Givaudan
Human by nature

April 27, 2022

Dr. Paulette Gaynor
Office of Food Additive Safety (HFS-200)
Center for Food Safety and Applied Nutrition
Food and Drug Administration
5001 Campus Drive
College Park, MD
20740-3835

Dear Dr. Gaynor

RE: GRAS Exemption Claim for Oat Oil PL40

In accordance with 21 CFR §170.225(c)(1) [Notice of a claim for exemption based on a Generally Recognized as Safe (GRAS) determination] published in the *Federal Register* [81 FR 54960 (17 August 2016], I am submitting one hard copy and one electronic copy (on USB), as the notifier [Naturex (Part of Givaudan), Kemptpark 50, 8310 Kemptthal, Switzerland], a Notice of the evaluation, on the basis of scientific procedures, that Oat Oil PL40, as defined in the enclosed documents and manufactured according to current Good Manufacturing Practices, is GRAS under specific conditions of use as an ingredient in food and beverages, and therefore, is exempt from the premarket approval requirements of the *Federal Food, Drug, and Cosmetic Act*. Information setting forth the basis for the GRAS evaluation, which includes detailed information on the notified substance and a summary of the basis for GRAS status, as well as a consensus opinion of an independent panel of experts in support of the safety of oat oil PL40 under the intended conditions of use, also are enclosed.

The enclosed electronic files for the Notice entitled, "GRAS Notice for Oat Oil PL40" were scanned for viruses prior to submission and are thus certified as being virus-free using Symantec Endpoint Protection version 12.1.5.

Should you have any questions or concerns regarding this GRAS Notice, please do not hesitate to contact me at any point during the review process so that we may provide a response in a timely manner.

Yours sincerely

[redacted]

Severin Mueller
Global Head Scientific Affairs
Naturex
Givaudan International SA,
Kemptpark 50, 8310 Kemptthal,
Switzerland
Encl.

GRAS NOTICE FOR OAT OIL PL40

SUBMITTED TO:
Office of Food Additive Safety (HFS-200)
Center for Food Safety and Applied Nutrition (CFSAN)
Food and Drug Administration
5001 Campus Drive
College Park, MD
20740 USA

SUBMITTED BY:
Naturex
Givaudan International SA,
Kemptpark 50, 8310
Kemptthal, Switzerland

DATE:
26 April 2022

GRAS Notice for Oat Oil PL40

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GRAS Notice for Oat Oil PL40

Part 1. §170.225 Signed Statements and Certification

In accordance with Title 21 of the *Code of Federal Regulations* (CFR), Part 170, Subpart E consisting of §170.203 through §170.285 (U.S. FDA, 2021), Naturex (Part of Givaudan) hereby informs the United States (U.S.) Food and Drug Administration (FDA) that the intended uses of Oat Oil PL40 (oat polar lipids), as manufactured by Naturex, in various conventional food and beverage products as described in Section 1.3 below, are not subject to the premarket approval requirements of the Federal Food, Drug, and Cosmetic Act based on Naturex's view that these notified uses of Oat Oil PL40 are Generally Recognized as Safe (GRAS). In addition, as a responsible official of Naturex, the undersigned hereby certifies that all data and information presented in this notice represent a complete and balanced submission that is representative of the generally available literature. Naturex considered all unfavorable, as well as favorable, information that is publicly available and/or known to Naturex and that is pertinent to the evaluation of the safety and GRAS status of Oat Oil PL40 as a food ingredient for addition to food and beverage products as described herein.

Signed,

27 April 2022

Severin Mueller
Global Head Scientific Affairs
Naturex (Part of Givaudan)

Date

1.1 Name and Address of Notifier

Severin Mueller
Naturex
Givaudan International SA,
Kemptpark 50, 8310 Kemptthal,
Switzerland

Telephone: +41523540541
Email: severin.mueller@givaudan.com

1.2 Common Name of Notified Substance

Oat polar lipids; oat oil; oat lipid extract; oat polar lipid extract; SWEOAT© Oil PL40; vegetable oil (oat)

1.3 Conditions of Use

Naturex intends to market Oat Oil PL40 (oat polar lipids) as a vegetable oil that will be a source of oat phospholipids and/or as an emulsifier. Oat Oil PL40 may be used as a partial substitute or in addition to other fats and oils within food, up to its intended level of use in that product (see Table 1.3-1).

In addition to the use levels of Oat Oil PL40 in chocolate, which are dictated by the standard of identity, a summary of the food categories and use levels in which Oat Oil PL40 is intended for use is provided in Table 1.3-1 below. Food uses are organized according to 21 CFR §170.3 (U.S. FDA, 2021).

Table 1.3-1 Summary of the Individual Proposed Food Uses and Use Levels for Oat Oil PL40 in the U.S.

Food Category (21 CFR §170.3) (U.S. FDA, 2021)	Food Uses	RACC[a] (g or mL)	Oat Oil Use Levels (g/100 g)
Baked Goods and Baking Mixes	Cakes		
	Heavy weight cakes	125	1.0
	Medium weight cakes	80	1.0
	Light weight cakes	55	1.0
	Muffins	110	1.0
	Biscuits	55	1.0
Beverages and Beverage Bases	Non-Milk-Based Meal Replacement Beverages	240	2.0
Dairy Product Analogs	Coffee/Tea Whiteners[b]	15	3.0
Fats and Oils	Margarine and Margarine-Like Spreads	15 (or 1 tbsp)	1.0
Nuts and nut products	Nut spreads	30 (or 2 tbsp)	2.0
Soft Candy	Chocolate[c]	30	1.0
	White chocolate[c]	30	1.5

CFR = *Code of Federal Regulations*; RACC = Reference Amounts Customarily Consumed per Eating Occasion; U.S. = United States.
[a] RACC based on values established in 21 CFR §101.12 (U.S. FDA, 2021). RACCs are included for reference; however, the assessment was conducted based on use levels expressed per liter.
[b] No RACC available; RACC for cream included as a surrogate.
[c] In standardized chocolate, oat oil is intended to be used only as an emulsifier due to the limitations on the types of optional additives permitted under Title 21 §163 of the CFR (U.S. FDA, 2021). In sweet chocolate, milk chocolate, buttermilk chocolate, skim milk chocolate, and mixed dairy products, the total combined emulsifying agent content may not exceed 1.0% by weight (U.S. FDA, 2021). Additionally, emulsifying agents may not exceed a total of 1.5% by weight in white chocolate (U.S. FDA, 2021). Oat Oil PL40 is not intended to be used under the U.S. standard of identity for chocolate for any purpose outside of emulsification.

1.4 Basis for GRAS

Pursuant to 21 CFR §170.30 (a)(b) (U.S. FDA, 2021), Naturex has concluded that the intended uses of Oat Oil PL40 (oat polar lipids) as described in Section 1.3 are GRAS on the basis of scientific procedures.

1.5 Availability of Information

The data and information that serve as the basis for this GRAS Notice will be sent to the FDA upon request, or will be available for review and copying at reasonable times at the offices of:

Naturex
Givaudan International SA,
Kemptpark 50, 8310 Kemptthal, Switzerland

Should the FDA have any questions or additional information requests regarding this Notice, Naturex will supply these data and information upon request.

1.6 Freedom of Information Act, 5 U.S.C. 552

It is Naturex's view that all data and information presented in Parts 2 through 7 of this Notice do not contain any trade secret, commercial, or financial information that is privileged or confidential, and therefore, all data and information presented herein are not exempted from the Freedom of Information Act, 5 U.S.C. 552.

Part 2. §170.230 Identity, Method of Manufacture, Specifications, and Physical or Technical Effect

2.1 Identity

The ingredient that is the subject of this GRAS Notice is an extract from food-grade oat grain seeds of the *Avena sativa* (*A. sativa*) plant (*i.e.,* Oat Oil PL40, oat polar lipids). The concentration of total lipid in the oat grain seeds is approximately 8.3%, of which 21% of the oat oil (1.7% of the oat kernel flour on a dry weight basis) is polar lipids (glycolipids and phospholipids) (Doehlert *et al.*, 2010). The oat varieties used in Sweden are cultivated through traditional breeding practices to thrive in the Nordic climate. Oats can be farmed on all types of soil and in Sweden they are planted in the spring for early autumn harvest.

Oat Oil PL40 (Chemical Abstract Services Registry Number 84012-26-0) is a yellow-brown oil with a typical moisture content of 2% or less and an acid value of 30 mg potassium hydroxide (KOH)/g or less. Oat Oil PL40 consists of 2 primary classes of lipids: triglycerides (neutral lipids) and polar lipids, the latter of which is further subdivided into phospholipids (phosphatidylcholine, phosphatidylglycerol, lyso-phosphatidylglycerol, n-acyl phosphatidylethanolamine, phosphatidylethanolamine, di-acyl-phosphatidylglycerol, and phosphatidic acid) and glycolipids [mono- and digalactosyldiacylglycerol (MGDG and DGDG, respectively), diacylglycerol-diacyl phosphatidylglycerol, and sterylglucoside]. All of these lipids are natural constituents of the oat grain and are not modified during manufacturing. Additional information on the identity and composition of Oat Oil PL40 is presented below and in Tables 2.1-1, 2.1-2, 2.1-3, 2.1-4, 2.1-5, and 2.1-6; product specifications are provided in Table 2.3.1-1.

Table 2.1-1 Typical Composition of Oat Oil PL40

Component	Composition (% of Oat Oil PL40)
Total polar lipids	43.9
Phospholipids	24.0
Glycolipids	19.9
Triglycerides	56.1
Total of Oat Oil PL40	100

Based on analysis of representative production lot 40FO-090915.

Fatty Acids

Four representative production lots of Oat Oil PL40 were analyzed by gas chromatography with flame ionization detection (GC-FID; performed by Eurofins Sweden), and the fatty acid profile is presented in Table 2.1-2 below. The fatty acid content of Oat Oil PL40 is primarily comprised of palmitic (*ca.* 17%), oleic (*ca.* 36%), and linoleic acids (*ca.* 41%).

