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Safety evaluation of the food enzyme Phospholipase A₂ from the genetically modified *Trichoderma reesei* strain RF8793

EFSA Panel on Food Contact Materials, Enzymes and Processing Aids (CEP),
Vittorio Silano, José Manuel Barat Baviera, Claudia Bolognesi, Pier Sandro Cocconcelli,
Riccardo Crebelli, David Michael Gott, Konrad Grob, Evgenia Lampi, Alicja Mortensen,
Gilles Rivière, Inger-Lise Steffensen, Christina Tlustos, Henk Van Loveren, Laurence Vernis,
Holger Zorn, Boet Glandorf, Lieve Herman, Jaime Aguilera, Magdalena Andryszkiewicz, Yi Liu,
Sandra Rainieri and Andrew Chesson

Abstract

The food enzyme phospholipase A₂ (phosphatidylcholine 2-acylhydrolase) is produced with the genetically modified *Trichoderma reesei* strain RF8793 by AB Enzymes GmbH. The genetic modifications do not give rise to safety concerns. The food enzyme is free from viable cells of the production organism and its DNA. The food enzyme is intended to be used in degumming of fats and oils and modified lecithin production from egg. Due to lack of data on the compositional parameters, total organic solids (TOS) values could not be calculated. For this reason, the representativeness of the batch used for toxicological examination could not be established and dietary exposure could not be calculated. The Panel considered that, under the intended conditions of use, the risk of allergic sensitisation and elicitation reactions by dietary exposure cannot be excluded, but the likelihood is considered to be low. As TOS values form the basis of toxicological and exposure assessments, the Panel is not in a position to conclude its assessment of the food enzyme phospholipase A₂ produced with the genetically modified *Trichoderma reesei* strain RF8793.

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Correspondence: FIP@efsa.europa.eu

Panel members: Vittorio Silano, José Manuel Barat Baviera, Claudia Bolognesi, Pier Sandro Cocconcelli, Riccardo Crebelli, David Michael Gott, Konrad Grob, Evgenia Lampi, Alicja Mortensen, Gilles Rivière, Inger-Lise Steffensen, Christina Tlustos, Henk Van Loveren, Laurence Vernis, Holger Zorn and Andrew Chesson.

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1. Introduction

Article 3 of the Regulation (EC) No 1332/2008¹ provides definition for ‘food enzyme’ and ‘food enzyme preparation’.

‘Food enzyme’ means a product obtained from plants, animals or microorganisms or products thereof including a product obtained by a fermentation process using microorganisms: (i) containing one or more enzymes capable of catalysing a specific biochemical reaction; and (ii) added to food for a technological purpose at any stage of the manufacturing, processing, preparation, treatment, packaging, transport or storage of foods.

‘Food enzyme preparation’ means a formulation consisting of one or more food enzymes in which substances such as food additives and/or other food ingredients are incorporated to facilitate their storage, sale, standardisation, dilution or dissolution.

Before January 2009, food enzymes other than those used as food additives were not regulated or were regulated as processing aids under the legislation of the Member States. On 20 January 2009, Regulation (EC) No 1332/2008 on food enzymes came into force. This Regulation applies to enzymes that are added to food to perform a technological function in the manufacture, processing, preparation, treatment, packaging, transport or storage of such food, including enzymes used as processing aids. Regulation (EC) No 1331/2008² established the European Union (EU) procedures for the safety assessment and the authorisation procedure of food additives, food enzymes and food flavourings. The use of a food enzyme shall be authorised only if it is demonstrated that:

- it does not pose a safety concern to the health of the consumer at the level of use proposed;
- there is a reasonable technological need;
- its use does not mislead the consumer.

All food enzymes currently on the European Union market and intended to remain on that market, as well as all new food enzymes, shall be subjected to a safety evaluation by the European Food Safety Authority (EFSA) and approval via an EU Community list.

The Guidance on submission of a dossier on food enzymes for safety evaluation (EFSA, 2009a) lays down the administrative, technical and toxicological data required.

