile (studies 1[26] and 2[27]) and moderately difficult to ensile (studies 3[28] and 4[29]) as specified by Regulation (EC) 429/2008. The characteristics of the plant materials are shown in Table 2.

In all trials, the fresh materials were sprayed with a fixed amount of water, which was either not supplemented (control) or supplemented with $4.0\times10^2$ CFU *S. cerevisiae* and $3.2\times10^6$ CFU *L. rhamnosus* per kg fresh material, which were ensiled for a minimum of 90 days[30] in 16 2.75 L mini-silos (eight replicates per group). All experiments were conducted at room temperature.[31]

**TABLE 2** Characteristics of the fresh materials used in the four ensiling experiments.

| Study | Test material | Dry matter content (%) | Water-soluble carbohydrate content (% fresh matter) |
|---|---|---|---|
| 1 | Grass+clover | 43.6 | 7.80 |
| 2 | Grass (late mowed) | 51.3 | 10.1 |
| 3 | Red clover | 47.6 | 2.60 |
| 4 | Tall fescue | 31.1 | 2.83 |

After the ensiling process, the silos were opened and their content was analysed for dry matter (DM), pH, lactic and other volatile fatty acids (acetic, propionic, butyric acid), ethanol and ammonia nitrogen in total nitrogen. The DM loss was calculated, considering the correction for the content of volatile products of the DM after ensiling.[32] Two and a half weeks before opening the silos, the samples were exposed to the air for 24 h. A rise of 3°C above the room temperature was considered as indicator of silage deterioration, and the time at which that rise was observed was taken as a measure of the aerobic stability of treated and control silages.[33]

The experimental data were analysed with a Welch *t*-test or Wilcoxon test based on the normality assessment. The significance level was set at 0.05. Results are shown in Table 3.

**TABLE 3** Effects of *S. cerevisiae* NBRC 0203 and *L. rhamnosus* NBRC 3425 on the characteristics of ensiled material recovered at the end of the ensiling period.

| Study | Group | Dry matter loss (%) | pH | Lactic acid (%FM) | Acetic acid (%FM) | Alcohol (%FM) | Ammonia-N (% of total N) | Aerobic stability (h) |
|---|---|---|---|---|---|---|---|---|
| 1 | Control | 8.80 | 4.81 | 2.79 | 0.72 | 3.81 | 8.86 | > 165 |
| | Supplemented | 1.91* | 3.84* | 7.52* | 3.49* | 1.87* | 4.90* | >165 |
| 2 | Control | 15.75 | 5.18 | 1.51 | 0.36 | 4.96 | 8.84 | 161 |
| | Supplemented | 2.44* | 3.88* | 4.16* | 1.99* | 1.40* | 4.51* | > 165 |
| 3 | Control | 4.47 | 4.52 | 4.51 | 1.68 | 1.06 | 5.43 | > 170 |
| | Supplemented | 4.99 | 4.37* | 4.93* | 3.56* | 1.75* | 4.70* | > 170 |
| 4 | Control | 1.35 | 4.38 | 7.69 | 3.24 | 2.29 | 10.9 | 167 |
| | Supplemented | 0.56* | 4.34* | 7.21 | 3.91* | 2.68* | 10.6* | > 175* |

Abbreviation: FM, fresh material.

*Values in a column within a given trial are considered as significantly different when $p < 0.05$ (one-tailed).

The inoculated silages showed lower DM losses in three studies, pH and ammonia-N were reduced in all the trials.

Regarding the aerobic stability, according to the Guidance on the assessment of the efficacy of feed additives (EFSA FEEDAP Panel, 2024), the additive should provide evidence of stability for at least 2 days longer than that shown by the untreated control. In trial 4, the difference observed is about 8 h. Therefore, the results, despite being significant, are not considered sufficient to support the efficacy of the additive to improve aerobic stability.

[26] 4.1.1. EM silage grass – clover Consolidated 250728.

[27] 4.1.2. EM silage meadow grass Consolidated 250728.

[28] 4.1.3. EM silage red clover Consolidated 250728.

[29] 4.1.4. EM silage tall fescue Consolidated 250728.

[30] Duration: Trial1 (94 days); Trial 2 (94 days); Trial 3 (91 days); Trial 4 (97 days).

[31] Sect_4_Efficacy Consolidated 250506, 4.1.b Q7 Agriton protocol_Consolidated 250428 and 4.1.c Q2 CoA EM Silage 2.02292063068.

[32] The post-ensiling DM content was corrected using the method of Dulphy and Demarquilly (1981).

[33] Aerobic stability was tested using the method of Honig (1991).

### 3.3.1 | Conclusions on efficacy

The use of the additive at the proposed inclusion level has the potential to improve the production of silage made from easy and moderately difficult to ensile fresh plant material, with a DM range between 31% and 51% by enhancing the preservation of nutrients. No conclusion can be reached regarding the improvement of the aerobic stability. In the absence of data, no conclusions can be reached on the efficacy of the additive on difficult to ensile plant materials.

## 4 | CONCLUSIONS

The FEEDAP Panel concludes that the additive consisting of *S. cerevisiae* NBRC 0203 and *L. rhamnosus* NBRC 3425 is safe for all animal species, consumers and the environment.

Regarding user safety, the additive should be considered as a skin and respiratory sensitiser, and any exposure through the skin and respiratory tract is considered a risk. The Panel cannot conclude on the eye irritation potential.

The addition of the additive at a minimum level of $4.0 \times 10^2$ *S. cerevisiae* NBRC 0203 and $3.2 \times 10^6$ *L. rhamnosus* NBRC 3425 CFU/kg fresh plant material has the potential to improve the production of silage made from easy and moderately difficult to ensile fresh plant material, with DM content ranging from 31% to 51%. In the absence of data, no conclusions can be reached on the efficacy of the additive on difficult to ensile plant materials.

### ABBREVIATIONS

| | |
|---|---|
| AMR | antimicrobial resistance |
| ANI | Average Nucleotide Identity |
| CFU | colony forming unit |
| DM | Dry matter |
| EURL | European Union Reference Laboratory |
| FEEDAP | EFSA Scientific Panel on Additives and Products or Substances used in Animal Feed |
| LOD | limit of detection |
| LOQ | limit of quantification |
| MIC | minimum inhibitory concentration |
| QPS | Qualified Presumption of Safety |
| WGS | whole genome sequence |

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### REQUESTOR

European Commission

### QUESTION NUMBER

EFSA-Q-2023-00715

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