Table 2.1-2 Fatty Acid Profile of Oat Oil PL40

Fatty Acid (as % of total Fatty Acids)	Oat Oil PL40 Batch No.				Average	Standard Deviation
	PL40-FG 40FG-210915	PL40FG -QI012L40_I118/004/A20	PL40FG konv_QI012L40_I126/001/A21	PL40FG_QI012L40_I350/005/A20		
C 6:0 Caproic acid	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 8:0 Caprylic acid	<0.1	<0.1	<0.1	<0.1	<0.1	0

Table 2.1-2 Fatty Acid Profile of Oat Oil PL40

Fatty Acid (as % of total Fatty Acids)	Oat Oil PL40 Batch No.				Average	Standard Deviation
	PL40-FG 40FG-210915	PL40FG -QI012L40_I118/004/A20	PL40FG konv_QI012L40_I126/001/A21	PL40FG_QI012L40_I350/005/A20		
C 10:0 Capric acid	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 12:0 Lauric acid	<0.1	<0.1	<0.1	<0.1	<0.1	0
C14:0 Myristic acid	0.2	0.2	0.2	0.2	0.2	0
C 14:1 Myristoleic acid	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 15:0 Pentadecanoic acid	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 15:1 n-5	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 16:0 Palmitic acid	16.9	17.2	16.4	17.1	16.9	0.4
C 16:1 n-7 Palmitoleic acid	0.2	0.2	0.2	0.2	0.2	0
C 17:0 Margaric acid	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 17:1 n-7 Heptadecenoic acid	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 18:0 Stearic acid	1.7	1.4	1.5	1.6	1.6	0.1
C 18:1 n-9 Oleic acid	37.7	35.4	36.5	34.8	36.1	1.3
C 18:2 n-6 Linoleic acid	38.4	41.4	41.4	41.2	40.6	1.5
C 18:3 n-3 *alpha*-Linolenic acid	1.3	1.5	1.4	1.5	1.4	0.1
C 18:3 n-6 *gamma*-Linolenic acid	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 18:4 n-3 Octadecatetraenoic acid	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 20:0 Arachidic acid	0.1	0.1	0.1	0.1	0.1	0
C 20:1 n-9 Gadoleic acid	0.6	0.6	0.6	0.7	0.6	0.1
C 20:2 n-6 Eicosadien acid	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 20:3 n-6	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 20:3 n-3	<0.1	<0.1	<0.1		<0.1	0
C 20:4 n-6 Arachidonic acid	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 20:4 n-3	<0.1	<0.1	<0.1		<0.1	0
C 20:5 n-3 Eicosapentaenoic acid	<0.1	<0.1	<0.1	0.2	0.1	0.1
C 22:0 Behenic acid	<0.1	0.1	<0.1	0.1	0.1	0
C 22:1	0.2	0.4	0.2	<0.1	0.2	0.1
C 22:2 n-6 Docosadienoic acid	0.1	<0.1	<0.1	<0.1	<0.1	0
C 22:4 n-6	<0.1	<0.1	<0.1		<0.1	0
C 22:5 n-6	<0.1	<0.1	<0.1	<0.1	<0.1	0
C 22:5 n-3 Docosapentaenoic acid	<0.1	<0.1	<0.1		<0.1	0
C 22:6 n-3 Docosahexaenoic acid	<0.1	<0.1	0.1	<0.1	0.1	0
C 24:0 Lignoceric acid	<0.1	0.1	<0.1	<0.1	0.1	0
C 24:1 n-9 Tetracosenoic acid	<0.1	<0.1	0.2	<0.1	0.1	0.1

Table 2.1-2 Fatty Acid Profile of Oat Oil PL40

Fatty Acid (as % of total Fatty Acids)	Oat Oil PL40 Batch No.				Average	Standard Deviation
	PL40-FG 40FG-210915	PL40FG -QI012L40 _I118/004/A20	PL40FG konv _ QI012L40_ I126/001/A21	PL40FG_ QI012L40_ I350/005/A20		
Saturated fatty acids	**19.2**	**19.3**	**18.3**	**19.3**	19.0	0.5
Mono-unsaturated fatty acids	**38.7**	**36.7**	**37.8**	**36.7**	37.5	1.0
Polyunsaturated fatty acids	**39.9**	**42.9**	**43.0**	**43.0**	42.2	1.5
Total fatty acids	**97.7**	**98.9**	**99.1**	**98.0**	98.4	0.7
Unidentified compounds	**2.3**	**1.1**	**0.9**	**0.9**	1.3	0.7
Sum of *omega*-6 fatty acids	38.5	41.4	41.5	41.2	40.7	1.4
Sum of *omega*-3 fatty acids	1.3	1.5	1.5	1.7	1.5	0.2
omega-6:*omega*-3 ratio	29.13	26.86	27.44	24.2	26.9	2.0
Trans fatty acids	NA	0.2	0.2	0.2	0.2	0

NA = not assessed
Analyzed by gas chromatography with flame ionization detection.

Natural lipid sources have some trans fatty acids in low concentrations. Trans fatty acids are formed by using hydrogen or acids and bases during the manufacture of the final product. Oat Oil PL40 is manufactured using only food-grade ethanol and water as solvents; no hydrogen, acids, or bases are used. Trans fatty acids are therefore not created during the production of Oat Oil PL40. The concentration of trans fatty acids in Oat Oil PL40 was determined to be 0.2% of total fatty acids based on analysis of 3 production lots (see Table 2.1-2).

The major fatty acid constituents of Oat Oil PL40 are presented below in comparison with the corresponding fatty acid content of soy lecithin, a substance with similar uses to those proposed for Oat Oil PL40 in foods (Table 2.1-3). The 2 substances contain comparable amounts of palmitic acid, while Oat Oil PL40 contains higher levels of oleic acid and monounsaturated fatty acids (MUFAs), and lower levels of linoleic acid, saturated fatty acids (SFAs), and polyunsaturated fatty acids (PUFAs).

Table 2.1-3 Fatty Acid Profile of Oat Oil PL40 and Soy Lecithin

Fatty Acid (as % of total fatty acids)	Oat Oil PL40[a] (%)	Soy Lecithin[b] (%)
C 16:0 Palmitic acid	17.17	17.46
C 18:1 n-9 Oleic acid	36.68	16.91
C 18:2 n-6 Linoleic acid	41.25	54.83
Saturated fatty acids	19.33	22.88
Mono-unsaturated fatty acids	38.07	17.76
Polyunsaturated fatty acids	42.88	59.36

[a] Average values calculated from 4 production lots presented in Table 2.1-2.
[b] Average values calculated from Thornton *et al.* (1944); Fernandes *et al.* (2012); Butina *et al.* (2017).

Phospholipids

An analysis was conducted by an external laboratory using an in-house method designated (LS-W-01) to determine the amounts of phospholipids and glycolipids in Oat Oil PL40. Briefly, neutral lipids and polar lipids in a sample of Oat Oil PL40 (Lot No. 40FO-090915) were separated using a silica column and then the polar lipids were determined gravimetrically. The sample contained a total polar lipid content of 43.9%. The composition of the lipid mixture was further characterized using normal-phase high-performance liquid chromatography (HPLC) with nuclear magnetic resonance (NMR) detection. The peaks of the chromatogram were identified using an in-house database developed based on previous determinations. The amounts of the individual phospholipid peaks were determined and summed to estimate the phospholipid content which was 24.0% for this batch of Oat Oil PL40. The remaining 19.9% of the polar lipids was calculated as the glycolipid fraction. The phospholipid profile, expressed both as a percentage of the total polar lipids and as a percentage of the Oat Oil PL40, is summarized and presented in Table 2.1-4.

Table 2.1-4 Typical Phospholipid Profile of Oat Oil PL40

Phospholipid	Oat Oil PL40 Representative Batch Results (40FO-090915)		
	Concentration as % of Total Phospholipids[a]	Concentration as % of Total Polar Lipids[b]	Concentration as % of Oat Oil PL40[c]
PC	32.2	17.6	7.7
PE	2.9	1.6	0.7
PA	2.6	1.4	0.6
PG	21.0	11.5	5.0
PI	0	0	0
PS	0	0	0
Lyso-PC	0	0	0
Lyso-PE	0	0	0
Lyso-PA	0	0	0
Lyso-PG	18.0	9.8	4.3
Lyso-PI	0	0	0
Lyso-PS	0	0	0
n-acyl-PE	15.7	8.6	3.8
Acyl-PG	5.1	2.8	1.2
Di-acyl-PG	2.6	1.4	0.6
Total Phospholipids	**100**	**54.7**	**24.0**

PA = phosphatic acid; PC = phosphatidylcholine; PE = phosphatidylethanolamine; PG = phosphatidylglycerol; PI = phosphatidylinositol; PS = phosphatidylserine.

[a] Analyzed by high-performance liquid chromatography with nuclear magnetic resonance detection.

[b] The concentration of the individual phospholipids in the polar lipid fraction was calculated using the concentration of phospholipids in the polar lipid fraction (24.0%/43.9% = 54.7%)

[c] The concentration of the individual phospholipids in Oat Oil PL40 was calculated using the concentration of the phospholipids in Oat Oil PL40 (24.0%)

Glycolipids

The unique glycolipids found in oats are difficult to measure; however, the United States Department of Agriculture (USDA) has published a report detailing the polar lipid profiles of various oat kernels and includes the measurement of glycolipids (Doehlert *et al.,* 2010). Samples of extracts from 18 varieties of oat were analyzed using HPLC with evaporative light scattering detection to quantify the amounts of 6 classes of glycolipids common in oat kernels. The mean values obtained for each glycolipid class are presented in

Table 2.1-5. Digalactosyldiacylglycerol and its estolides represent the main glycolipid in oats and comprise 77.4% of the total glycolipids. Considering that the manufacturing process for Oat Oil PL40 (see Section 2.2) will not modify the polar lipid profile but will only change the ratio of polar lipids to neutral lipids, the data presented by the USDA provides a representative summary of the glycolipid content in Naturex's product.

Table 2.1-5 Glycolipid Profile of Oat Extract (Comparable to Oat Oil PL40)

Glycolipid	Mean Concentration in Kernel Flour Extracts of 18 Varieties of Oat, Determined by HPLC-ELSD (Doehlert *et al.*, 2010)		Representative Concentration in Oat Oil PL40	
	mg of lipid/100 g flour	% of Total Glycolipids [a]	% of Total Polar Lipids [b]	% of Oat Oil PL40 [c]
ASG	59.4	7.4	3.4	1.5
GC	8	1.0	0.5	0.2
Diacyl-DGDG	38.3	4.8	2.2	1.0
Acyl-DGDG	161	20.2	9.1	4.0
DGDG	418	52.4	23.7	10.4
DGMG	13.9	1.7	0.8	0.4
Diacyl-TriGDG	13.1	1.6	0.7	0.3
Acyl-TriGDG	16.0	2.0	0.9	0.4
TriGDG	59.0	7.4	3.4	1.5
TriGMG	2.5	0.3	0.1	0.1
Acyl-tetraGDG	6.5	0.8	0.4	0.2
TetraGDG	2.4	0.3	0.1	0.1
Total	**798.1**	**100**	**45.3**	**19.9**

ASG = acyl steryl glucoside; DGDG = digalactosyldiacylglycerol; DGMG = digalactosylmonoglycerol; ELSD = evaporative light scattering detection; GC = glucocerebroside; GDG = galactosyldiacylglycerol; GMG = galactosylmonoacylglycerol; HPLC = high-performance liquid chromatography.

[a] The concentration was calculated by dividing the concentration of the individual glycolipid by the concentration of total glycolipids.

[b] The representative concentration of the individual glycolipids in the polar lipid fraction of Oat Oil PL40 was calculated using the concentration of glycolipids in the polar lipid fraction (19.9%/43.9% = 45.3%)

[c] The representative concentration of the individual glycolipids in Oat Oil PL40 was calculated using the concentration of the glycolipids in Oat Oil PL40 (19.9%)

Ceramides and Pigmented Material

In the initial characterization of Oat Oil PL40 using high performance thin layer chromatography, the presence of ceramides and pigmented material was identified at concentrations of 4.0 to 6.0% (ceramides) and 2.7 to 4.0% (pigmented material).

To provide further detail on the ceramide content, samples from 3 additional representative production lots of Oat Oil PL40 (PL40FG-006603-0040, PL40FG-QI012L40, PL40NG-20180108) and 1 sample from oat kernels were analyzed using liquid chromatography with high-resolution mass spectrometry to determine the relative concentrations of ceramides in both substances (Table 2.1-6). The ceramide profiles were comparable between Oat Oil PL40 and oat kernels. There were no ceramides detected in Oat Oil PL40 that were unique to Oat Oil PL40 and not present in oat kernels.