1.1. Background and Terms of Reference as provided by the requestor

1.1.1. Background as provided by the European Commission

Only food enzymes included in the European Union (EU) Community list may be placed on the market as such and used in foods, in accordance with the specifications and conditions of use provided for in Article 7 (2) of Regulation (EC) No 1332/2008 on food enzymes.

Two applications have been introduced by the company “AB Enzymes” for the authorisation of the food enzymes Xylanase from a genetically modified strain of *Trichoderma reesei* (strain RF 5703) and Phospholipase A₂ from a genetically modified strain of *Trichoderma reesei* (strain RF 8793).

Following the requirements of Article 12.1 of Regulation (EC) No 234/2011 implementing Regulation (EC) No 1331/2008³, the Commission has verified that the two applications fall within the scope of the food enzyme Regulation and contain all the elements required under Chapter II of that Regulation.

1.1.2. Terms of Reference

The European Commission requests the European Food Safety Authority to carry out the safety assessments on the food enzymes Xylanase from a genetically modified strain of *Trichoderma reesei* (strain RF 5703) and Phospholipase A₂ from a genetically modified strain of *Trichoderma reesei* (strain RF 8793) in accordance with Article 17.3 of Regulation (EC) No 1332/2008 on food enzymes.

¹ Regulation (EC) No 1332/2008 of the European Parliament and of the Council of 16 December 2008 on Food Enzymes and Amending Council Directive 83/417/EEC, Council Regulation (EC) No 1493/1999, Directive 2000/13/EC, Council Directive 2001/112/EC and Regulation (EC) No 258/97. OJ L 354, 31.12.2008, pp. 7–15.

² Regulation (EC) No 1331/2008 of the European Parliament and of the Council of 16 December 2008 establishing a common authorisation procedure for food additives, food enzymes and food flavourings. OJ L 354, 31.12.2008, pp. 1–6.

³ Commission Regulation (EU) No 234/2011 of 10 March 2011 implementing Regulation (EC) No 1331/2008 of the European Parliament and of the Council establishing a common authorisation procedure for food additives, food enzymes and food flavourings. OJ L 64, 11.3.2011, pp. 15–24.

1.2. Interpretation of the Terms of Reference

The present scientific opinion addresses the European Commission's request to carry out the safety assessment of food enzyme Phospholipase A₂ from a genetically modified strain of *Trichoderma reesei* (strain RF 8793).

2. Data and methodologies

2.1. Data

The applicant has submitted a dossier in support of the application for authorisation of the food enzyme Phospholipase A₂ from a genetically modified strain of *Trichoderma reesei* (strain RF 8793). The dossier was updated on 12 January 2015.

Additional information was requested from the applicant during the assessment process on 18 May 2020 and was consequently provided (see 'Documentation provided to EFSA').

2.2. Methodologies

The assessment was conducted in line with the principles described in the EFSA Guidance on transparency in the scientific aspects of risk assessment (EFSA, 2009b) as well as in the Statement on characterisation of microorganisms used for the production of food enzymes' (EFSA CEP Panel, 2019) and following the relevant existing guidances of EFSA Scientific Committees.

The current Guidance on the submission of a dossier on food enzymes for safety evaluation (EFSA, 2009a) has been followed for the evaluation of the application with the exception of the exposure assessment, which was carried out in accordance with the methodology described in the CEF Panel statement on the exposure assessment of food enzymes (EFSA CEF Panel, 2016).

3. Assessment

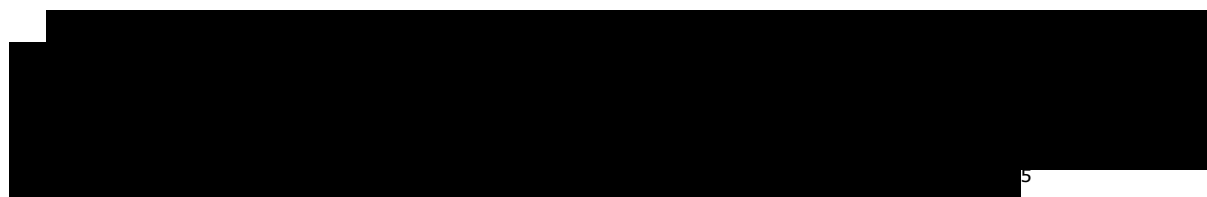
IUBMB nomenclature	phospholipase A ₂
Systematic name	phosphatidylcholine 2-acylhydrolase
Synonyms	lecithinase A, phosphatidase, phosphatidolipase, phospholipase A
IUBMB No	EC 3.1.1.4
CAS No	9001-84-7
EINECS No	232-637-7

