# Safety of oil from Schizochytrium sp. (strain ATCC 20889) for use in infant and follow-on formula as a novel food pursuant to Regulation (EU) 2015/2283.

Dominique Turck, T. Bohn, J. Castenmiller, S. de Henauw, K. I. Hirsch-Ernst, A. Maciuk, I. Mangelsdorf, H. J. Mcardle, A. Naska, C. Pelaez, et al.

SCIENTIFIC OPINION

EFSA Journal

ADOPTED: 16 December 2021

doi: 10.2903/j.efsa.2022.7083

# Safety of oil from *Schizochytrium* sp. (strain ATCC 20889) for use in infant and follow-on formula as a novel food pursuant to Regulation (EU) 2015/2283

EFSA Panel on Nutrition, Novel Foods and Food Allergens (NDA), Dominique Turck, Torsten Bohn, Jacqueline Castenmiller, Stefaan De Henauw, Karen Ildico Hirsch-Ernst, Alexandre Maciuk, Inge Mangelsdorf, Harry J McArdle, Androniki Naska, Carmen Pelaez, Kristina Pentieva, Alfonso Siani, Frank Thies, Sophia Tsabouri, Marco Vinceti, Francesco Cubadda, Thomas Frenzel, Marina Heinonen, Rosangela Marchelli, Monika Neuhäuser-Berthold, Morten Poulsen, Miguel Prieto Maradona, Josef Rudolf Schlatter, Henk van Loveren, Emanuela Turla and Helle Katrine Knutsen

## Abstract

Following a request from the European Commission, the EFSA Panel on Nutrition, Novel Foods and Food Allergens (NDA) was asked to deliver an opinion on the safety of *Schizochytrium* sp. oil as a novel food (NF) pursuant to Regulation (EU) 2015/2283. The NF which is the subject of the application is an oil rich in docosahexaenoic acid (DHA) that is produced by the microalgae *Schizochytrium* sp. (strain ATCC-20889). The applicant proposed to add the NF in infant formulae (IF) and follow-on formulae (FOF) at use levels in accordance with Regulation (EU) No 609/2013. The evidence provided by the applicant does not demonstrate to which species the strain *Schizochytrium* sp. ATCC 20889 belongs. As the source organism of the NF is not characterised at species level, no assessment for inclusion in the Qualified Presumption of Safety (QPS) list can be performed by EFSA. Marine biotoxins (including cyanotoxins) in the NF were below their limits of quantification. However, since it is unknown to which species the strain *Schizochytrium* sp. ATCC 20889 belongs, the concern that this strain has the potential to produce other toxins remains. No toxicological studies with the NF were provided by the applicant. Toxicological studies are available with DHA-rich algal oils produced from other strains of *Schizochytrium* sp. However, the Panel considers that those toxicological studies cannot be used to establish the safety of the oil produced by the strain which is under assessment in this application (*Schizochytrium* sp. ATCC 20889). Therefore, based on the information provided by the applicant, the Panel concludes that the safety of the NF has not been established.



**Keywords:** Novel foods, *Schizochytrium*, alga, docosahexaenoic acid, infants, young children, safety

**Requestor:** European Commission

**Question number:** EFSA-Q-2019-00548

**Correspondence:** nda@efsa.europa.eu

**Panel members:** Dominique Turck, Torsten Bohn, Jacqueline Castenmiller, Stefaan De Henauw, Karen Ildico Hirsch-Ernst, Helle Katrine Knutsen, Alexandre Maciuk, Inge Mangelsdorf, Harry J McArdle, Androniki Naska, Carmen Pelaez, Kristina Pentieva, Alfonso Siani, Frank Thies, Sophia Tsabouri and Marco Vinceti.

**Declarations of interest:** The declarations of interest of all scientific experts active in EFSA's work are available at https://ess.efsa.europa.eu/doi/doiweb/doisearch.

**Suggested citation:** EFSA NDA Panel (EFSA Panel on Nutrition, Novel Foods and Food Allergens), Turck D, Bohn T, Castenmiller J, De Henauw S, Hirsch-Ernst KI, Maciuk A, Mangelsdorf I, McArdle HJ, Naska A, Pelaez C, Pentieva K, Siani A, Thies F, Tsabouri S, Vinceti M, Cubadda F, Frenzel T, Heinonen M, Marchelli R, Neuhäuser-Berthold M, Poulsen M, Prieto Maradona M, Schlatter JR, van Loveren H, Turla E and Knutsen HK, 2022. Scientific Opinion on the safety of oil from *Schizochytrium* sp. (strain ATCC 20889) for use in infant and follow-on formula as a novel food pursuant to Regulation (EU) 2015/2283. EFSA Journal 2022;20(1):7083, 15 pp. https://doi.org/10.2903/j.efsa.2022.7083

**ISSN:** 1831-4732



The EFSA Journal is a publication of the European Food Safety Authority, a European agency funded by the European Union.

# Table of contents

# 1. Introduction

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

*Schizochytrium* sp. oil is authorised, in accordance with Regulation (EC) No 258/97[1], as a novel food for a number of uses as listed in Commission Implementing Regulation (EU) 2017/2470[2] establishing the Union list of novel foods in accordance with Regulation (EU) 2015/2283[3].

On 18 July 2019, the company Bioplus Life Sciences submitted a request to the European Commission in accordance with Article 10 of Regulation (EU) 2015/2283 for an extension of use of *Schizochytrium* sp. oil as a novel food.

The application requests to authorise the use of *Schizochytrium* sp. oil, produced from *Schizochytrium* sp. ATCC 20889, in additional food categories, namely, infant formulae and follow-on formulae.

In accordance with Article 10(3) of Regulation (EU) 2015/2283, the European Commission asks the European Food Safety Authority to provide a scientific opinion on *Schizochytrium* sp. oil.