Table 2.1-6 Analysis of Ceramides in 3 Production Lots of Oat Oil PL40

Ceramide	Concentration as % Ratio of total ceramides			
	Oat Oil PL40 Batch No.			Raw Oats (6790-2814)
	PL40FG-0066-03-0040	PL40FG-QI012L40	PL40NG-20180108	
GlcCER-d18:2/16:0	0.10	0.25	0.16	0.21
GlcCER-d18:2/18:0	1.59	1.63	1.43	2.09
GlcCER-d18:1/18:0	0.16	0.34	0.17	0.23
GlcCER-t18:1/20:0	1.08	1.15	1.04	1.35
GlcCER-d18:2/20:0	17.97	17.16	16.89	15.63
GlcCER-d18:1/20:0	2.16	4.37	2.39	2.35
GlcCER-t18:1/22:0	5.95	6.47	5.88	6.29
GlcCER-t18:1/24:1	29.32	26.09	30.69	29.40
CER-d18:1/20:0	0.17	0.36	0.15	0.09
GlcCER-d18:2/22:0	3.42	3.58	3.25	2.96
GlcCER-t18:1/23:0	0.93	1.04	0.97	1.11
CER-t18:1/24:1	2.15	2.40	2.11	1.16
GlcCER-t18:1/24:0	21.87	22.83	21.81	23.65
GlcCER-d18:2/24:0	6.71	6.35	6.47	6.65
CER-t18:1/20:0	2.44	1.89	2.31	3.54
GlcCER-t18:1/26:0	2.34	2.76	2.81	2.28
CER-t18:1/26:0	1.63	1.31	1.47	1.00
Total (as % of total oil)	**100**	**100**	**100**	**100**

CER = ceramide; GlcCER = glucosylceramide.
Note: Analyzed by gas chromatography with flame ionization detection.

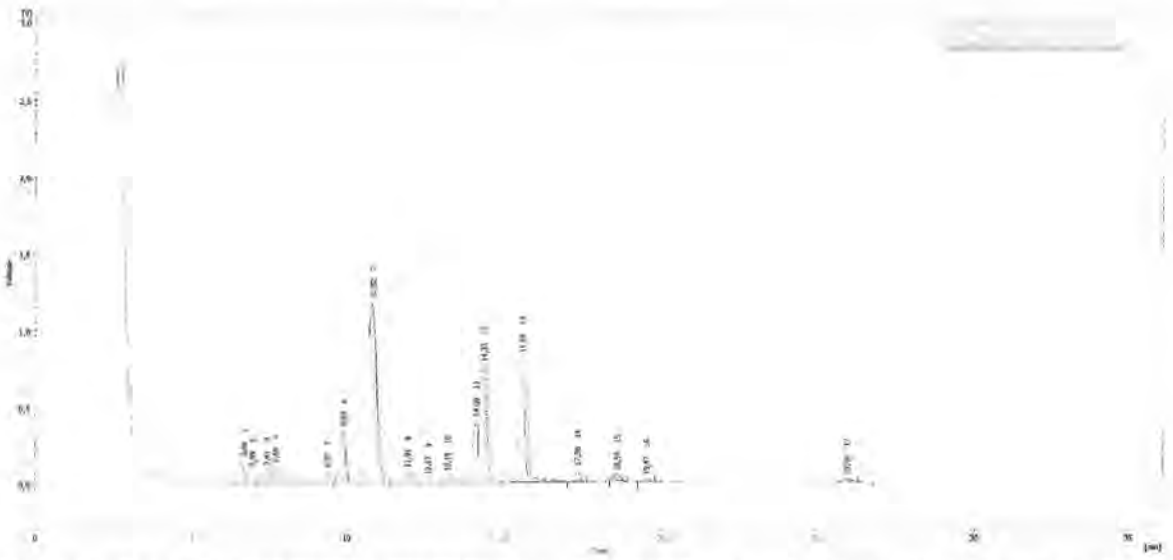
Pigmented materials were characterized using a sample of 1 additional production lot of Oat Oil PL40 (PL40NG-20180108). The sample was partitioned using hexane and methanol:water (95:5). The hexane partition contained color while the methanol/water partition was transparent. The hexane partition was further separated using HPLC with serial elutions of polar and nonpolar solvents. Each fraction was then analyzed using HPLC with mass spectrometry. The study investigators concluded that the color in Oat Oil PL40 is "*mainly due to phenolic compounds (ferulic acid derivatives and avenanthramides) and to a lesser extent polar lipids*". Analysis of oat kernels and Oat Oil PL40 using UV spectrophotometry indicated that the pigmented materials are equally present in the oat kernels and Oat Oil PL40, and were not formed during the manufacture (including extraction) of Oat Oil PL40.

Batch Variability

The consistency in the lipid profile between individual batches of Oat Oil PL40 is further supported using straight phase high performance liquid chromatography to analyse 3 representative production lots of Oat Oil PL40 (I118/004/A20, I350/005/A20, I041/004/A21). Figure 2.1-1 provides an overlay of the 3 chromatograms, each from a different Oat Oil PL40 production lot sample. The samples were not separated and include all lipid classes. The most neutral lipids eluted first as polarity was increased during elution. According to the study investigators, triglycerides, diglycerides, and monoglycerides eluted prior to 5 minutes. The identities of the major peaks are as follows: peak 1 after 5 minutes is sterolglycoside; peak 5 around 7 or 8 minutes is DGDG-2; peak 6 just before 10 minutes is DGDG-1; peak 7 just after 10 minutes is DGDG; and all other peaks were phospholipids. The identity of the individual phospholipids was not

evaluated as the purpose of the analysis was to demonstrate the consistency of the lipid profile between batches of Oat Oil PL40.

Figure 2.1-1 Chromatograms for 3 Representative Production Lots of Oat Oil PL40 Analyzed by High-Performance Liquid Chromatography



The analyzed batches are I118/004/A20, I350/005/A20, and I041/004/A21. The analyses were conducted using straight phase high-performance liquid chromatography eluting the most neutral lipids first and polarity increases during elution.

2.2 Manufacturing

The manufacturing process to produce Oat Oil PL40 is conducted in accordance with the principles of current Good Manufacturing Practices (cGMP), the principles of Hazard Analysis and Critical Control Points (HACCP), and the Food Safety System Certification (FSSC 22000) standard using food-grade ingredients and equipment commonly used in food manufacture.

The production process can be divided into several stages: reception and preparation of the oats; partial extraction; clarification by centrifugation; evaporation; phase separation; and final evaporation. A schematic of the overall manufacturing process is provided in Figure 2.2-1.

Within its FSSC 22000 program, Naturex has a purchasing policy in place, including material specifications. Suppliers are only authorized after auditions confirming appliance to European Union (EU) food standards for oats. The most common (but not sole) oat variety used by Naturex is Belinda, a Swedish spring variety of oats. Naturex may, in the future, produce Oat Oil PL40 in the U.S. using locally sourced oats and would utilize a similar vetting process to ensure that the source material is of an acceptable quality for use in food. Manufacture occurs in Sweden using oats sourced from either Sweden or Finland. Prior to the transport of kernels to the processing facility, they are first heat-treated to reduce the moisture content to 11 to 12% to inactivate endogenous lipases and thereby reduce the development of rancidity during transport. Upon arrival at the production facility, the oats are first checked for quality then milled and sieved. The sieving segregates the kernels into a coarse and fine fraction, and the course, fiber-rich bran fraction is checked for

β-glucan content, moisture, and particle size. Partial fat extraction utilizing ethanol is conducted to obtain oat oil extract. The extract is then clarified by centrifugation and evaporation.

Using water and ethanol as extraction solvents, the oat oil extract is then partitioned to remove a portion of nonpolar lipids and concentrate the polar lipid fraction, which takes place by gravity at room temperature (20°C) in a closed system with minimal oxygen impact.

The phase of the oat extract with the greater polar lipid content (approximately 60% dry matter) is filtered using cartridge polypropylene filters and then clarified/concentrated with a final evaporation step, resulting in Oat Oil PL40 containing a standardized polar lipid content of at least 35%. These gentle chemical and physical processes allow for the oats to be processed without undergoing hydrolysis. The use of ethanol and evaporation to remove moisture reduces potential for microbial growth within the final product.

Figure 2.2-1 Schematic Overview of the Manufacturing Process for Oat Oil PL40

The raw materials used in the manufacture of Oat Oil PL40 are suitable food-grade materials and are used in accordance with applicable U.S. federal regulations.

The final product is imported into the U.S. from Sweden; however, future production of Oat Oil PL40 may occur in the U.S. using food-grade oats sourced from the U.S. In this situation, the production process of Oat Oil PL40 will be similar to that used in the facility in Sweden and the facility will follow appropriate protocols, such as the use of a HACCP plan and compliance with cGMP, to ensure the Oat Oil PL40 is safe for use in food and identical to the substance characterized in this GRAS notice.

2.3 Product Specifications and Batch Analyses

2.3.1 Specifications

The proposed product specifications for Oat Oil PL40 are provided in Table 2.3.1-1 along with the method of analysis for each parameter. The methods employed are either internationally recognized or in cases of internal methods of analysis, they have been confirmed to be suitable and/or validated for the intended use. Impurities from oat farming, harvesting, and storage (*i.e.*, pesticides and mycotoxins) are effectively controlled by the farms and associated facilities as part of the task of producing "food-grade" oats. Furthermore, concentration of deoxynivalenol in Oat Oil PL40 is unlikely to occur due to this mycotoxin being water-soluble and unlikely to dissociate into the lipid fraction during manufacture.

Table 2.3.1-1 Specifications for Oat Oil PL40

Specification Parameter	Specification	Method
Description	Oat cereal taste	Sensorial
	Oil with a yellowish-brown color	Visual
Identification		

Table 2.3.1-1 Specifications for Oat Oil PL40

Specification Parameter	Specification	Method
Polar lipids (%w/w)	>35	Gravimetrical chromatography; Internal method LS-W-01
Purity		
Loss on drying (%)	<2	Adam PMB 53 moisture analyzer; Internal method LS-W-03
Acid value (mg KOH/g)	<30	Mettler Toledo application, M621-2012
Peroxide value (meq O_2/kg fat)	<10	Mettler Toledo application, M624-2012
Arsenic (mg/kg)	<0.1	NMKL No 161 1998 mod
Lead (mg/kg)	<0.05	NMKL No 161 1998 mod
Mercury (mg/kg)	<0.01	EN 16277:2012; ASU L00.00-19/4 (2003-12), mod
Microbiological		
Aerobic plate count (CFU/g)	<1,000	3M 01/01-09/89
Yeast (CFU/g)	<100	NMKL98, 2005
Molds (CFU/g)	<100	NMKL98, 2005
Enterobacteriaceae (CFU/g)	<10	NMKL Method 144, 2005
Aerobic spores (CFU/g)	<1	BHI Agar-S Eurofins internal method
Salmonella	Not detected in 25 g	NMKL 71
Other		
Cadmium (ppm)	<0.05	NMKL No 161 1998 mod
Residual ethanol (ppm)	<500	GC-FID
Pesticide residues[a]	According to 40 CFR §180[b] (U.S. EPA, 2020)	SLVM917, SLVK1f4m016.1, Eurofins
Deoxynivalenol (µg/kg)[a]	<40	LC-MS/MS; Eurofins internal method

CFR = *Code of Federal Regulations*; CFU = colony-forming units; GC-FID = gas chromatography with flame ionization detector; KOH = potassium hydroxide; LC-MS/MS = liquid chromatography with tandem mass spectrometry; meq = milliequivalent; ppm = parts per million.