Phospholipase A₂ catalyses the hydrolysis of the fatty acyl ester bond at the sn-2 position of the glycerol moiety, resulting in the formation of 2-acyl-2-lysophospholipids and free fatty acids. The enzyme is intended to be used in degumming of fats and oils and modified lecithin production from egg.

3.1. Source of the food enzyme

The phospholipase A₂ is produced with a genetically modified filamentous fungus *Trichoderma reesei* strain RF8793, which is deposited at the Centraalbureau voor Schimmelcultures (CBS, the Netherlands), with deposit number CBS 132467.⁴

3.1.1. Characteristics of the parental and recipient microorganisms



⁴ Technical Dossier/1st submission/Volume III/Appendix 13.

⁵ Technical Dossier/1st submission/Volume III/Appendix 2.

[REDACTED]

3.1.2. Characteristics of introduced sequences

[REDACTED]

3.1.3. Description of the genetic modification process

[REDACTED]

3.1.4. Safety aspects of the genetic modification

The technical dossier contains all necessary information on the recipient microorganism, the donor organism and the genetic modification process.

[REDACTED]

No issues of concern arising from the genetic modifications were identified by the Panel.

3.2. Production of the food enzyme

The food enzyme is manufactured according to the Food Hygiene Regulation (EC) No 852/2004,¹² with food safety procedures based on Hazard Analysis and Critical Control Points, and in accordance with current Good Manufacturing Practice.¹³

The production strain is grown as a pure culture using a typical industrial medium in a submerged, [REDACTED] fermentation system with conventional process controls in place. After completion of the

⁶ Technical Dossier/1st submission/Volume III/Appendix 1.

⁷ Technical Dossier/1st submission/Volume III/Appendix 4.

⁸ Technical Dossier/1st submission/Volume III/Appendix 8.

⁹ Technical Dossier/1st submission/Volume III/Appendix 12.

¹⁰ Technical Dossier/1st submission/Volume III/Appendix 14.

¹¹ Technical dossier/Additional information August 2020/Annex Q1.

¹² Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of food additives. OJ L 226, 25.6.2004, pp. 3–21.

¹³ Technical Dossier/1st submission/Volume II/Annex 9.

mercury were measured in the commercial and pilot batches. Values were below the limits of quantification of the employed methodologies.^{25,26}

The food enzyme preparation complies with the microbiological criteria (for total coliforms, *Escherichia coli* and *Salmonella*) as laid down in the general specifications and considerations for enzymes used in food processing (FAO/WHO, 2006). No antimicrobial activity was detected in any of the tested batches (FAO/WHO, 2006).²⁷

Strains of *Trichoderma*, in common with most filamentous fungi, have the capacity to produce a range of secondary metabolites (Frisvad et al., 2018). The presence of mycotoxins (aflatoxin B1, B2, G1, G2, sterigmatocystin, ochratoxin A, fumonisins B1 and B2, zearalenone, deoxynivalenol, T2-toxin, HT2-toxin) was examined in the four food enzyme batches, and were below the limits of detection (LoD) of the applied analytical methods,^{28,29} except for ochratoxin A, which was 2 µg/kg. The Panel considered this concentration as not of concern.²⁷ The applicant did not provide information on other potential secondary metabolites produced under the conditions of fermentation, which might contribute to the food enzyme TOS. This issue is addressed by the toxicological examination of the food enzyme TOS.

The Panel considers that information provided on the purity of the enzyme is sufficient.

3.3.4. Viable cells and DNA of the production strain

The absence of viable cells of the production strain in the food enzyme was demonstrated [REDACTED].³² No colonies of the production strain were detected.