## 1.2. Information on existing evaluations and authorisations

Three existing evaluations of the NDA Panel of EFSA need to be mentioned:

- In the Scientific Opinion on Dietary Reference Values for fats (EFSA NDA Panel, 2010), the Panel set an adequate intake (AI) of 250 mg for eicosapentaenoic acid (EPA) plus docosahexaenoic acid (DHA) for adults; an AI of 100 mg DHA for infants (> 6 months) and young children < 24 months; and an increase of 100–200 mg preformed DHA in addition to the AI for adults as an adequate supply of n-3 long-chain PUFA (polyunsaturated fatty acids) during pregnancy and lactation.
- In the Scientific opinion on nutrient requirements and dietary intakes of infants and young children in the European Union (EFSA NDA Panel, 2013), the Panel concluded on the levels of nutrient and energy intakes that are considered adequate for the majority of infants and young children. In particular, the AI for DHA of 100 mg/day was confirmed for infants and young children between 6 and 24 months and was also applied to infants of 0–6 months, taking into account the concentration of essential fatty acids (including DHA) in human breast milk. It is noted that EFSA has not set a AI for DHA for children older than 24 months.
- In the Scientific Opinion on the essential composition of infant and follow-on formulae (EFSA NDA Panel, 2014), the Panel concluded that DHA should be added to IF and FOF due to its structural role in the nervous system and the retina and its involvement in normal brain and visual development. A range for the recommended concentration of DHA in IF and FOF was derived: from 20 mg/100 kcal (4.8 mg/100 kJ), based on the AI of DHA (100 mg/day) and an average energy intake of 500 kcal/day, to 50 mg/100 kcal (12 mg/100 kJ) based on the highest observed DHA concentration in human milk (1% DHA in fatty acids (FA)) and the amount of FA in human milk.

# 2. Data and methodologies

## 2.1. Data

The safety assessment of this NF is based on data supplied in the application and information submitted by the applicant following EFSA requests for supplementary information.

Administrative and scientific requirements for NF applications referred to in Article 10 of Regulation (EU) 2015/2283 are listed in the Commission Implementing Regulation (EU) 2017/2469[4].

A common and structured format on the presentation of NF applications is described in the EFSA Guidance on the preparation and presentation of an NF application (EFSA NDA Panel, 2016). As

[1] Regulation (EC) No 258/97 of the European Parliament and of the Council of 27 January 1997 concerning novel foods andnovel foods ingredients. OJ L 43, 14.2.1997, p. 1.

[2] Commission Implementing Regulation (EU) 2017/2470 of 20 December 2017 establishing the Union list of novel foods inaccordance with Regulation (EU) 2015/2283 of the European Parliament and of the Council on novel foods. OJ L 351,30.12.2017, p. 72.

[3] Regulation (EU) 2015/2283 of the European Parliament and of the Council of 25 November 2015 on novel foods, amendingRegulation (EU) No 1169/2011 of the European Parliament and of the Council and repealing Regulation (EC) No 258/97 of theEuropean Parliament and of the Council and Commission Regulation (EC) No 1852/2001. OJ L 327, 11.12.2015, p. 1.

[4] Commission Implementing Regulation (EU) 2017/2469 of 20 December 2017 laying down administrative and scientific requirements for applications referred to in Article 10 of Regulation (EU) 2015/2283 of the European Parliament and of the Council on novel foods. OJ L 351, 30.12.2017, pp. 64-71

indicated in this guidance, it is the duty of the applicant to provide all of the available (proprietary, confidential and published) scientific data (including both data in favour and not in favour) that are pertinent to the safety of the NF.

This NF application does not include a request for the protection of proprietary data.

### 2.2. Methodologies

The assessment follows the methodology set out in the EFSA guidance on NF applications (EFSA NDA Panel, 2016) and the principles described in the relevant existing guidance documents from the EFSA Scientific Committee. The legal provisions for the assessment are laid down in Article 11 of Regulation (EU) 2015/2283 and in Article 7 of the Commission Implementing Regulation (EU) 2017/2469.

This assessment concerns only the risks that might be associated with the consumption of the NF under the proposed conditions of use, and is not an assessment of the efficacy of the NF with regard to any claimed benefit.

## 3. Assessment

### 3.1. Introduction

The NF, which is the subject of this application is an oil that is produced by the microalgae *Schizochytrium* sp. (strain ATCC-20889). With reference to article 3 of the NF Regulation (EU) 2015/2283, the NF falls under the category 2(a)(ii): 'food consisting of, isolated from or produced from microorganisms, fungi or algae'. The production process involves the controlled growth of these algae followed by extraction and refinement of the oil produced by the algae. The oil is a mixture of triglycerides in which docosahexaenoic acid (DHA) represents around 40% of total fatty acids (FAs). The NF is proposed to be used as an ingredient in infant formulae (IF) and follow-on formula (FOF).

### 3.2. Identity of the NF

The NF under assessment in the present application is an oil from the microalgae *Schizochytrium* sp. (strain ATCC-20889). The oil is a mixture of triglycerides in which DHA is the predominant one (40–43%), making up together with docosapentaenoic (DPA; n-6) and palmitic acid between 80% and 85% of the total FAs.

The applicant indicated that the oil is derived from marine microalgae belonging to the genus *Schizochytrium*. The taxonomic classification of the microalgae is as follows: Kingdom: Chromista; Phylum: Bigyra; Class: Labyrinthulea; Order: Thraustochytrida; Family: Thraustochytriaceae; Genus: *Schizochytrium*. The taxonomic classification of the genus *Schizochytrium* has been subject to discussions in 2007 (Yokohama and Honda, 2007) and the genus *Schizochytrium* can now also be referred to as *Aurantiochytrium*.

The applicant indicated that the strain used to produce the NF is *Schizochytrium* sp. ATCC-20889. This strain has not been developed by the applicant and it is obtained from the American Type Culture Collection (ATCC) under the reference number 'ATCC-20889'.

During the assessment, EFSA requested the applicant to identify the strain 'ATCC-20889' at the species level. Since the whole genome sequence of *Schizochytrium* sp. ATCC-20889 was not available, the applicant performed an NCBI blast analysis to compare the 18S rRNA partial gene sequence of *Schizochytrium* sp. ATCC 20889 against strains belonging to known species. The percentage of identity was 91.68% or below against strains belonging to *S. limacinum* species and 91.44% against one strain belonging to *S. mangrovei* (length of the fragment: 750 bp; query cover: 99%; max/total score: ~ 1.100). The Panel considers that the percentage of identity is insufficient to demonstrate which species the strain *Schizochytrium* sp. ATCC 20889 belongs to. The applicant performed an additional sequencing of the 18S rRNA partial gene of ATCC 20889 and a second targeted NCBI blast analysis of the gene from the NF source strain against strains belonging to *S. limacinum* obtaining percentages of identity over 99.5% (length of fragment: 200 bp; query cover: 94–95%; max/total score: 370 approx.). The Panel notes that the length of the fragment of *Schizochytrium* sp. ATCC 20889 which was sequenced and used for the comparison was extremely short (200 bp). Considering that short fragments of gene sequences can be shared among different species, comparisons of such short fragments do not unequivocally identify the species a strain belongs to.