[a] Pesticide residues and deoxynivalenol are not measured for every production lot.

[b] 40 CFR §180 – Tolerances and Exemptions for Pesticide Chemical Residues in Food (U.S. EPA, 2020).

2.3.2 Batch Analysis

The results of 4 non-consecutive lots of Oat Oil PL40 shows that the ingredient is manufactured consistent with the proposed chemical specifications and microbiological product specifications (Table 2.3.2-1). Complete certificates of analysis for these 4 lots are provided in Appendix B.

Table 2.3.2-1 Summary of the Product Analysis for 4 Lots of Oat Oil PL40

Parameter	Specification	Manufacturing Lot[a]			
		PL40-2017-0102	PL40-20170106	40FO-071216	40FO-131216
Description	Oat cereal taste/Oil with a yellowish brown color	Complies	Complies	Complies	Complies
Identification					
Polar lipids (%w/w)	>35	44.0	41.9	44.7	42.4
Purity					

Table 2.3.2-1 Summary of the Product Analysis for 4 Lots of Oat Oil PL40

Parameter	Specification	Manufacturing Lot[a]			
		PL40-2017-0102	PL40-20170106	40FO-071216	40FO-131216
Loss on drying (%)	<2	0.333	0.307	0.730	0.235
Acid value (mg KOH/g)	<30	NA Lot I350/005/A20, 16.1	NA Lot I126/001/A21, 10.2	9.8 Lot I118/004/A20, 1.9	NA
Peroxide value (meq O_2/kg fat)	<10	1.78	1.10	0.53	2.45
Arsenic (mg/kg)	<0.1	NA Lot I350/005/A20, <0.05	NA Lot I126/001/A21, <0.05	NA Lot I118/004/A20, <0.05	NA
Lead (mg/kg)	<0.05	<0.04	<0.04	<0.04	<0.04
Mercury (mg/kg)	<0.01	NA Lot I350/005/A20, <0.005	NA Lot I126/001/A21, <0.005	NA Lot I118/004/A20, <0.005	NA
Microbiological					
Aerobic plate count (CFU/g)	<1,000	<3	<3	<3	<3
Yeast (CFU/g)	<100	<2	<2	<2	<2
Molds (CFU/g)	<100	<2	<2	<2	<2
Enterobacteriaceae (CFU/g)	<10	<1	<1	<1	<1
Aerobic spores (CFU/g)	<1	<1	<1	<1	<1
Salmonella	Not detected in 25 g	NA Lot I350/005/A20, Complies	NA Lot I126/001/A21, Complies	NA Lot I118/004/A20, Complies	NA
Other					
Cadmium (ppm)	<0.05	<0.02	<0.02	<0.02	<0.02
Residual ethanol (ppm)	<500	59.0	79.4	79.1	54.9
Pesticide residues[b]	According to 40 CFR §180[c] (U.S. EPA, 2020)	<LOD	<LOD	<LOD	<LOD
Deoxynivalenol (µg/kg)[b]	<40	<20	<20	<20	<20

CFR = *Code of Federal Regulations*; CFU = colony forming units; KOH = potassium hydroxide; LOD = limit of detection; meq = milliequivalent; NA = not assessed; ppm = parts per million.

[a] Unless a different production lot was noted for the value.

[b] Parameters are not part of the typical analyses performed for every production lot.

[c] 40 CFR §180 – Tolerances and Exemptions for Pesticide Chemical Residues in Food (U.S. EPA, 2020).

2.4 Stability

The stability of Oat Oil PL40 under normal conditions of storage (*i.e.*, at room temperature and at 4°C, stored in the dark in plastic 500-mL containers) was evaluated in a series of tests by Naturex. Among the samples examined, water content slightly exceeded the specified value in 1 production lot after 9 months and remained within the specification limit in the other 3 production lots for 24 months. Peroxide values in the Oat Oil PL40 production lots were within the specified limit for 12 months. Thus, the available data on

oxidation of Oat Oil PL40 (*i.e.*, peroxidation value) support the stability of Oat Oil PL40 under appropriate conditions for up to 12 months. The results from the stability studies have been provided in Appendix B.

Part 3. §170.235 Dietary Exposure

3.1 Estimated Intake of Oat Oil PL40

3.1.1 Methods

An assessment of the anticipated intake of Oat Oil PL40 as an ingredient under the intended conditions of use (see Table 1.3-1) was conducted using data available in the U.S. National Center for Health Statistics' National Health and Nutrition Examination Surveys (NHANES) 2017-2018 (CDC, 2021a,b; USDA, 2021). A summary of the survey and methodology employed in the intake assessment of Oat Oil PL40 along with the pertinent results is presented herein.

The NHANES data are collected and released in 2-year cycles with the most recent cycle containing data collected in 2017-2018. Information on food consumption was collected from individuals *via* 24-hour dietary recalls administered on 2 non-consecutive days (Day 1 and Day 2). Sample weights were incorporated with NHANES data to compensate for the potential under-representation of intakes from specific populations and allow the data to be considered nationally representative. NHANES data were employed to assess the mean and 90th percentile intake of Oat Oil PL40 for each of the following population groups:

- Children, ages 2 to 5 years;
- Children, ages 6 to 11 years;
- Female teenagers, ages 12 to 19 years;
- Male teenagers, ages 12 to 19 years;
- Female adults, ages 20 years and older;
- Male adults, ages 20 years and older; and
- Total population (ages 2 years and older, and both gender groups combined).

Estimated intake data of Oat Oil PL40 by the U.S. population were generated from consumption data originating from individual dietary records, which detailed food items consumed by each survey participant[1]. Daily intake estimates of Oat Oil PL40 represent projected 2-day averages for each individual from Day 1 and Day 2 of NHANES 2017-2018 from which the mean and percentile intake estimates were determined. These mean and percentile estimates were generated by incorporating survey weights in order to provide representative intakes for the entire U.S. population. *"Per capita"* intake refers to the estimated intake of Oat Oil PL40 averaged over all individuals surveyed, regardless of whether they consumed food products in which Oat Oil PL40 is proposed for use, and therefore includes individuals with "zero" intakes (*i.e.*, those who reported no intake of food products containing Oat Oil PL40 during the 2 survey days). "Consumer-only" intake refers to the estimated intake of Oat Oil PL40 by those individuals who reported consuming food products in which the use of Oat Oil PL40 is currently under consideration. Individuals were considered "consumers" if they reported consumption of 1 or more food products in which Oat Oil PL40 is proposed for use on either Day 1 or Day 2 of the survey. The consumer-only estimates are more relevant to risk assessments as they represent exposures in the target population; consequently, only the consumer-only intake results are discussed in detail herein.

[1] Statistical analysis and data management were conducted in DaDiet Software (Dazult Ltd., 2018). DaDiet Software is a web-based software tool that allows accurate estimate of exposure to nutrients and to substances added to foods, including contaminants, food additives and novel ingredients. The main input components are concentration (use level) data and food consumption data. Data sets are combined in the software to provide accurate and efficient exposure assessments.

The estimates for the intake of Oat Oil PL40 were generated using the maximum use level indicated for each intended food use, as presented in Table 1.3-1, together with food consumption data available from the 2017-2018 NHANES datasets. The results for these assessments are presented in Section 3.1.2.

3.1.2 Intake Estimates for Oat Oil PL40

A summary of the estimated daily intake of Oat Oil PL40 from proposed food uses is provided in Table 3.1.2-1 on an absolute basis (g/person/day), and in Table 3.1.2-2 on a body weight basis (mg/kg body weight/day).

The percentage of consumers was high among all age groups evaluated in the current intake assessment; greater than 56.8% of the population groups consisted of consumers of food products in which Oat Oil PL40 is currently proposed for use (Table 3.1.2-1). Children aged 6 to 11 years had the greatest proportion of consumers at 79.7%.

Among the total population (2 and older), the mean and 90th percentile consumer-only intakes of Oat Oil PL40 were determined to be 0.71 and 1.43 g/person/day, respectively. Of the individual population groups, male adults were determined to have the greatest mean and 90th percentile consumer-only intakes of Oat Oil PL40 on an absolute basis, at 0.79 and 1.80 g/person/day, respectively, while children aged 2 to 5 years had the lowest mean and 90th percentile consumer-only intakes of 0.43 and 0.83 g/person/day, respectively (Table 3.1.2-1). On a body weight basis, the total population (2 and older) mean and 90th percentile consumer-only intakes of Oat Oil PL40 were determined to be 11.2 and 25.9 mg/kg body weight/day, respectively. Among the individual population groups, children aged 2 to 5 years were identified as having the highest mean and 90th percentile consumer-only intakes of any population group, of 25.3 and 55.8 mg/kg body weight/day, respectively. Male adults had the lowest mean consumer-only intake of 9.0 mg/kg body weight/day, while female teenagers had the lowest 90th percentile intake of 16.1 mg/kg body weight/day (Table 3.1.2-2).

Table 3.1.2-1 Summary of the Estimated Daily Intake of Oat Oil PL40 from Proposed Food Uses in the U.S. by Population Group (2017-2018 NHANES Data)

Population Group	Age Group (Years)	*Per Capita* Intake (g/day)		Consumer-Only Intake (g/day)			
		Mean	90th Percentile	%	n	Mean	90th Percentile
Children	2 to 5	0.33	0.80	78.4	359	0.43	0.83
Children	6 to 11	0.40	0.97	79.7	508	0.51	1.06
Female Teenagers	12 to 19	0.37	0.86	66.0	277	0.56	0.96
Male Teenagers	12 to 19	0.35	0.92	56.8	261	0.61	1.52
Female Adults	20 and older	0.56	1.30	74.1	1,566	0.75	1.50
Male Adults	20 and older	0.51	1.24	64.8	1,293	0.79	1.80
Total Population	2 and older	0.49	1.15	70.0	4,264	0.71	1.43

n = sample size; NHANES = National Health and Nutrition Examination Survey; U.S. = United States.

Table 3.1.2-2 Summary of the Estimated Daily Per Kilogram Body Weight Intake of Oat Oil PL40 from Proposed Food Uses in the U.S. by Population Group (2017-2018 NHANES Data)

Population Group	Age Group (Years)	*Per Capita* Intake (mg/kg bw/day)		Consumer-Only Intake (mg/kg bw/day)			
		Mean	90th Percentile	%	n	Mean	90th Percentile
Children	2 to 5	19.9	48.2	78.7	354	25.3	55.8
Children	6 to 11	12.7	32.3	79.7	507	15.9	36.3
Female Teenagers	12 to 19	6.2	14.7	66.4	274	9.3	16.1
Male Teenagers	12 to 19	5.8	14.6	56.6	259	10.3	25.7
Female Adults	20 and older	7.6	17.9	74.0	1552	10.3	21.8
Male Adults	20 and older	5.9	14.3	64.9	1283	9.0	19.2
Total Population	2 and older	7.8	20.2	70.0	4229	11.2	25.9

bw = body weight; n = sample size; NHANES = National Health and Nutrition Examination Survey; U.S. = United States.