The absence of recombinant DNA in the food enzyme was demonstrated [REDACTED].³³

3.4. Toxicological data

A battery of toxicological tests including a bacterial gene mutation assay (Ames test), an *in vitro* mammalian chromosomal aberration test, and a repeated dose 90-day oral toxicity study in rats has been provided. A full description was provided on the chemical parameters of the test item.³⁴ However, in the absence of reliable data on the composition of the commercial batches, the representativeness of the test item could not be established. Nevertheless, the data are reported for completeness.

3.4.1. Genotoxicity

3.4.1.1. Bacterial reverse mutation test

A bacterial reverse mutation assay (Ames test) was performed according to the Organisation for Economic Co-operation and Development (OECD) Test Guideline 471 (OECD, 1997) and following Good Laboratory Practice (GLP).³⁵ Five strains of *Salmonella Typhimurium* (TA98, TA100, TA102, TA1535 and TA1537) were used in the presence and absence of metabolic activation (S9-mix). Two separate experiments were carried out in triplicate. In the first experiment, eight different concentrations of the

²⁵ LoQ: Pb = 0.05 (commercial batches) and 0.09 (tox batch) mg/kg; As = 0.5 mg/kg; Cd = 0.05 mg/kg; Hg = 0.1 mg/kg.

²⁶ Technical Dossier/1st submission/Volume II/Annex 2_Methods analytical parameters/ Heavy metals Metropolilab; Technical Dossier/2nd submission/Annex 1_Analytical results_UPDATED.

²⁷ Technical Dossier/2nd submission/Annex 1/New Annex 1AB and annex 16.

²⁸ LoQ: aflatoxins B1, B2, G1 and G2 = 0.05 µg/kg each; ochratoxin A = 0.5 µg/kg; deoxynivalenol: 40 µg/kg; T2-toxin: 10 µg/kg; HT-2-toxin: 10 µg/kg; fumonisins B1 and B2: 10 µg/kg each; zearalenone: 50 µg/kg; sterigmatocystin: 10 µg/kg.

²⁹ Technical Dossier/1st submission/Volume II/Annex 2_Methods analytical parameters; Technical Dossier/2nd submission/Annex 1_Analytical results_UPDATED.

³⁰ Technical Dossier/2nd submission/Annex 1/New Annex AB.

³¹ Technical Dossier/1st submission/Volume III/Appendix 5B.

³² Technical Dossier/1st submission/Volume III/Appendix 21.

³³ Technical Dossier/1st submission/Volume III/Appendix 22 and Additional information August 2020/Annex Q2.

³⁴ Technical dossier/2nd submission/Annex 16.

³⁵ Technical dossier/1st submission/Volume II/Annex 17.

food enzyme (3, 10, 33, 100, 333, 1,000, 2,500 and 5,000 µg TOS/mL) were evaluated using the plate incorporation method. In the second experiment, a narrower range of concentrations (33, 100, 333, 1,000, 2,500 and 5,000 µg TOS/mL) was tested using the pre-incubation method.

No cytotoxicity, determined as a reduction in the number of revertants, was observed at any concentration tested in any strain used. No twofold increase in revertant colonies in comparison to the vehicle controls was found at any concentration, with or without metabolic activation.

The Panel concluded that the food enzyme did not induce gene mutations under the test conditions employed in this study.

3.4.1.2. *In vitro* mammalian chromosomal aberration test

The *in vitro* mammalian chromosomal aberration test was carried out in Chinese hamster V79 cells according to OECD Test Guideline 473 (OECD, 1997b) and following GLP.³⁶

Two independent experiments in duplicate cultures were performed. The first one involved a short-term treatment (4 h followed by 14 h recovery period) with and without metabolic activation (S9-mix) at concentrations of the food enzyme ranging from 85.9 to 5,495 µg TOS/mL. A confirmatory experiment was performed at 125, 250, 500 and 1,000 µg TOS/mL in the presence of S9-mix. The second experiment was carried out with a continuous treatment (18 h) in the absence of S9-mix at concentrations ranging from 21.5 to 5,495 µg TOS/mL. A dose-dependent cytotoxicity, determined as a reduction of the mitotic index, was observed in the presence of S9-mix. No cytotoxicity was observed in the absence of S9-mix up to the highest tested concentration.