According to the EFSA Guidance on characterisation of microorganisms[5] when data do not allow the assignment of a strain to a known microbial species, its phylogenetic position with respect to the

[5] Guidance on the characterisation of microorganisms used as feed additives or as production organisms. EFSA Journal 2018;16(3):5206, 24 pp. https://doi.org/10.2903/j.efsa.2018.5206

closest relatives should be provided. The applicant provided a molecular phylogenetic analysis by maximum likelihood method based on 18S rRNA gene partial sequence that indicates the closest homology of the strain *Schizochytrium* sp. ATCC 20889 with the strain *Schizochytrium* sp. ATCC 20888 (NCBI BLAST percentage of identity: 95.03%). The Panel notes that the percentage of identity of the two strains is only discrete and that the species of *Schizochytrium* sp. ATCC 20888 is unknown and, therefore, the strain cannot be considered identified unambiguously at species level as requested by the above-mentioned guidance.

The applicant also provided the publication by Jakobsen et al. (2007), which presented a phylogenetic tree based on 18S rRNA gene sequence. According to the applicant, this phylogenetic tree indicated a similarity between the strain *Schizochytrium* sp. ATCC 20889 and the strain *Thraustochytrium* sp. ONC-T18 (also named *Schizochytrium* sp. T-18). The Panel notes that no information was provided on the percentage identity between the strain *Schizochytrium* sp. ATCC 20889 and *Thraustochytrium* sp. ONC-T18. The Panel also notes that the species of *Thraustochytrium* sp. ONC-T18 is unknown.

The Panel considers that the evidence provided by the applicant does not demonstrate to which species the strain *Schizochytrium* sp. ATCC 20889 belongs.

## 3.3. Production process

According to the information provided, the NF is produced in accordance with Global Standards for Food Safety and with Hazard Analysis Critical Control Points (HACCP) system.

The unicellular microalgae *Schizochytrium* sp. (strain ATCC-20889) are grown under controlled conditions (time, temperature, pH and aeration) in a sterile liquid culture medium containing the necessary nutrients. The microalgal biomass is separated from the culture medium by using a decanter. The microalgal biomass is subjected to cell disruption via a solvent (ethyl acetate) under defined pressure and temperature conditions. After centrifugation to remove cell debris, the solvent is evaporated to yield crude oil. The crude oil is winterised and centrifuged. The crude oil is refined using standard techniques (neutralisation, bleaching, deodorisation). High oleic sunflower oil is added prior to a deodorisation step to adjust the DHA content. EU-authorised antioxidants (ascorbyl palmitate and tocopherols) are also added to ensure stability. The NF is finally filtered and packed under nitrogen conditions.

Considering the solvent used, the pressure and the temperature applied in the production process, viable cells are not expected to remain in the NF. The Panel considers that microalgae are not expected to survive the production process. Considering the temperature applied during the refining steps, the Panel considers that potential residual of the solvent used to lyse the microalgae is removed.

The Panel considers that the production process is sufficiently described and does not raise safety concerns.

## 3.4. Compositional data

The NF consists of triglycerides composed of polyunsaturated fatty acids (PUFA), in which DHA is the predominant one (40–43%), making up, together with docosapentaenoic (DPA; n-6) and palmitic acid, between 80% and 85% of the total FAs.

To confirm that the manufacturing process is reproducible and adequate to produce a product with certain characteristics on a commercial scale, the applicant provided analytical information for five batches of the NF (Table 1). The batch analyses presented in Table 1 were performed after the addition of high oleic sunflower oil and after deodorisation. Upon EFSA's request of information, the applicant clarified that the batches of the NF are routinely tested against the specifications before and after the addition of the sunflower oil. In this respect, the applicant provided the results of the analysis of five batches of the NF prior to the addition of sunflower oil and prior to deodorisation (Table 2).

In terms of chemical contaminants, the concentrations of heavy metals, polychlorobiphenyls, dioxins, polycyclic aromatic hydrocarbons and pesticides in this batch to batch analysis are below limits of quantifications and within the EU limits established in the respective regulations and do not present safety concerns. The Panel notes the presence of erucic acid in the NF, which is below the maximum level (ML) permitted in vegetable oils. These five batches of the NF were also tested for the process contaminants glycidyl fatty acid esters (expressed as glycidol) and total 3-monochloro-propanol-1,2-diol (MCPD) (free and fatty acid esters). The concentration of glycidyl fatty acid esters (expressed as glycidol) and 3-MCPD (sum of 3-MCPD and 3-MCPD fatty acid esters, expressed as 3-MCPD) determined in the NF are below the ML permitted for oils for the production of baby foods.

Upon EFSA's request for information, the applicant analysed five batches of the NF for marine biotoxins [domoic acid (DA), yessotoxins (YTX), azaspiracids (AZA), dinophysistoxins (DTX), okadaic

acid (OA), pectenotoxins (PTX), saxitoxins (STX), gonyautoxins (GTX) and cyanotoxins (i.e. microcystins and nodularine)]. Marine biotoxins (including cyanotoxins) were below their limit of quantification (LOQ) (LOQ for DA: < 1 mg/kg; LOQ for YTX, AZA, DTX, OA: < 5 μg/kg; LOQ for PTX, STX and GTX: < 20 μg/kg; LOQ for cyanotoxins: < 25 μg/kg). These data indicate that the algal strain *Schizochytrium* sp. (strain ATCC-20889) is not expected to produce these marine biotoxins.

Information was provided on the accreditation of the laboratories that conducted the analyses presented in the application.

The Panel considers that the information provided on the composition is sufficient for characterising the NF.