3.1.3 Estimated Intake of Fatty Acids from Oat Oil PL40

Using the average fatty acid content of Oat Oil PL40 from Table 2.1-3, the corresponding intakes of the 6 primary fatty acid groups from the consumption of Oat Oil PL40 by the U.S. population were calculated on an absolute basis and are presented in Table 3.1.3-1.

The introduction of Oat Oil PL40 to the U.S. marketplace would not lead to any significant increases in the cumulative consumption of the major fatty acid groups outlined, with the highest overall mean and 90th percentile intake estimated in adult males for PUFAs at 0.34 and 0.77 g/day, respectively. These estimates are well below the adequate intake (AI) values of 7 to 17 g/day for n-6 PUFAs for ages 1 to 70 years, and similar to the AIs of 0.7 to 1.6 g/day established for n-3 PUFAs (IOM, 2005). They are also far lower than the mean PUFA intakes reported for the total U.S. population by adult males from the 2017-2018 NHANES What We Eat in America dataset, at 23.7 g/day (USDA ARS, 2020). As demonstrated in Table 2.1-3, n-6 linoleic acid comprises the majority of PUFAs in Oat Oil PL40. The intakes of linoleic acid as calculated from the use of Oat Oil PL40 (0.33 and 0.74 g/day in adult males) were similarly low when compared to the background intake levels of this fatty acid (21.02 g/day).

The highest estimated intake of MUFAs from Oat Oil PL40 was also reported in adult males at 0.30 and 0.69 g at the mean and 90th percentile, respectively (Table 3.1.3-1). The Institute of Medicine (IOM) indicated that there is no evidence to suggest MUFAs are essential in the diet, and they have no independent role in preventing chronic diseases; as such, an AI was not established. When compared with the mean total dietary reported intakes of this fatty acid group by male adults, of 34.9 g/day (USDA ARS, 2020), the estimates were similarly minimal.

Finally, when considering intakes of SFAs from Oat Oil PL40, mean and 90th percentile values were determined to be 0.15 and 0.35 g/day, respectively. The IOM has stated that:

> "[...] *neither an AI nor RDA is set for saturated fatty acids. There is a positive linear trend between total saturated fatty acid intake and total and low density lipoprotein (LDL) cholesterol concentration and increased risk of coronary heart disease (CHD). A UL is not set for saturated fatty acids because any incremental increase in saturated fatty acid intake increases CHD risk. It is neither possible nor advisable to achieve 0 percent of energy from saturated fatty acids in typical whole-food diets*" (IOM, 2005).

As such, there is no upper limit (UL) available. The background intake of saturated fatty acids from the diet in adult males has been reported at 33 g/day from the 2017-18 cycle of the NHANES (USDA ARS, 2020); as such, these values are extremely low. It should also be noted that these estimates are conservative due to the assumptions that all food products will contain Oat Oil PL40 at the maximum specified level of use and that the ingredient will have 100% market penetration in all identified food categories, particularly as Oat Oil PL40 is intended to be used as a partial substitute for other fats and oils. Therefore, it is highly unlikely that the SFA intakes would be as high as estimated herein. As such, although the IOM states that any increase in the intake of SFAs may increase the risk of coronary heart disease (CHD), Oat Oil PL40 is not considered to result in an "incremental" increase in SFA intakes by the U.S. population.

Table 3.1.3-1 Summary of the Estimated Daily Intake of Fatty Acids from Oat Oil PL40 from Proposed Food Uses in the U.S. by Population Group (2017-2018 NHANES Data)

Population Group	Age Group (Years)	Consumer-Only Intake (g/day)											
		SFA		Palmitic Acid		MUFA		Oleic Acid		PUFA		Linoleic Acid	
		Mean	P90	Mean	P90	Mean	P90	Mean	P90	Mean	P90	Mean	P90
Children	2 to 5	0.08	0.16	0.07	0.14	0.16	0.32	0.16	0.30	0.18	0.36	0.18	0.34
Children	6 to 11	0.10	0.20	0.09	0.18	0.19	0.40	0.19	0.39	0.22	0.45	0.21	0.44
Female Teenagers	12 to 19	0.11	0.19	0.10	0.16	0.21	0.37	0.20	0.35	0.24	0.41	0.23	0.40
Male Teenagers	12 to 19	0.12	0.29	0.10	0.26	0.23	0.58	0.22	0.56	0.26	0.65	0.25	0.63
Female Adults	20 and older	0.14	0.29	0.13	0.26	0.29	0.57	0.28	0.55	0.32	0.64	0.31	0.62
Male Adults	20 and older	0.15	0.35	0.14	0.31	0.30	0.69	0.29	0.66	0.34	0.77	0.33	0.74
Total Population	2 and older	0.14	0.28	0.12	0.24	0.27	0.54	0.26	0.52	0.30	0.61	0.29	0.59

MUFA = monounsaturated fatty acids; NHANES = National Health and Nutrition Examination Survey; P90 = 90th percentile; PUFA = polyunsaturated fatty acids; SFA = saturated fatty acids; U.S. = United States.

3.1.4 Summary and Conclusions

Consumption data and information pertaining to the intended food uses of Oat Oil PL40 were used to estimate the *per capita* and consumer-only intakes of this ingredient for specific demographic groups and for the total U.S. population. As mentioned, there were a number of assumptions included in the assessment which render exposure estimates suitably conservative. For example, it has been assumed in this exposure assessment that all food products within a food category contain Oat Oil PL40 at the maximum specified level of use. In reality, the levels added to specific foods will vary depending on the nature of the food product and it is unlikely that the ingredient will have 100% market penetration in all identified food categories.

In summary, on consumer-only basis, the resulting mean and 90th percentile intakes of Oat Oil PL40 by the total U.S. population from proposed food uses in the U.S., were estimated to be 0.71 g/person/day (11.2 mg/kg body weight/day) and 1.43 g/person/day (25.9 mg/kg body weight/day), respectively. Among the individual population groups, the highest mean and 90th percentile intakes of Oat Oil PL40 were determined to be 0.79 g/person/day (9.0 mg/kg body weight/day), and 1.80 g/person/day (19.2 mg/kg body weight/day), respectively, as identified among male adults. Children aged 2 to 5 years had the lowest mean and 90th percentile consumer-only intakes of 0.43 g/person/day and 0.83 g/person/day, respectively, on an absolute basis. When expressed on a body weight basis, this age group had the highest daily intakes of 25.3 and 55.8 mg/kg body weight/day at the mean and 90th percentile intake, respectively.

Overall, the contribution to the background intake of PUFAs, MUFAs, and SFAs from the consumption of Oat Oil PL40 is negligible, with less than 1 g/day being contributed to each fatty acid group, even for the highest consuming population group, *i.e.*, adult males at a high level (*i.e.*, 90th percentile) intake of the ingredient. These intakes were notably lower than the UL (where available) and the background dietary intakes for each of the fatty acids investigated (based on the 2017-2018 NHANES What We Eat in America dataset). Furthermore, since Oat Oil PL40 is intended to be used as a partial substitute for other fats and oils currently in the marketplace, an additive consumption of fatty acids would not be expected. As such, cumulative intakes of fatty acids and lipids in general are not anticipated to change.

Part 4. §170.240 Self-Limiting Levels of Use

No known self-limiting levels of use are associated with Oat Oil PL40.

Part 5. §170.245 Experience Based on Common Use in Food Before 1958

Not applicable.

Part 6. §170.250 Narrative and Safety Information

6.1 Introduction

The safety of Naturex's Oat Oil PL40 under the conditions of its intended uses are based on scientific procedures. In particular, safety is substantiated on the basis that the dietary exposure from the intended uses of Oat Oil PL40 as an ingredient in food and beverages is comparable to the background consumption of oats, specifically the lipid component of oats, which are widely consumed by humans, as discussed in this section.

As the levels of consumption of oat lipids from oats are comparable to the estimated intake of Oat Oil PL40 based on its proposed uses in food and beverages, it may be concluded that consumption of Oat Oil PL40 is safe.

The safety of Oat Oil PL40 was further supported through information on its metabolic fate in animals and humans and generally available data on oat oil. A comprehensive literature search was performed to identify studies pertaining to the safety of oats, oat oil, and its major constituents. Using the ProQuest search dialog, the following databases were searched: AdisInsight: Trials, AGRICOLA, AGRIS, Allied & Complementary Medicine™, BIOSIS® Toxicology, BIOSIS Previews®, CAB ABSTRACTS, Embase®, Foodline®: SCIENCE, FSTA®, MEDLINE®, NTIS: National Technical Information Service, ToxFile®, Toxicology Abstracts, and Toxicology Abstracts. Search terms included "oat", "84012-26-0", "*Avena sativa*", and "*A. sativa*" occurring within 5 words of the terms "oil" or "extract". The search was initially performed in 2017 and generated 2,403 hits. The 2017 search was refined using typical keywords used in safety, toxicology, genotoxicity, and toxicokinetic studies due to the number of results returned. Subsequent literature searches carried out in September 2018, July 2021, and November 2021 did not refine the searches as there were a manageable number of results. Articles were first screened for relevance by reviewing the titles then abstracts and full text of the articles. Relevant articles were obtained and included in the GRAS evaluation.

Oat oil preparations have been investigated in mice and rats to examine its potential protective effects against certain pathological states. While they are not designed to investigate safety, these studies can provide additional support that the administration of oat oil is not associated with adverse effects and are able to mitigate toxicological effects (*e.g.*, testicular biomarkers of toxicity [Ben Halima *et al.*, 2014], obesity [Tong *et al.*, 2014], and formation of pre-neoplastic hepatic lesions [Li *et al.*, 1999]) under specific conditions. The oat oils tested in these studies are not Oat Oil PL40 and would therefore have different ratios of polar lipids to triglycerides; however, the findings from these large doses corroborate the safety of Oat Oil PL40 under the intended conditions of use in food and beverages and support a conclusion that Oat Oil PL40 is GRAS for the intended conditions of use.

Unpublished toxicological studies (consisting of a 28-day study in Sprague-Dawley rats and a 28-day study in Beagle dogs) and genotoxicity studies (consisting of a bacterial reverse mutation assay and a chromosome aberration test in human blood lymphocytes) of the commercial Oat Oil PL40 ingredient have been included in the notice for completeness of the dataset, **but are not considered pivotal** due to their unpublished state and deficiencies in the dataset such as the duration of the animal studies. The findings from these studies corroborate the safety of Oat Oil PL40, as no adverse effects or genotoxicity were reported.

The following sections summarize the available data on Oat Oil PL40 which are used to support the above statements.

6.2 Comparison to Background Sources and Consumption

Oat Oil PL40 has not been the subject of previous GRAS assessments and has not been previously used in food in the U.S.

Oat Oil PL40 consists of 2 primary classes of lipids: triglycerides (neutral lipids), and polar lipids, which are further subdivided into phospholipids and glycolipids. Further characterization of these constituents are provided in Section 2.1. The compounds within each group are structurally similar to one another and to other substances of the same structural class found in common foods; however, the relative amounts of the individual triglycerides, phospholipids, and glycolipids are specific to oats. Triglycerides, phospholipids, and glycolipids share common metabolic fates and have the same safety profiles as other substances found in food which reside within the same structural class (see Section 6.4). Triglycerides and phospholipids are also endogenously synthesized in humans to fulfill particular metabolic functions such as energy storage, cellular membrane transporters and/or receptors, cell-to-cell aggregation and dissociation, and for brain and eye functions (Brandenburg *et al.*, 2010; Gimenez *et al.*, 2011).