For chromosome aberration analysis, the concentrations tested for the short-term experiment in the presence of the S9-mix were 343.4, 686.9, 1,373.8 µg TOS/ml in the first experiment and 250, 500 and 1,000 µg TOS/mL in the confirmatory experiment. In the absence of the S9-mix, both for short-term and continuous exposure, the concentrations tested were: 1,373.8, 2,747.5 and 5,495.0 µg TOS/mL. The frequency of structural and numerical chromosomal aberrations in treated cultures was comparable to the values detected in negative controls and within the range of the laboratory historical solvent control data with the exception of the value detected at 686.9 µg TOS/ml for 4 + 14 h with S9-mix. This value slightly exceeded the historical control range but was not statistically significant and was not reproduced in the confirmatory experiment.

The Panel concluded that food enzyme did not induce chromosome aberrations under the test conditions employed in this study.

3.4.2. Repeated dose 90-day oral toxicity study in rodents

The repeated dose 90-day oral toxicity study was performed in accordance with OECD Test Guideline 408 (OECD, 1998) and following GLP.³⁷ Groups of 10 male and 10 female RccHanTM:WIST (SPF) rats received by gavage the food enzyme at dose level of 100, 300 and 1,000 mg TOS/kg body weight (bw) per day. Controls received the vehicle (bi-distilled water).

Altogether five males died in the study: two mid-dose males on days 44 and 47, respectively, and three high-dose males, one on day 29 and two on day 69. At necropsy and by microscopic examination, inflammatory changes in the lung were recorded. These changes could develop due to misdosing during the administration of the test compound by gavage.

Among functional observational battery parameters statistically significant differences to controls were a lower grip strength in mid-dose females; a higher locomotor activity from 0 to 20 s in low-dose females and a lower total locomotor activity in mid-dose males. These findings were considered incidental due to the lack of dose response.

Relative feed intake as compared to controls was statistically significantly lower in mid-dose males between days 1–15, 22–29, 36–43 and 43–50. Statistically significant higher relative feed intake was observed in low- and mid-dose females between days 8 and 15, 71 and 78 and in mid-dose females also between days 85 and 91. These findings were not dose-related and did not impact on body weights, and were therefore not considered toxicologically relevant by the Panel.

Haematological examination revealed several statistically significant differences to controls. High-dose males had a lower haemoglobin distribution width (HDW) and higher values of low and high fluorescence reticulocytes (L-RETI and H-RETI). However, increases in the total or relative reticulocyte counts were not observed. Therefore, these findings were considered as incidental. In addition, high-

³⁶ Technical dossier/1st submission/Volume II/Annex 18.

³⁷ Technical dossier/1st submission/Volume II/Annex 19.

dose males had higher absolute counts of leucocytes (WBC), basophils (BASO) and large unstained cells (LUC). In the high-dose females, absolute and relative reticulocyte counts and relative thromboplastin time were higher. Mid-dose females had lower absolute lymphocyte count. All these findings were not clearly dose related. Therefore, they were not considered toxicologically relevant by the Panel.

Clinical chemistry examination revealed several statistically significant differences to controls. In mid-dose males, sodium and chloride concentrations were increased. In high-dose females, sodium, calcium, phosphorous and globulin concentrations were increased. The increases in the concentrations of ions were not dose-related. The increase in globulin, although it appeared dose-related, was not accompanied by any inflammatory changes based on macro- and micro pathology reports. Therefore, these findings were considered not to be of toxicological significance by the Panel.

Furthermore, decreases in activities of creatine kinase in all treated females and of lactate dehydrogenase in mid- and high-dose females were recorded. For both parameters, the decreases were dose-related. The activity of both enzymes in the treated males was also lower than in the controls, but the difference was not statistically significant, and the dose relationship was not apparent. The Panel noted that a large inter-individual variability in activity of both enzymes is known. Therefore, the Panel considered these findings as not toxicologically significant.