**Table 1:** Batch to batch analysis of the NF (after addition of sunflower oil)

| Parameter (unit) | Batch number | | | | | Method of analysis |
|---|---|---|---|---|---|---|
| | #1 | #2 | #3 | #4 | #5 | |
| **Proximate analysis** | | | | | | |
| **Fat (g/100 g)** | 99.6 | 99.7 | 99.6 | 99.8 | 99.5 | AOAC Ch-34 – gravimetric method |
| **Proteins (g/100 g)** | < 0.625[(a)] | < 0.625[(a)] | < 0.625[(a)] | < 0.625[(a)] | < 0.625[(a)] | Kjeldahl method |
| **Carbohydrates (g/100 g)** | ND | ND | ND | ND | ND | AOAC 986.25 Ch-50.1.16 (by calculation) |
| **Energy (kcal/100 g)** | 896 | 897 | 896 | 898 | 895 | Pearson's chemical analysis |
| **Physico-chemical parameters** | | | | | | |
| **Acid value (mg KOH/g)** | 0.13 | 0.13 | 0.14 | 0.1 | 0.14 | AOCS – Cd 3d-63 |
| **Peroxide value (meq/kg)** | 0.54 | 0.52 | 0.81 | 0.49 | 0.62 | AOCS – Cd 8-53 |
| **Moisture and volatiles %** | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | AOCS – Ca 2d-25 |
| **Unsaponifiable matter %** | 1.57 | 1.61 | 1.68 | 1.63 | 1.65 | AOCS – Ca 6d-53 |
| **Free fatty acids (g/100g)** | 0.07 | 0.07 | 0.07 | 0.05 | 0.07 | AOCS – Cd 3d-63 |
| **p-Anisidine value** | 19.66 | 11.23 | 14.19 | 14.67 | 12.11 | Ph. Eur. Method 2.5.36 |
| **Organic volatile impurities (mg/kg)** | < 10 | < 10 | < 10 | < 10 | < 10 | In-house method |
| **Fatty acids (% FA)** | | | | | | |
| Myristic acid – C14:0 | 1.87 | 1.83 | 1.77 | 1.53 | 1.94 | AOAC – GC/FID |
| Pentadecanoic acid – C15:0 | 0.57 | 0.73 | 0.55 | 0.60 | 0.71 | |
| Palmitic acid- C16:0 | 27.43 | 29.17 | 30.96 | 29.55 | 32.38 | |
| Heptadecanoic acid – C17:0 | 0.27 | 0.34 | 0.32 | 0.20 | 0.34 | |
| Stearic acid – C18:0 | 1.48 | 1.62 | 1.86 | 1.56 | 1.52 | |
| Oleic acid – C18:1(n-9) | 9.24 | 8.34 | 4.80 | 8.56 | 4.58 | |
| Linoleic acid – C18:2(n-6) | 1.43 | 1.30 | 0.91 | 1.17 | 0.77 | |
| Arachidic acid – C20:4 | 0.36 | 0.43 | 0.49 | 0.37 | 0.23 | |
| Eicosadienoic acid – C20:2 | 0.26 | 0.23 | 0.23 | 0.23 | 0.22 | |
| Eicosatrienoic acid – C20:3 | 0.71 | 0.75 | 0.72 | 0.19 | 0.66 | |
| Arachidonic acid – C20:4(n-6) | 0.36 | 0.75 | 0.29 | 0.64 | 0.66 | |
| Eicosapentaenoic acid (EPA) – C20:5(n-3) | 1.26 | 1.01 | 1.08 | 1.14 | 1.11 | |
| Erucic acid – C22:1 | 0.44 | 0.49 | 0.52 | 0.20 | 0.20 | |
| Docosapentaenoic acid (DPA) – C22:5(n-6) | 8.71 | 10.05 | 10.97 | 9.86 | 9.78 | |
| Docosahexaenoic acid (DHA) – C22:6(n-3) | 43.2 | 40.7 | 42.1 | 41.7 | 43.0 | |
| Lignoceric acid – C24:0 | 0.67 | 0.68 | 0.75 | 0.68 | 0.67 | |
| Nervonic acid – C24:1 | 0.45 | 0.46 | 0.24 | 0.34 | 0.17 | |
| **Trans fatty acids (mg/kg)** | < 36.3[(a)] | < 36.3[(a)] | < 36.3[(a)] | < 36.3[(a)] | < 36.3[(a)] | AOAC[(c)] |

| Parameter (unit) | Batch number | | | | | Method of analysis |
|---|---|---|---|---|---|---|
| | #1 | #2 | #3 | #4 | #5 | |
| **Sterols (mg/100 g)** | | | | | | |
| Total sterols | 402.56 | 307.66 | 442.42 | 497.45 | 461.94 | AOAC 994.10 –GC-FID |
| Cholesterol | 285.57 | 181.13 | 296.63 | 349.69 | 326.13 | |
| Sitosterol | 36.68 | 35.45 | 63.95 | 82.14 | 64.03 | |
| Stigmasterol | 48.93 | 35.98 | 52.09 | 51.09 | 47.25 | |
| Campesterol | 2.44 | 1.85 | 9.53 | 5.43 | 4.78 | |
| Brassicasterol | 28.94 | 53.25 | 20.22 | 9.10 | 19.75 | |
| **Heavy metals (mg/kg)** | | | | | | |
| Mercury (mg/kg) | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | AOAC, 18th edition Chp-9/ICP |
| Cadmium (mg/kg) | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | |
| Arsenic (mg/kg) | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | |
| Lead (mg/kg) | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | |
| Copper (mg/kg) | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | |
| **Microbiological analysis** | | | | | | |
| Total aerobic count (CFU/g) | < 10 | < 10 | < 10 | < 10 | < 10 | IS 5402:2012 |
| Yeast and moulds (CFU/g) | < 10 | < 10 | < 10 | < 10 | < 10 | IS 5403:1999 |
| Coliform count (CFU/g) | < 10 | < 10 | < 10 | < 10 | < 10 | IS 5401 (P1):2012 |
| *E. coli* (per 1 g) | Absent | Absent | Absent | Absent | Absent | IS 5887 (PA):1976 |
| *Salmonella* (per 25 g) | Absent | Absent | Absent | Absent | Absent | IS 5587 (P3):1999 |
| Enterobacteriaceae (CFU/mL) | < 1 | < 1 | < 1 | < 1 | < 1 | ISO 21528:2017 |
| *Cronobacter sakazakii* (per 10 mL) | Absent | Absent | Absent | Absent | Absent | ISO 22964:2017 |
| *Staphylococcus aureus* (CFU/mL) | < 1 | < 1 | < 1 | < 1 | < 1 | ISO 6888-1:1999 |
| **PCB and dioxins** | | | | | | |
| Sum of dioxins (WHO-PCDD/F-TEQ) (pg/g) | < 0.5[(b)] | < 0.5[(b)] | < 0.5[(b)] | < 0.5[(b)] | < 0.5[(b)] | GC-MS/MS |
| Sum of dioxin and dioxins like PCBs (WHO-PCDD/F-TEQ) (pg/g) | < 1.0[(b)] | < 1.0[(b)] | < 1.0[(b)] | < 1.0[(b)] | < 1.0[(b)] | GC-MS |
| PCB (total 6 ndl-PCB) (ng/g) | < 1.0[(b)] | < 1.0[(b)] | < 1.0[(b)] | < 1.0[(b)] | < 1.0[(b)] | GC-MS |
| **Polycyclic aromatic hydrocarbons (μg/kg)** | | | | | | |
| Benzo(a)pyrene | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | GC-MS/MS |
| Benzo(a)anthracene | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | GC-MS/MS |
| Chrysene | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | GC-MS/MS |
| Benzo(b)-fluoranthene | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | < 0.01[(a)] | GC-MS/MS |
| **Process contaminants** | | | | | | |
| Glycidyl fatty esters, expressed as glycidol (μg/kg) | < 100[(a)] | < 100[(a)] | < 100[(a)] | < 100[(a)] | < 100[(a)] | GC-MS/MS |
| Sum of 3-MCPD and 3-MCPD fatty esters, expressed as 3-MCPD (μg/kg) | < 100[(a)] | < 100[(a)] | < 100[(a)] | < 100[(a)] | < 100[(a)] | GC-MS |

Abs: absent; MCPD: monochloro-propanol-1,2-diol; PCB: polychlorinated biphenyls; ND: not determined.
(a): LOQ: limit of quantification.
(b): LOD: limit of detection.
(c): The number of the method is missing.