Oats also contain epoxy- and hydroxy-fatty acids at concentrations in the total oil of up to 3.3% and 0.4%, respectively (corresponds to approximately 33 and 4 mg/g, respectively) (Leonova *et al.*, 2008). Hydroxy- and epoxy-fatty acids are produced by an endogenous enzymatic process that commonly uses oleic acid as a substrate, although linoleic and linolenic acids may also be used by the oat plant (Leonova *et al.*, 2008; Doehlert *et al.*, 2010; Meesapyodsuk and Qiu, 2011). Hydroxy-fatty acids are commonly measured in the polar lipid fraction, whereas epoxy-fatty acids are mainly present in the neutral lipid fraction of the total fats (Leonova *et al.*, 2008; Doehlert *et al.*, 2010; Meesapyodsuk and Qiu, 2011). The occurrence of hydroxy- and epoxy-fatty acids have also been described in plant and seed oils in general, including flax seeds, wheat seeds, corn seeds, and soybeans, and is produced in these plants *via* similar enzymatic modification of fatty acids (Manson, 1980; Grechkin *et al.*, 1991; Blée and Schuber, 1992). Xia and Budge (2017) noted that epoxy fatty acids can be generated at levels of up to 14.24 mg/g in olive oil and 9.44 mg/g in sunflower oil when used as frying oils. Marmesat *et al.* (2008) reported that hydroxy fatty acids in fried sunflower oil ranged from 1.9 to 5.5 mg/g, which is similar to the amount in oat oil. Under the intended conditions of use of oat oil and considering the relatively greater levels of use of frying oils, it is estimated that the exposure to epoxy- and hydroxy-fatty acids from Oat Oil PL40 will be similar to or less than the amount from the consumption of frying oils in food even when any potential concentration effect of the manufacturing process.

Consumption of oats is widespread in the U.S. Background consumption of oats were calculated using food consumption data from the 2017-2018 NHANES data combined with the oat content identified in the Food and Nutrient Database for Dietary Studies for each of the relevant food codes (USDA ARS, 2021a,b). A total of 89 food codes were identified as containing oats in the NHANES 2017-2018 database. Based on the estimated intake of oat-containing foods, the consumer-only intakes of oat oil from the background diet were calculated assuming an oil content of 8.3% in oats (see Section 2.1) and compared to the consumer-only intakes of Oat Oil PL40 (Table 6.2-1 and 6.2-2).

Overall, the intake of Oat Oil PL40 on an absolute and body weight-basis across all population groups was estimated to be lower than the intake of oat oil from the consumption of oats. The highest mean intake of oat oil was reported in male adults, at 1.84 from background diet and less than half this level, 0.79 g/day, from Oat Oil PL40, respectively. The highest statistically reliable 90th percentile intake of 4.54 g/day for oat oil was reported in children (aged 2 to 5 years) for background diet, which was over twice the highest intake from Oat Oil PL40 of 1.80 g/day, as noted by male adults. Based on the higher intake of oat oil from the

normal diet, the intake of Oat Oil PL40 from the current proposed uses is not expected to pose a safety concern in consumers.

Table 6.2-1 Comparison of the Estimated Daily Intake of Oat Oil from Background Consumption of Oats and Oat Oil PL40 in the U.S. by Population Group (2017-2018 NHANES Data)

Population Group	Age Group (Years)	Consumer-Only Intake of Oat Oil from Oats (g/day)[a]				Consumer-Only Intake of Oat Oil PL40 (g/day)			
		%	n	Mean	90th Percentile	%	n	Mean	90th Percentile
Children	2 to 5	17.7	93	1.69	**4.54**	78.4	359	0.43	0.83
Children	6 to 11	10.0	78	0.84	2.19*	79.7	508	0.51	1.06
Female Teenagers	12 to 19	9.6	48	1.11	2.82*	66.0	277	0.56	0.96
Male Teenagers	12 to 19	7.1	34	1.63	4.61*	56.8	261	0.61	1.52
Female Adults	20 and older	15.2	408	1.73	3.57	74.1	1,566	0.75	1.50
Male Adults	20 and older	15.2	321	**1.84**	3.89	64.8	1,293	0.79	1.80
Total Population	2 and older	14.2	982	1.69	3.57	70.0	4,264	0.71	1.43

n = sample size; NHANES = National Health and Nutrition Examination Survey; U.S. = United States.
[a] Assessment conducted to examine background intakes of oat oil from consumption of oats (8.3% oil) in the U.S. diet.
* Indicates an intake estimate that may not be statistically reliable, as the sample size does not meet the minimum reporting requirements (mean n<30; 90th percentile n<80).

Table 6.2-2 Comparison of the Estimated Daily Per Kilogram Body Weight Intake of Oat Oil from Background Consumption of Oats and Oat Oil PL40 in the U.S. by Population Group (2017-2018 NHANES Data)

Population Group	Age Group (Years)	Consumer-Only Intake of Oat Oil from Oats (mg/kg bw day)[a]				Consumer-Only Intake of Oat Oil PL40 (mg/kg bw/day)			
		%	n	Mean	90th Percentile	%	n	Mean	90th Percentile
Children	2 to 5	17.6	91	104.8	235.5	78.7	354	25.3	55.8
Children	6 to 11	10.0	78	26.1	65.8*	79.7	507	15.9	36.3
Female Teenagers	12 to 19	9.5	47	18.3	36.5*	66.4	274	9.3	16.1
Male Teenagers	12 to 19	7.2	34	27.1	96.4*	56.6	259	10.3	25.7
Female Adults	20 and older	15.1	402	25.4	60.2	74.0	1,552	10.3	21.8
Male Adults	20 and older	15.3	319	21.9	47.1	64.9	1,283	9.0	19.2
Total Population	2 and older	14.1	971	28.9	62.7	70.0	4,229	11.2	25.9

bw = body weight; n = sample size; NHANES = National Health and Nutrition Examination Survey; U.S. = United States.
[a] Assessment conducted to examine background intakes of oat oil from consumption of oats (8.3% oil) in the U.S. diet.
* Indicates an intake estimate that may not be statistically reliable, as the sample size does not meet the minimum reporting requirements (mean n<30; 90th percentile n<80).

The intake of polar lipids from the consumption of oats in the background diet was also calculated assuming a polar lipid content of 1.7% in oats (Doehlert *et al.*, 2010) and compared to the intake of polar lipids from Oat Oil PL40 based on the mean polar lipid content from 4 representative batches at 43% (see Section 2.3.2). The results are presented in Table 6.2-3 and 6.2-4. The estimated intake of polar lipids from both sources are comparable, with the highest mean polar lipid intakes of 0.38 g/day and 0.34 g/day reported in male adults from background consumption and Oat Oil PL40, respectively, and the highest reliable 90th percentile intake of 0.93 g/day in children (aged 2 to 5 years) from background diet, with the

highest estimated figure at 0.77 g/day from Oat Oil PL40 in male adults. Based on these results, the intake of polar lipids from Oat Oil PL40 is not expected to pose a safety concern in consumers.

Table 6.2-3 Comparison of the Estimated Daily Intake of Polar Lipids from Background Consumption of Oats and Polar Lipids from Oat Oil PL40 in the U.S. by Population Group (2017-2018 NHANES Data)

Population Group	Age Group (Years)	Consumer-Only Intake of Polar Lipids from Oats (g/day)[a]				Consumer-Only Intake of Polar Lipids from Oat Oil PL40 (g/day)[b]			
		%	n	Mean	90th Percentile	%	n	Mean	90th Percentile
Children	2 to 5	17.7	93	0.35	**0.93**	78.9	362	0.18	0.36
Children	6 to 11	10.0	78	0.17	0.45*	80.6	516	0.22	0.46
Female Teenagers	12 to 19	9.6	48	0.23	0.58*	67.0	285	0.24	0.41
Male Teenagers	12 to 19	7.1	34	0.33	0.94*	58.8	267	0.26	0.65
Female Adults	20 and older	15.2	408	0.35	0.73	75.4	1,592	0.32	0.65
Male Adults	20 and older	15.2	321	**0.38**	0.80	67.3	1,322	**0.34**	**0.77**
Total Population	2 and older	14.2	982	0.35	0.73	71.7	4,344	0.30	0.61

n = sample size; NHANES = National Health and Nutrition Examination Survey; U.S. = United States.
[a] Assessment conducted to examine background intakes of polar lipids from consumption of oats (1.7% polar lipids; Doehlert *et al.* [2010]) in the U.S. diet.
[b] Calculation: [Consumer only Intake of Oat Oil (g/day)] * [mean polar lipid content of 43% in 4 production lots of Oat Oil PL40].
* Indicates an intake estimate that may not be statistically reliable, as the sample size does not meet the minimum reporting requirements (mean n<30; 90th percentile n<80).

Table 6.2-4 Comparison of the Estimated Daily Per Kilogram Body Weight Intake of Polar Lipids from Background Consumption of Oats and Polar Lipids from Oat Oil PL40 in the U.S. by Population Group (2017-2018 NHANES Data)

Population Group	Age Group (Years)	Consumer-Only Intake of Polar Lipids from Oats (mg/kg bw day)[a]				Consumer-Only Intake of Polar Lipids from Oat Oil PL40 (mg/kg bw/day)[b]			
		%	n	Mean	90th Percentile	%	n	Mean	90th Percentile
Children	2 to 5	17.6	91	21.5	48.2	79.2	357	10.9	24.0
Children	6 to 11	10.0	78	5.4	13.5	80.6	515	6.8	15.6
Female Teenagers	12 to 19	9.5	47	3.7	7.5	67.5	282	4.0	6.9
Male Teenagers	12 to 19	7.2	34	5.6	19.7	58.6	265	4.4	11.1
Female Adults	20 and older	15.1	402	5.2	12.3	75.3	1,578	4.4	9.4
Male Adults	20 and older	15.3	319	4.5	9.6	67.3	1,312	3.9	8.3
Total Population	2 and older	14.1	971	5.9	12.9	71.7	4,309	4.8	11.1

bw = body weight; n = sample size; NHANES = National Health and Nutrition Examination Survey; U.S. = United States.
[a] Assessment conducted to examine background intakes of polar lipids from consumption of oats (1.7% polar lipids; Doehlert *et al.* [2010]) in the U.S. diet.
[b] Calculation: [Consumer only Intake of Oat Oil (mg/kg bw/day)] * [mean polar lipid content of 43% in 4 production lots of Oat Oil PL40].
* Indicates an intake estimate that may not be statistically reliable, as the sample size does not meet the minimum reporting requirements (mean n<30; 90th percentile n<80).

6.3 Absorption, Distribution, Metabolism, and Excretion

Oat oil is a component of the oat grain seeds and is expected to exhibit similar metabolic fates to that of other edible vegetable oils and fatty acids derived from common sources. The available data on the metabolic fate of the constituents of oat oil support that these substances are metabolized through normal metabolic processes for lipids to innocuous products which are also obtained from other foods in the diet.