Absolute and relative brain weight in low-dose males and relative weight of adrenals in mid-dose females were increased when compared with the controls. The Panel considered these findings as incidental because these changes were small, there was no apparent dose-response relationship and the changes were not accompanied by histopathological findings.

No other statistically significant differences to controls were observed.

The Panel could not identify a no observed adverse effect level (NOAEL) because of the number of unscheduled deaths and the high number of scattered observed effects in the treatment groups.

3.4.3. Allergenicity

The allergenicity assessment considers only the food enzyme and not any carrier or other excipient which may be used in the final formulation.

The potential allergenicity of the phospholipase A₂ produced with the genetically modified *Trichoderma reesei* strain RF8793 was assessed by comparing its amino acid sequence with those of known allergens according to the scientific opinion on the assessment of allergenicity of GM plants and microorganisms and derived food and feed of the Scientific Panel on Genetically Modified Organisms (EFSA GMO Panel, 2010). Using higher than 35% identity in a sliding window of 80 amino acids as the criterion, no match was found.³⁸

No information is available on oral and respiratory sensitisation or elicitation reactions of this phospholipase A₂.

Phospholipases are implicated in allergic responses to insect bites. However, a literature search provided by the applicant did not find reports on allergic reactions to phospholipases after oral exposure.³⁹

According to the information provided, substances or products that may cause allergies or intolerances are used as raw materials (██████████) in the media fed to the microorganisms. However, during the fermentation process, these products will be degraded and utilised by the microorganisms for cell growth, cell maintenance and production of enzyme protein. In addition, the fungal biomass and fermentation solids are removed. Taking into account the fermentation process and downstream processing, the Panel considered that potentially allergenic residues of these foods employed as protein sources are not expected to be present.

Quantifying the risk for allergenicity is not possible in view of the individual susceptibility to food allergens. Allergenicity can be ruled out only if the proteins are fully removed. In the fats and oils processing for degumming, experimental data showed a significant removal (> 99%) of protein. However, traces of protein could be present in final degummed oils. The food enzyme remains in egg-derived foods.

The Panel considered that, under the intended conditions of use, the risk of allergic sensitisation and elicitation reactions upon dietary exposure to this food enzyme cannot be excluded, but the likelihood of such reactions occurring is considered to be low.

³⁸ Technical Dossier/1st submission/Volume II/Annex 20.

³⁹ Technical Dossier/Additional information August 2020/Annex Q7.

3.5. Dietary exposure

3.5.1. Intended use of the food enzyme

The food enzyme is intended to be used in two food processes at the recommended use levels summarised in Table 2.⁴⁰

Table 1: Intended uses and recommended use levels of the food enzyme as provided by the applicant

Food manufacturing process ^(b)	Raw material	Recommended dosage of the food enzyme ^(a)
Degumming of fats and oils	Crude oil	Up to 0.5 mg TOS/kg crude oil
Modified lecithin production from egg	Egg lecithin or egg yolk	Up to 1 mg TOS/kg lecithin (up to 6 mg TOS/kg egg yolk)

(a): TOS values provided by the applicant.

(b): The description provided by the applicant has been harmonised by EFSA according to the 'EC working document describing the food processes in which food enzymes are intended to be used' – not yet published at the time of adoption of this opinion.

In fats and oil processing, when added to crude oil, phospholipase A₂ hydrolyses the phospholipids naturally present in crude oil to form lysophospholipids and fatty acids. This conversion results in enzymatic degumming of oil, which helps to reduce the amount of gum phospholipids. Modified lecithin is obtained as a by-product of this process.

In modified lecithin production from egg, the phospholipase A₂ is added either to lecithin isolated from egg or to the egg yolk directly (at a higher level) in order to hydrolyse the naturally present phospholipids prior to pasteurisation. In the production of modified lecithin from egg yolk, addition of phospholipase A₂ leads to improved emulsifying properties of lecithin.