**Table 2:** Batch to batch analysis of the NF (prior to the addition of sunflower oil)

| | PRO/DHA/ 061/18 | PRO/DHA/ 062/18 | PRO/DHA/ 063/18 | PRO/DHA/ 065/18 | PRO/DHA/ 067/18 |
|---|---|---|---|---|---|
| **Acid value (mg KOH/g)** | 0.06 | 0.05 | 0.14 | 0.08 | 0.06 |
| **Peroxide value (meq/kg)** | 0.77 | 0.55 | 0.88 | 0.65 | 0.69 |
| **Moisture and volatiles (%)** | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 |
| **Unsaponifiables (%)** | 1.66 | 1.69 | 1.75 | 1.72 | 1.77 |
| **Trans fatty acids** | Not detected | Not detected | Not detected | Not detected | Not detected |
| **DHA content (mg/g)** | 477.4 | 435.5 | 430.5 | 445.4 | 448.8 |

### 3.4.1. Stability

**Stability of the NF**

The applicant provided stability studies with three batches of the NF stored at −30°C and at 4°C up to 18 months and at 25°C and at 60% RH up to 6 months. The applicant also provided a stability report for one batch of the NF stored at −20°C up to 36 months and at 4°C up to 24 months. Acid values, peroxide values and DHA contents were within the limits set in the current specifications at each sampling time point.

Noting that the p-anisidine value in the batch analysis ranged from 11.2 to 19.7 (Table 2), EFSA requested the applicant to address the potential secondary oxidation that may occur during storage and thus requested to test the NF for p-anisidine. The applicant provided a report on the stability of one batch of the NF on p-anisidine value, peroxide and acid values and DHA content over a period of 18 months at −20°C and at 4°C. P-anisidine values increased from 8.2 (t = 0) up to 10.1 (t = 18 months) in both storage conditions. Peroxide, acid values and DHA content remained within the limits defined by the current specifications.

Based on the stability studies provided, the applicant proposed a shelf-life for the NF of 36 months from the date of manufacture, to be stored at −20°C, under nitrogen atmosphere. The Panel considers that the stability data provide sufficient information with respect to the stability of the NF up to 24 months under the proposed storage conditions.

**Stability of the NF ingredient under the intended conditions of use (i.e. when the NF is powdered to be incorporated into IF and FOF)**

According to the conditions of use proposed by the applicant, the NF is intended to be incorporated into IF and FOF. The NF is microencapsulated into a powder form before being incorporated into IF and FOF. During the assessment, EFSA requested information on the stability of the NF when undergoing the process of powdering and the storage of the powder.

The applicant provided a report on stability of two batches of the NF, which underwent microencapsulation. The batches were tested for p-anisidine value, peroxide value, free fatty acids and DHA content over 6 months at 25°C and over 18 months at 5°C. When stored at 25°C up to 6 months, p-anisidine values increased from 9.7 (t = 0) to 9.9 (t = 6 months) in one batch and from 8.0 (t = 0) to 9.8 (t = 6 months) in the second batch. When stored at 5°C up to 18 months, p-anisidine values increased from 9.7 (t = 0) to 10.2 (t = 18 months) in one batch and from 8.0 (t = 0) to 9.4 (t = 18 months) in the other batch. Peroxide and DHA content comply with the current specifications. Instead of acid values, the applicant measured free fatty acids (which ranged from 0.30 to 0.40 in the first batch and from 0.11 to 0.20 in the second batch) under both testing conditions. Moisture was around 3% in both batches.

The Panel considers that the data provided sufficient information with respect to the stability of the NF.

## 3.5. Specifications

**Current specifications of the 'Schizochytrium sp. oil' in the Union list**

*Schizochytrium* sp. oil is authorised as an NF (Section 3.6.2). The specifications for *Schizochytrium* sp. oil in the Union list are presented in Table 3. According to the data submitted in the present application, which is an extension of use of *Schizochytrium* sp. oil, the NF under assessment complies with the current authorised specifications for *Schizochytrium* sp. oil (Table 3).

**Table 3:** Specifications of *Schizochytrium* sp. oil in the Union list and comparison with the NF under assessment

| Parameter | Specification for *Schizochytrium* sp. oil (union list) | NF under assessment (based on batch to batch analysis – Table 2 – pure algal oil before addition of sunflower oil) | NF under assessment (based on batch to batch analysis – Table 1 – algal oil after addition of sunflower oil) |
|---|---|---|---|
| Acid value (mg KOH/g) | ≤ 0.5 | 0.14 (max) | 0.14 (max) |
| Peroxide value ($m_{eq}$/kg oil) | ≤ 5.0 | 0.88 (max) | 0.81 (max) |
| Moisture and volatile (%) | ≤ 0.05 | 0.03 (max) | 0.03 (max) |
| Unsaponifiables (%) | ≤ 4.5 | 1.77 (max) | 1.68 (max) |
| Trans-fatty acids (%) | ≤ 1.0 | Not detected | < 0.004 (LOD) |
| DHA-content (%) | ≥ 32.0 | 43.0–47.7 | 40.7–43.2 |

LOD: Limit of Detection.

**Discussion on additional specifications assessed in the present application**

The Panel notes that the p-anisidine value, which allows monitoring the secondary oxidation of oils, has not been considered on the Union list for *Schizochytrium* sp. oils. However, secondary oxidation products (such as α,β-unsaturated carbonyl compounds, malonaldehyde) may be of safety concern (Kanner, 2007; Vieira et al., 2017). Therefore, the Panel proposes to add the p-anisidine value in the specifications for *Schizochytrium* sp. oils. Considering the European Pharmacopoeia values defined for cod liver and salmon oils and the compositional data, a maximum limit of 10 could be used for the p-anisidine value in *Schizochytrium* oils.