According to the IOM (2005), when ingested, dietary lipids are hydrolyzed by buccal, gastric, pancreatic, and intestinal lipases. These lipases catalyze the breakdown of triacylglycerides into a mixture of free fatty acids and acylglycerols. Due to the long-chain fatty acid lipids in oat oil, it is expected that triglycerides from oat oil may persist into the upper portion of the small intestine, where bile salts are able to emulsify lipid droplets and pancreatic lipases may hydrolyze long-chain triacylglycerols before absorption.

Dietary phospholipids are hydrolyzed *via* pancreatic phospholipase A_2 in the gastrointestinal lumen (IOM, 2005). The lyso-phospholipids are then re-esterified and may then be assembled together with cholesterol, free fatty acids, glycerols, and apoproteins into lipoproteins. These lipoproteins and lyso-phospholipids are absorbed through the intestinal mucosal cells through the small intestine and may enter the circulation through the thoracic duct where they are subjected to first-pass metabolism in the liver (IOM, 2005). Most newly absorbed fatty acids are stored as triacylglycerol in adipose tissue, but, when required (*i.e.*, during exercise or fasting states), may be hydrolyzed by hormone-sensitive lipases to free fatty acids, which are liberated into the circulation and can be oxidized by skeletal muscles or the liver. The oxidative process for fatty acids produces only carbon dioxide and water, with small amounts of ketone bodies produced by fatty acid oxidation that may be excreted in the urine.

Dietary lipids are utilized for energy production (as described above) or are converted to other endogenous substances such as phospholipids and cholesterol. Polar lipids in the human body mainly include phospholipids and sphingolipids which are structural components of neural tissues and all cell membranes (Zheng *et al.*, 2019). Over 60% of the total lipid content in the brain constitutes phospholipids as part of the meninges. Kwee and Nakada (1987) investigated the phospholipid distribution in human brains (n = 12 for grey matter, 12 for white matter, and 7 for myelin, ages 34 to 74) obtained from autopsies using ^{31}P NMR. The 5 most abundant polar lipids in the brain (including grey matter, white matter, and myelin) were phosphatidylcholine (27 to 44%), phosphatidylethanolamine (23 to 28%), phosphatidylserine (14 to 20%), sphingomyelin (13 to 22%), and phosphatidylinositol (<1 to 3%). The authors concluded that the ratios of phospholipid content are consistent under various metabolic conditions, and that alterations in the phospholipid profile of the brain have been observed in disease states such as Alzheimer's (Kwee and Nakada, 1987).

Various classes of lipids are also found in cell membranes. Polar and non-polar lipids together account for approximately 50% of the mass in animal cell membranes, with phospholipids being the most abundant type (Alberts *et al.*, 2002). The composition of the lipids in bilayers dictates the function of cells, thus membrane compositions vary greatly depending on the type of cell and tissue. Over 95% of dietary lipids are absorbed in the intestine, hydrolyzed, and assembled into chylomicrons for transport to the bloodstream and tissues for energy utilization or storage (Michalski *et al.*, 2021). Most lipids such as phospholipids are digested in the small intestine to yield free fatty acids and triacylglycerol moieties which are reformed within chylomicrons as triglycerides or newly formed phospholipids as needed to maintain lipid homeostasis (Cohn *et al.*, 2010). Considering that lipid composition in the brain and cell membranes are highly regulated based on cell function in healthy adults, the distribution of endogenous, intact polar and non-polar lipids in the body is not expected to be affected by consumption of Oat Oil PL40.

The average daily intake of phospholipids in the general population is estimated to be 2 to 8 g/day, with some of the highest phospholipid-containing foods being egg yolk (10.3 g/100 g), pig or chicken liver (2.9 g/100 g), soybeans (2 g/100 g), and dehulled oats (1.4 g/100 g) (Zheng *et al.*, 2019). In comparison, Oat Oil PL40 is comprised of 24% phospholipids, resulting in a worst-case intake of 0.43 g phospholipids/day assuming the ingredient is consumed at the highest 90th percentile intake (*i.e.*, 1.80 g Oat Oil PL40/day, see Table 3.1.2-1). Clearly, the contribution to the background phospholipid intake from high-level Oat Oil PL40 consumption is minimal. It should be noted that dietary lipids are hydrolyzed into moieties prior to absorption and ultimately accumulate as triglycerides primarily in adipose tissue (Lara-Castro and Garvey, 2008). Thus, dietary phospholipid intake will not influence phospholipid distribution within the body. The location and degree of triglyceride accumulation is largely dependent on the individual's overall health. Disruption to phospholipid homeostasis in the brain is only seen in disease states (*e.g.*, Alzheimer's disease) and is dependent on various factors outside of the diet (Kwee and Nakada, 1987). However, as discussed in Section 3.1.4, cumulative intake of the lipids comprising Oat Oil PL40 is not expected since the proposed food uses of the ingredient are substitutional to other vegetable oils and emulsifiers. Pancreatic enzymes in the gastric lumen similarly digest glycolipids, which results in free fatty acids and a sugar moiety that are each subsequently absorbed and metabolized *via* well-established pathways as previously noted (Andersson *et al.*, 1995). The biological effect of glycolipids from the diet is equivalent to their composite lipids and sugars. Compositional analysis of glycolipids in oats indicate that the likely hydrolysis products following digestion in the gastric lumen will be galactose, glycerol, fatty acids, phosphate, and plant sterols.

Lindberg Yimaz *et al.* (2021) carried out an *in vitro* digestibility study to investigate the rate of lipolysis of oat polar lipids using pancreatin and a pH-stat digestion model of the duodenum. In this study, the test substances were added to a pH 7 buffered solution and centrifuged (oil samples) or vortexed (oat base samples) and transferred to a reaction vessel containing porcine pancreatin. Specific enzymatic activity was measured by titration. The oil test substances examined were rapeseed oil (control), oat polar lipid extracts with 4%, 15%, or 40% polar lipids (the latter was Oat Oil PL40), and blends of rapeseed oil with 50%, 20%, or 10% Oat Oil PL40. Additionally, oat base was used to simulate an oat drink and was combined with 6% water, 6% rapeseed oil, 6% oat oil extract with 4% polar lipids, or 6% Oat Oil PL40. The lipolysis rate of oat oils were substantially reduced ($p<0.001$) and decreased as the concentration of polar lipids increased. This observation was also reported for emulsions of oat oils with rapeseed oil and for oat oil in oat base. The products of lipolysis was measured using thin layer chromatography. The study authors noted that there were "*no additional bands originating from digestion products such as digalactosyl monoacylglycerol and monogalactosyl monoacylglycerol*" on the TLC plate and, "*this indicates that the digestion of polar lipids was minor during the lipolysis reaction in the pH-stat*". The authors noted that oat oils are high in phosphatidylcholine contained within glycerophospholipids and these have been associated with reduced lipolysis rates in other studies; however, the potential role of other fatty acids on lipolysis was also considered. The authors note that the reduced lipolysis rate, regardless of the true mechanism of action, is consistent with findings in previous studies.

6.4 Non-Pivotal Safety Data

While the pivotal data to support the safety of Oat Oil PL40 is based on the widespread consumption of oats, all available information pertinent to the safety of a substance must be evaluated as part of a GRAS conclusion. Therefore, unpublished toxicological studies (consisting of a 28-day study in Sprague-Dawley rats and a 28-day study in Beagle dogs) and genotoxicity studies (consisting of a bacterial reverse mutation assay and a chromosome aberration test in human blood lymphocytes) of the commercial Oat Oil PL40 ingredient have been included in the notice and are corroborative. These studies were originally commissioned to fulfill regulatory requirements for the authorization of Oat Oil PL40 as a pharmaceutical excipient and were not published because this was not a requirement for submission at the time. The findings from these studies corroborate the safety of Oat Oil PL40 as no adverse effects or genotoxicity were reported. However, due to deficiencies in the study design (*e.g.*, duration) and the unpublished status, the unpublished studies are considered **not pivotal**.

6.4.1 Unpublished Studies

Oat Oil PL40 was evaluated in 28-day oral toxicity studies in Sprague-Dawley rats and Beagle dogs, which complied with the principles of Good Laboratory Practice (GLP) (Saynor, 2003, 2004 [unpublished and confidential]). These studies were unpublished and are of an insufficient duration to evaluate the safety of Oat Oil PL40 and are not pivotal to the safety data; nevertheless, the study details are included within this notice as they are relevant to the safety of Oat Oil PL40. A summary of the study methods and findings are provided below.

In both 28-day oral toxicity studies, no adverse effects were reported and there were no macroscopic or histopathological test item-related findings. The study authors concluded that the NOAELs were 5,000 mg/kg body weight/day, the highest dose tested, for both studies. Based on the polar lipid content of Oat Oil PL40, the NOAELs reported in these studies correspond to a NOAEL of 2,000 mg/kg body weight/day for the polar lipid component. These findings corroborate the safety of Oat Oil PL40 under the intended conditions of use established above.

6.4.1.1 28-Day Repeat Dose Study in Crl:CD(SD) IGS BR Rats

A GLP-compliant 28-day oral toxicity study in Crl:CD(SD) IGS BR rats was conducted in order to determine the toxicity of Oat Oil PL40 (Saynor, 2003 [unpublished and confidential]). Rats (10/sex/group) were administrated corn oil (control) or Oat Oil PL40 at doses of 1,250, 2,500, or 5,000 mg/kg body weight/day by gavage (dose volumes were 5 mL/kg body weight for control and high-dose groups, 1.25 mL/kg body weight for the low-dose group, and 2.5 mL/kg body weight for the mid-dose group) for 28 days[2]. Animals were observed daily for changes in clinical condition, with ophthalmoscopic examinations performed on control and high-dose animals before the start of dosing and in Week 4. Body weights and food consumption were recorded weekly. Blood samples were collected in Week 4 for hematology and clinical biochemistry assessments, with urine samples also collected at the end of the study for analysis of urinary parameters. At the end of the treatment period, animals were subjected to a gross macroscopic necropsy, where selected organs (adrenals, kidneys, spleen, liver, heart, brain, pituitary and thyroids/parathyroids, ovaries, prostate, testes/epididymides) were weighed and subsequently fixed for microscopic examination.

[2] A 7-day dose range finding study also was conducted in which rats were administered doses of oat oil ranging from 600 to 5,000 mg/kg body weight/day. Authors reported no adverse effects.

No test article-related deaths were observed during the study; 1 mid-dose female died due to a dosing error (rupture of the esophagus and inflammatory changes in-and-around the thoracic cavity were seen macroscopically). Clinical observations (including some instances of staining of fur to the dorsal region in all male groups and for mid- and high-dose females in addition to infrequent occurrences of thinning fur among low-, mid-, and high-dose groups) were considered to be unrelated to the test article and normal for animals of the age and strain used in the study investigator's laboratory; there were also no test item-related ophthalmoscopic findings. No differences in body weight or food consumption were observed between test item-treated groups and controls. No test article-related changes in hematological, clinical chemistry, or urinalysis parameters were observed. Where statistically significant differences were observed, there was either no dose-response relationship (increased hemoglobin distribution width for low-dose males and high-dose females; increased red cell distribution width for high-dose females; increased calcium for low-dose males; increased urea for low- and high-dose males; increased cholesterol for low-dose females; increased urine volume and specific gravity for mid-dose males) or the differences were inconsistent between the sexes (increased activated partial thromboplastin time for high-dose males only and increased potassium for high-dose females only) and they were therefore considered to be unrelated to administration of the test item.