Concerning the degumming of fats and oils, technical information and experimental data provided on the removal of food enzyme–TOS was considered by the Panel as sufficient to exclude these processes from the exposure assessment (Annex B in EFSA CEF Panel, 2016). However, modified plant lecithin obtained as a by-product during oil refining, and which is separated together with the food enzyme during the centrifugation step, is assumed to contain residual TOS.

The food enzyme remains in the modified lecithin obtained from egg and in the modified plant lecithin obtained as by-product during the oil-refining process. Based on data provided on thermostability (see Section 3.3.1), it is expected that the phospholipase A₂ is inactivated during production of modified lecithin from egg and during the degumming process of fats and oils.

Due to the incorrect calculation of the TOS values (Section 3.3.2), the validity of the provided use levels could not be verified, and therefore, dietary exposure to the food enzyme from modified lecithin could not be estimated.

4. Conclusions

Based on the data provided, TOS values, which form the basis of toxicological and exposure assessments, could not be calculated. In addition, an NOAEL could not be identified from the repeated dose 90-day oral toxicity study. Therefore, the Panel is not in a position to conclude its assessment of the food enzyme phospholipase A₂ produced with the genetically modified *Trichoderma reesei* strain RF8793.

The CEP Panel considers the food enzyme free from viable cells of the production organism and recombinant DNA.

5. Documentation as provided to EFSA

- 1) Application for authorisation of a Phospholipase A₂ from a genetically modified strain of *Trichoderma reesei*. January 2015. Submitted by AB Enzymes GmbH.
- 2) Additional information. August 2020. Submitted by AB Enzymes GmbH.
- 3) Summary report on GMM part for phospholipase A₂ produced by *Trichoderma reesei* strain RF8793, EFSA-Q-2014-00411. 2015. Delivered by Technical University of Denmark (Lyngby, Denmark).

⁴⁰ Technical dossier/1st submission/p. 51–55.

- 4) Summary report on technical data and dietary exposure related to phospholipase A₂ from a genetically modified strain of *Trichoderma reesei* (strain RF8793) by AB Enzymes and ROAL Oy. May 2015. Delivered by Hylobates Consulting (Rome, Italy) and BiCT (Lodi, Italy).
- 5) Summary report on genotoxicity and subchronic toxicity study related to phospholipase A₂ produced with a strain of *Trichoderma reesei* (strain RF8793) by AB Enzymes GmbH. 2015. Delivered by FoBiG (Freiburg, Germany).

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- EFSA (European Food Safety Authority), 2009a. Guidance of EFSA prepared by the Scientific Panel of Food Contact Material, Enzymes, Flavourings and Processing Aids on the Submission of a Dossier on Food Enzymes. EFSA Journal 2009;7(8):1305, 26 pp. <https://doi.org/10.2903/j.efsa.2009.1305>
- EFSA (European Food Safety Authority), 2009b. Guidance of the Scientific Committee on transparency in the scientific aspects of risk assessments carried out by EFSA. Part 2: general principles. EFSA Journal 2009;7(5):1051, 22 pp. <https://doi.org/10.2903/j.efsa.2009.1051>
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Abbreviations

bw	body weight
CAS	Chemical Abstracts Service
CEF	EFSA Panel on Food Contact Materials, Enzymes, Flavourings and Processing Aids
CEP	EFSA Panel on Food Contact Materials, Enzymes and Processing Aids
EC	European Commission

EINECS	European Inventory of Existing Commercial Chemical Substances
FAO	Food and Agricultural Organization of the United Nations
GLP	Good Laboratory Practice
GMM	genetically modified microorganism
GMO	genetically modified organism
IUBMB	International Union of Biochemistry and Molecular Biology
JECFA	Joint FAO/WHO Expert Committee on Food Additives
kDa	kiloDalton
NOAEL	no observed adverse effect level
LoD	limit of detection
LoQ	Limit of quantification
OECD	Organisation for Economic Cooperation and Development
PCR	polymerase chain reaction
SDS-PAGE	sodium dodecyl sulfate-polyacrylamide gel electrophoresis
TOS	total organic solids
WHO	World Health Organization