The Panel notes that in two recently authorised oils from strains of *Schizochytrium limacinum* (strain WZU477 and strain FCC-3204) (Section 3.6.1), the parameter p-anisidine has been listed among the authorised specifications, with a maximum limit of 10.

## 3.6. History of use of the NF and/or of its source

### 3.6.1. History of use of the source

The source of the NF is a microalgae belonging to the genus *Schizochytrium*. Table 4 presents the different entries referring to oils from the genus *Schizochytrium* which are authorised in the Union list.

**Table 4:** Overview of the entries referring to oils from *Schizochytrium* sp. which are authorised in the Union list

| Novel Food | Year of 1st authorisation | Decisions | Remarks |
|---|---|---|---|
| *Schizochytrium* sp. oil | 2003 | Decision 2003/427/EC[(a)] | Authorised to be added to foods but not in IF and FOF |
| *Schizochytrium* sp. oil rich in DHA and EPA | 2012 | Assessed by UK and authorised under Regulation (EC) No. 258/97[(b)] | Authorised to be added to foods but not in IF and FOF |
| *Schizochytrium* sp. (ATCC PTA-9695) oil | 2015 | Decision (EU) 2015/545[(c)] | Authorised use in IF and FOF |
| *Schizochytrium* sp. (T18) oil | 2017 | Assessed by UK and authorised under Regulation (EC) No. 258/97 | Authorised use in IF and FOF |
| Oil from *Schizochytrium limacinum* (strain WZU477) | 2021 | Regulation (EU) 2021/670[(d)] | Authorised use in IF and FOF |
| Oil from *Schizochytrium limacinum* (strain FCC-3204) | 2021 | Regulation (EU) 2021/1326[(e)] | Authorised use in IF and FOF |

(a): Commission Decision 2003/427/EC: Commission Decision of 5 June 2003 authorising the placing on the market of oil rich in DHA (docosahexaenoic acid) from the microalgae *Schizochytrium* sp. as a novel food ingredient under Regulation (EC) No 258/97 of the European Parliament and of the Council; OJ L 144, 16.6.2003, p. 13–14.
(b): Regulation (EC) No 258/97 of the European Parliament and of the Council of 27 January 1997 concerning novel foods and novel food ingredients.
(c): Commission Implementing Decision (EU) 2015/545 of 31 March 2015 authorising the placing on the market of oil from the microalgae Schizochytrium sp. (ATCC PTA-9695) as a novel food ingredient under Regulation (EC) No 258/97 of the European Parliament and of the Council; OJ L 90, 2.4.2015, p. 7–10.
(d): Commission Implementing Regulation (EU) 2021/670 of 23 April 2021 authorising the placing on the market of *Schizochytrium* sp. (WZU477) oil as a novel food under Regulation (EU) 2015/2283 of the European Parliament and of the Council, and amending Commission Implementing Regulation (EU) 2017/2470; OJ L 141, 26.4.2021, p. 14–18.
(e): Commission Implementing Regulation (EU) 2021/1326 of 10 August 2021 authorising the placing on the market of *Schizochytrium* sp. (FCC-3204) oil as a novel food under Regulation (EU) 2015/2283 of the European Parliament and of the Council, and amending Commission Implementing Regulation (EU) 2017/2470. OJ L 288, 11.8.2021, p. 24–27.

This genus has been used as a source of DHA-rich oils since 2003, the year of the first authorisation of the NF DHA-rich oil from *Schizochytrium* sp. The first assessment of DHA-rich oil from *Schizochytrium* sp. involved the strain ATCC 20888 (United Kingdom, 2002). Following two substantial equivalence assessments (FSAI, 2014; ANSES, 2018), two other strains (FCC-1324 and FCC-3204, respectively) were recognised as valid sources to produce DHA-rich oils equivalent to the original NF. On the Union list, the DHA-rich oils produced from these strains are commonly referred to as '*Schizochytrium* sp. oil'. It is noted that these authorisations currently do not cover the use of these oils in IF and FOF.

Other strains belonging to the genus *Schizochytrium* have been also authorised for the production of DHA-rich oils to be used in IF and FOF: *Schizochytrium* sp. ATCC PTA-9695, *Schizochytrium* sp. T18, *Schizochytrium limacinum* WZU477 and *Schizochytrium limacinum* FCC-3204.

### 3.6.2. History of use of the NF

DHA-rich oils from the genus *Schizochytrium* are authorised as NFs in the Union List (Table 4 in Section 3.6.1).

The NF application under assessment is an extension of use for the oil referred to as *Schizochytrium* sp. oil. *Schizochytrium* sp. oil is currently authorised as a food supplement and as a food ingredient in a wide range of food products (e.g. milk-based drinks and similar products intended for young children; processed cereals-based food and baby foods for infants and young children; bakery products; cereal bars; breakfast cereals; fruit and vegetables puree).

Other *Schizochytrium* sp. oils are also present on the Union list: *Schizochytrium* sp. oil rich in DHA and EPA; *Schizochytrium* sp. (ATCC PTA-9695) oil, *Schizochytrium* sp. (T18) oil, *Schizochytrium limacinum* (WZU477) oil and *Schizochytrium limacinum* (FCC-3204) oil. The two strain-specific *Schizochytrium* sp. (ATCC PTA-9695) oil and *Schizochytrium* sp. (T18) oil were authorised for the same food categories as the generic *Schizochytrium* sp. oil plus for the use in IF and FOF. The oils derived from *Schizochytrium limacinum* (WZU477) and *Schizochytrium limacinum* (FCC-3204) have been recently authorised for the use in IF and FOF. These NFs can be used in IF and FOF in accordance with Regulation (EU) 609/2013[6].

## 3.7. Proposed uses and use levels and anticipated intake

### 3.7.1. Target population

The NF is intended to be added in IF and FOF. Consequently, the target population defined by the applicant is infants and young children.

### 3.7.2. Proposed uses and use levels

The NF is intended to be added to IF and FOF. The proposed use levels are in accordance with Regulation (EU) No 609/2013 and its supplementing Regulation (EU) 2016/127[7], which states the

[6] Regulation (EU) No 609/2013 of the European Parliament and of the Council of 12 June 2013 on food intended for infants and young children, food for special medical purposes, and total diet replacement for weight control and repealing Council Directive 92/52/EEC, Commission Directives 96/8/EC, 1999/21/EC, 2006/125/EC and 2006/141/EC, Directive 2009/39/EC of the European Parliament and of the Council and Commission Regulations (EC) No 41/2009 and (EC) No 953/2009 Text with EEA relevance; OJ L 181, 29.6.2013, p. 35–56.
[7] Commission Delegated Regulation (EU) 2016/127 of 25 September 2015 supplementing Regulation (EU) No 609/2013 of the European Parliament and of the Council as regards the specific compositional and information requirements for infant formula and follow-on formula and as regards requirements on information relating to infant and young child feeding

mandatory addition of DHA in IF and FOF at levels ranging between 4.8 and 12 mg/100 kJ (eq. 20–50 mg/100 kcal). Considering a standard energy content of maximum 70 kcal per 100 mL of IF/FOF defined in Regulation (EU) 2016/127, the DHA level in the reconstituted formula is expected to range between 14 and 35 mg DHA/100 mL. Considering a minimum DHA concentration of 320 mg DHA/g in the NF (lowest concentration set in the specifications for *Schizochytrium* sp. oil), the use level for the NF corresponds to 43–109 mg NF/100 mL, to reach the target of 14–35 mg DHA/100 mL.

It should be noted that manufacturers of IF and FOF who may powder the NF and incorporate it into their formulae shall guarantee that the concentration of DHA meets the requirement of the Regulation. This is also the case if other sources of DHA are used in combination with the NF.

#### 3.7.3. Anticipated intake of the NF

As the proposed use levels are in accordance with Regulation (EU) No 609/2013, the intake of DHA for infants and young children fed with IF and FOF supplemented with the NF at the proposed use levels is within the range foreseen by the Regulation.

Four other DHA-rich oils from *Schizochytrium* are currently authorised for use in IF and FOF (Table 4 in Section 3.6.1), with use levels also in accordance with Regulation (EU) No 609/2013. Consequently, the intended use of IF and FOF under assessment for the NF *Schizochytrium* sp. (ATCC 20889) oil is not expected to modify the current daily intake of DHA-rich oil for infants and young children.

### 3.8. Absorption, distribution, metabolism and excretion (ADME)

The applicant did not submit specific ADME data for the NF. Digestion, absorption and metabolism of DHA have been extensively documented in the EFSA Scientific Opinion on Tolerable Upper Intake Level of EPA, DHA and DPA (EFSA NDA Panel, 2012).

### 3.9. Nutritional information

The nutritional content of the NF is provided by the batch to batch analysis. The NF mainly consists of fat in the form of triglycerides. Trans-fatty acids were not detected, and based on the acid value, free FAs are not expected to be of concern. The FA profile reveals that DHA is the predominant compound. DHA is an essential nutrient for infants and children. The essential role of DHA for the development of the nervous system and the retina in infants and young children has been documented in the EFSA Scientific Opinion on nutrient requirements and dietary intakes of infants and young children in the European Union (EFSA NDA Panel, 2013). When used in accordance with the proposed use level, the NF can enrich the composition of IF and FOF to such extent that the DHA falls within the range targeted by the current Regulation (20–50 mg DHA/100 kcal).

The concentration of sterols in the NF ranges between 3,076 and 4,974 mg/kg and corresponds to 0.0033–0.0054 mg/mL in IF and FOF containing the maximum amount of the NF (109 mg NF/100 mL). The concentration of sterols in IF and FOF containing the NF is below the concentration of sterols reported in marketed IF and FOF (total animal sterols: 0.017–0.054 mg/mL; total plant sterols: 0.03–0.05 mg/mL reported by Claumarchirant et al., 2015; total sterols: 0.09–0.15 mg/mL reported by Hamdan et al., 2018).

The analysis of the FA profile of the NF shows the presence of other components that might affect the overall ratio of FA in IF and FOF. However, it falls under the responsibility of the manufacturers to guarantee that the overall ratio of FA complies with the current regulations.

The Panel considers that, taking into account the composition of the NF and the proposed conditions of use, consumption of the NF is not nutritionally disadvantageous.

#### 3.9.1. Toxicological information

No toxicity studies that were conducted with the NF under assessment (oil produced from strain ATCC-20889 of *Schizochytrium* sp.) have been provided by the applicant.

During the assessment, owing to the lack of data demonstrating to which species the strain *Schizochytrium* sp. ATCC 20889 belongs, and hence the ineligibility to be included in the Qualified Presumption of Safety (QPS) list, EFSA requested the applicant to provide toxicological studies with the NF. In reply, the applicant did not provide toxicological studies with the NF but pursued the intention to demonstrate that the strain *Schizochytrium* sp. ATCC 20889 belongs to the species *S. limacinum*, which has a QPS status. As presented in Section 3.2, the additional analysis performed by the

applicant is not sufficient to demonstrate to which species the strain *Schizochytrium* sp. ATCC 20889 belongs.

Based on the batch analysis of the NF, marine biotoxins (including cyanotoxins) tested were below their LOQ (Section 3.4). However, since it is unknown to which species the strain *Schizochytrium* sp. ATCC 20889 belongs, the concern that the strain *Schizochytrium* sp. ATCC 20889 has the potential to produce other toxins remains.

The Panel notes that toxicological studies with DHA-rich algal oils produced from different strains of *Schizochytrium* sp. are available and have previously been evaluated by Competent National Authorities in former authorisation frameworks. However, the Panel considers that toxicological studies with DHA-rich algal oils produced from other strains of *Schizochytrium* sp. cannot be used to establish the safety of the oil produced by the strain which is under assessment in this application (*Schizochytrium* sp. ATCC 20889).

### 3.9.2. Allergenicity

In the analysis of five batches of the NF, the protein content was below the LOQ (0.625%). The Panel considers that the NF is unlikely to trigger adverse allergic reactions in the general population or subgroups thereof under the proposed conditions of use.

## 4. Discussion

The NF, which is the subject of the application, is a DHA-rich oil derived from *Schizochytrium* sp. ATCC 20889. The applicant intends to market the NF as an ingredient in IF and FOF at use levels in accordance with Regulation (EU) No 609/2013.

The evidence provided by the applicant does not demonstrate which species the strain *Schizochytrium* sp. ATCC 20889 belongs to. As the source organism of the NF is not characterised at species level, no assessment for a QPS qualification can be performed by the EFSA Panel on BIOHAZ. The batch analysis on the NF indicated that marine biotoxins (including cyanotoxins) tested were below their LOQ. However, since it is unknown to which species the strain *Schizochytrium* sp. ATCC 20889 belongs, the concern that the strain *Schizochytrium* sp. ATCC 20889 has the potential to produce other toxins remains.

No toxicological studies with the NF were provided by the applicant. Toxicological studies are available with DHA-rich algal oils produced from other strains of *Schizochytrium* sp. However, the Panel considers that those toxicological studies cannot be used to establish the safety of the oil produced by the strain which is under assessment in this application (*Schizochytrium* sp. ATCC 20889).

Therefore, based on the information provided by the applicant, the Panel cannot conclude on the safety of the NF.

## 5. Conclusions

The Panel concludes that the safety of the NF, i.e. *Schizochytrium* sp. oil (produced from the strain ATCC-20889), has not been established.

## 6. Steps taken by EFSA

1) On 15/10/2019, EFSA received a letter from the European Commission with the request for a scientific opinion on the safety of *Schizochytrium* sp. oil Ref. Ares(2019)6404581.
2) On 15/10/2019, a valid application on the safety of *Schizochytrium* sp. oil, which was submitted by BIOPLUS LIFE SCIENCES (India), was made available to EFSA by the European Commission through the Commission e-submission portal (NF 2019/1213) and the scientific evaluation procedure was initiated.
3) On 20/1/2020, 11/12/2020 and 22/4/2021, EFSA requested the applicant to provide additional information to accompany the application and the scientific evaluation was suspended.
4) On 1/7/2020, 18/2/2021 and 7/9/2021, additional information was provided by the applicant through the Commission e-submission portal and the scientific evaluation was restarted.
5) During its meeting on 16 December 2021, the NDA Panel, having evaluated the data, adopted a scientific opinion on the safety of oil from the microalgae *Schizochytrium* sp. (strain ATCC-20889) as an NF pursuant to Regulation (EU) 2015/2283.

## References

ANSES [Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail (French Agency for Food, Environmental and Occupational Health and Safety)], 2018. Avis de l'Agence nationale de sécurité alimentaire de l'alimentation, de l'environnement et du travail relatif à une demande d'autorisation de mise sur le marché d'un nouvel aliment ou ingrédient alimentaire: huile riche en DHA issue du Schizochytrium sp. Mai, 2018.

Claumarchirant L, Matencio E, Sanchez-Siles LM, Amparo Alegría A and Lagarda MJ, 2015. Sterol composition in infant formulas and estimated intake. Journal of Agricultural and Food Chemistry, 63, 7245–7251.

EFSA NDA Panel (EFSA Panel on Dietetic Products, Nutrition and Allergies), 2010. Scientific Opinion on Dietary Reference Values for fats, including saturated fatty acids, polyunsaturated fatty acids, monounsaturated fatty acids, trans fatty acids, and cholesterol. EFSA Journal 2010;8(3):1461, 107 pp. https://doi.org/10.2903/j.efsa.2010.1461

EFSA NDA Panel (EFSA Panel on Dietetic Products, Nutrition and Allergies), 2012. Scientific Opinion related to the Tolerable Upper Intake Level of eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and docosapentaenoic acid (DPA). EFSA Journal 2012;10(7):2815, 48 pp. https://doi.org/10.2903/j.efsa.2012.2815

EFSA NDA Panel (EFSA Panel on Dietetic Products, Nutrition and Allergies), 2013. Scientific Opinion on nutrient requirements and dietary intakes of and young children the European Union. EFSA Journal 2013;11(10):3408, 103 pp. https://doi.org/10.2903/j.efsa.2013.3408

EFSA NDA Panel (EFSA Panel on Dietetic Products, Nutrition and Allergies), 2014. Scientific Opinion on the essential composition of infant and follow-on formulae. EFSA Journal 2014;12(7):3760, 106 pp. https://doi.org/10.2903/j.efsa.2014.3760

EFSA NDA Panel (EFSA Panel on Dietetic Products, Nutrition and Allergies), 2016. Guidance on the preparation and presentation of an application for authorisation of a novel food in the context of Regulation (EU) 2015/2283. EFSA Journal 2016;14(11):4594, 24 pp. https://doi.org/10.2903/j.efsa.2016.4594

FSAI (Food Safety Authority of Ireland), 2014. Substantial Equivalence Opinion DHA-Rich Algal Oil. Available online: https://www.fsai.ie/uploadedFiles/Science_and_Health/Novel_Foods/Notifications/Fermentalg%20DHA%20rich%20oil.pdf

Hamdan IJA, Sanchez-Siles LM, Garcia-Llatas G and Lagarda MJ, 2018. Sterols in infant formulas: a bioaccessibility study. Journal of Agricultural and Food Chemistry, 66, 1377–1385.

Jakobsen AN, Aase IM and Strom AR, 2007. Endogenously synthesized (-)-proto-quercitol and glycine betaine are principal compatible solutes of *Schizochytrium* sp. Strain S8 (ATCC 20889) and three new isolates of phylogenetically related thraustochytrids. Applied and Environmental Microbiology, 73, 5848–5856.

Kanner J, 2007. Dietary advanced lipid oxidation endproducts are risk factors to human health. Molecular Nutritional Food and Research, 51, 1094–1101.

United Kingdom, 2002. Opinion on an application under the Novel Food Regulation from OmegaTech for clearance of DHA GoldTM, a DHA rich oil. Available online: https://webarchive.nationalarchives.gov.uk/20200405232644/https://acnfp.food.gov.uk/assess/fullapplics/60694

Vieira SA, Zhang G and Decker EA, 2017. Biological implications of lipid oxidation products. Journal of the American Oil Chemists Society, 94, 339–351.

Yokohama R and Honda D, 2007. Taxonomic rearrangement of the genus *Schizochytrium* sensu lato based on morphology, chemotaxonomic characteristics, and 18S rRNA gene phylogeny (*Thraustochytriaceae*, *Labyrinthulomycetes*): emendation for *Schizochytrium* and erection of *Aurantiochytrium* gen. nov. Mycoscience, 48, 199–211.

## Abbreviations

| | |
|---|---|
| ADME | absorption, distribution, metabolism and excretion |
| AI | adequate intake |
| ATCC | American Type Culture Collection |
| BIOHAZ | Panel on Biohazards |
| CFU | colony forming unit |
| DHA | docosahexaenoic acid |
| DPA | docosapentaenoic acid |
| EPA | eicosapentaenoic acid |
| FA | fatty acids |
| FOF | follow-on formula |
| GMP | Good Manufacturing Practice |
| HACCP | Hazard Analysis Critical Control Point |
| IF | infant formula |
| LOQ | limit of quantification |

| | |
|---|---|
| MCPD | monochloro-propanol-1,2-diol |
| ML | maximum level |
| NCBI | National Center for Biotechnology Information |
| NDA | Panel on Nutrition, Novel Foods and Food Allergens |
| NF | novel food |
| PCB | polychlorinated biphenyls |
| PUFA | polyunsaturated fatty acids |
| QPS | qualified presumption of safety |
| RH | relative humidity |
| rRNA | ribosomal ribonucleic acid |
| UK | United Kingdom |