At necropsy, there were no test item-related macroscopic findings and no differences in organ weights between controls and test item-treated animals. Microscopic findings were generally infrequent, of a minor nature and consistent with the usual pattern of findings in rats of this strain and age. Inflammatory cell foci/myofiber degeneration in the sternum and esophagus of some control and high-dose animals was not associated with any dose-response relationship and was deemed by the study investigators to be associated with dosing procedure (possibly exacerbated by the larger dose volumes used for the control and high-dose groups), rather than any effect of the test item.

6.4.1.2 28-Day Repeat Dose Study in Beagle Dogs

A GLP-compliant 28-day oral toxicity study in dogs was conducted to further investigate the potential toxicity of Oat Oil PL40 (Saynor, 2004 [unpublished and confidential]). The study was not conducted according to an Organisation for Economic Co-operation and Development Test Guideline but did meet the requirements of Directive 2001/83/EC (EC, 2001). Beagle dogs (3/sex/group) were administered by gavage corn oil (control) or Oat Oil PL40 at 1,250, 2,500, or 5,000 mg/kg body weight/day (dose volumes were 5 mL/kg body weight for control and high-dose groups, 1.25 mL/kg body weight for the low-dose group, and 2.5 mL/kg body weight for the mid-dose group) for 28 days. Animals were observed twice daily for signs of ill health or overt toxicity. Ophthalmoscopic examinations were performed on control and high-dose animals before the start of dosing and in Week 4. Body weights and food consumption were recorded weekly. Blood samples were collected before the start of the exposure period and in Week 4 for hematology and clinical biochemistry assessments, with urine samples also collected at the end of the study for analysis of urinary parameters. At the end of the treatment period, animals were necropsied and adrenals, kidneys, spleen, liver, heart, brain, pituitary, thyroids/parathyroids, ovaries, prostate, and testes/epididymides were weighed and fixed for microscopic examination.

There were no deaths, no test item-related clinical signs, and no ocular findings related to administration of the test item. No biologically relevant differences in body weight or food consumption were reported between test item-treated group and controls. There were no test item-related differences in hematological, clinical biochemistry, or urinalysis parameters between controls and test item-treated groups. At necropsy, there were no differences in organ weights and no macroscopic or microscopic findings related to administration of the test item.

6.4.1.3 Genotoxicity Studies

Genotoxicity is not anticipated following consumption of Oat Oil PL40 under the intended conditions of use based on the composition of the product and the ubiquity of its constituents in the normal diet, which are readily metabolized to innocuous and endogenous substances *via* normal digestive processes. As such, Oat Oil PL40 is not genotoxic. Regardless, unpublished *in vitro* genotoxicity studies consisting of a bacterial reverse mutation assay in *Salmonella* Typhimurium strains TA98, TA100, TA1535, and TA1537 (Johnson, 2003) and a chromosomal aberration test in cultured human blood lymphocytes (Kumaravel, 2003) were conducted to evaluate the genotoxic potential of Oat Oil PL40. The *in vitro* chromosomal aberration test is considered a viable alternative to the *in vitro* mammalian cell micronucleus test (which would normally be conducted with the bacterial reverse mutation assay as part of the basic test battery), as it also evaluates clastogenic potential. In both assays, there was no evidence of genotoxicity at up to the highest test concentrations used (5,000 µg/plate and 5,000 µg/mL for the bacterial reverse mutation assay and chromosomal aberration assay, respectively). Due to their unpublished status, these genotoxicity studies were only used to corroborate the safety of Oat Oil PL40 and are not considered pivotal.

6.4.2 Published Studies

6.4.2.1 Animal Studies

In a 35-day repeated dose study in male Swiss mice (68/group), animals were administered by gavage 5 mg deltamethrin/kg body weight/day alone or in combination with 6 g/kg body weight/day of a hexane-extracted oat oil, or the oat oil alone without deltamethrin to evaluate the effect of oat oil on reproductive parameters (Ben Halima *et al.*, 2014). There were no statistically significant effects of the oat oil on sperm parameters. Co-administration of the oat oil ameliorated testicular biochemical markers of toxicity and the histopathological changes in the testes caused by deltamethrin exposure.

In a 30-day study, the effect of a supercritical carbon dioxide extract from oat fiber was evaluated in Wistar-Lewis rats (9/group) fed a hypercholesteremic diet supplemented with 70 g/kg diet of the oat extract or soybean oil to evaluate the effect of the extract on diet-induced hypercholesteremia (Tong *et al.*, 2014). There was no statistically significant effect of the oat extract on body weight, body weight gain, food intake, or liver weight relative to the soybean oil control group. Total adipose tissue and white adipose tissue sites were reduced in the oat extract group without any effect on brown adipose tissue, relative to the control group. Liver cholesterol, free cholesterol, cholesterol ester, and liver triglycerides were statistically significantly decreased relative to the control group.

In a study on the modulation of liver preneoplastic lesions, female Sprague-Dawley rats (10/group) were administered diets containing 10% corn oil or 10% oat lipids during a 4-week tumor initiation phase (exposure to diethyl nitrosamine after 70% partial hepatectomy) and a 5-month tumor promotion phase (Li *et al.*, 1999). There were no differences in body weight, liver weights, or growth between the oat lipid and corn oil groups. Oat lipid consumption exerted a protective effect against the formation or pre-neoplastic hepatic foci. I-compounds ("indigenous compounds"), an endogenously produced bulky DNA modification which occurs in response to dietary restriction or consumption of certain unprocessed foods, were increased in the oat lipid group. The study investigators previously (Li *et al.*, 1992) attributed the increase in I-compounds in rats to a sterol present in the oat oil. There is no indication in this study or elsewhere in the literature that suggests these endogenous compounds could form carcinogenic adducts.

The fatty acid profiles of the oat lipids used in the above studies are compared to that of Oat Oil PL40 in Table 6.4.2.1-1 for the purpose of supporting that the test articles are compositionally similar to Oat Oil PL40 and provide relevant safety information. Similar information on other oat oils is also included to support that the process to obtain Oat Oil PL40 does not significantly change the lipid profile compared to other extraction methods.

Table 6.4.2.1-1 Fatty Acid and Physicochemical Features of Oat Oils

Parameter	Oat Oil PL40 (Ethanol Extracted)	Conventional Oat Oil	Hexane-Extracted Oat Oil (Mean of Several Oat Species)	Hexane-Extracted Dal Oats (Range from 3 Cultivars)	Methanol-Extracted Oat Oil	Supercritical Carbon Dioxide-Extracted Oat Oil	Hexane-Extracted Oat Oil
Reference	Naturex	Bockisch (1998)	Frey and Hammond (1975)	Kalbasi-Ashtari and Hammond (1977)	Li *et al.* (1999)	Tong *et al.* (2014)	Ben Halima *et al.* (2014)
Fatty Acid Profile							
C14:0 Myristic Acid (%)	0.2	-	-	-	0.2	-	0.25
C16:0 Palmitic Acid (%)	16.4 to 17.2	10.5	18.9	15.0 to 16.4	16.0	17.7	17.75
C16:1 Palmitoleic (%)	0.2	-	-	-	-	-	0.37
C18:0 Stearic Acid (%)	1.4 to 1.7	-	1.7	1.9 to 2.8	2.0	1.5	2.25
C18:1 Oleic Acid (%)	34.8 to 37.7	58.5	42.2	39.5 to 43.6	36.9	32.5	41.75
C18:2 Linoleic Acid (%)	38.4 to 41.4	-	35.6	36.2 to 39.8	42.5	44.5	35.64
C18:3 Linolenic Acid (%)	1.3 to 1.5	-	1.8	2.0 to 2.7	1.5	1.9	1.02
C20:0 Arachidic Acid (%)	0.1	-	-	-	-	-	0.19
C20:1 Eicosenoic Acid (%)	0.6 to 0.7	-	-	-	-	-	0.68
Vitamin E content (mg/kg)	-	-	-	-	~14.39	726	-
Total sterols (mg/100 g)	-			-	~269.4	1,263	
Solidification point (°C)	-	-15 to -21	-	-	-	-	-
Relative density at 40°C	-	0.909	-	-	-	-	-
Refractive index (n_D^{40})	-	1.464 to 1.468	-	-	-	-	-
Iodine value	-	100 to 115	-	-	-	-	-
Unsaponifiable matter (%)	-	1.0 to 2.5	-	-	0.07	-	-

- = result not reported; n_D^{40} = neutral density material with 40% transmittance.

6.4.2.2 Human Studies

In a single-dose study, subjects consumed foods containing "liposomes made from fractionated oat oil". These liposomes were obtained first by ethanol extraction of oil from oats. The oat oil was then divided into "fractions" (*i.e.*, partitioning) using ethanol, water, and "sugar" and then a fraction high in polar lipids was identified by HPLC. Liposomes were then prepared by diluting the oil in an ethanol-water mixture. The extraction and partitioning process described by Ohlsson *et al.* (2014) is similar to the manufacturing process of Oat Oil PL40. On this basis, the triglyceride, phospholipid, and glycolipid profiles are expected to be similar. The lipid class composition of the test article evaluated by Ohlsson *et al.* (2014) is reproduced in Table 6.4.2.2-1 and compared to the composition of Oat Oil PL40. The oat oil portion used by Ohlsson *et al.* (2014) contains a greater concentration of phospholipids and glycolipids (identified as galactolipids in the article) relative to Oat Oil PL40, and as such would assist in the safety evaluation of these components. While the triglyceride content of the evaluated oat liposomes is less than Oat Oil PL40, the safety of triglycerides is already well-understood and does not demand further examination.

Table 6.4.2.2-1 Comparison of Lipid Profiles of Test Substances in Human Studies to Oat Oil PL40

Parameter	**Oat Oil PL40 (Ethanol-Extracted)**	**Liposomes from Ethanol-Extracted Fractionated Oat Oil**
Reference	Naturex	Ohlsson *et al.* (2014)
Units	% of oil	% of lipids
Triglycerides	56.1	40.9
Glycolipids	19.9	31.4 (reported as galactolipids)
Phospholipids	24.0	20.0
Sterols	4 to 6 (reported as ceramides)	6.6 (reported as sterols)
Others	0.2% (trans fatty acids)	1.3

The final liposome preparation consisted of 10% lipids and 90% water and was mixed into food; all dosage values were reported by Ohlsson *et al.* (2014) on a lipid basis. In the first phase of the study, volunteers (10 male and 9 female healthy adults with mean body mass index of 25 and mean age of 42 years) were randomly allocated into the test article or placebo breakfast groups. The breakfast intervention included yogurt with 35 g milk fat (control) or 35 g of oat oil lipids (as liposomes). In the second phase, 15 women (mean body mass index of 24 and mean age 34 years) were provided breakfast on 3 occasions which included yogurt that provided 35 g milk fat (control), 14 g oat oil lipids with 21 g milk fat, or 1.8 g oat oil lipids with 33.2 g milk fat (Ohlsson *et al.*, 2014).

Subjects reported that 35 g of oat lipids were not very palatable; however, the lower doses of 1.8 g and 14 g oat oil were palatable when mixed with the breakfast. There were reports of discomfort in the gut in the first few hours after exposure in "a few" subjects in the first hour after breakfast; however, there was no difference in incidence between the placebo and oat lipid groups. There were statistically significant increases in plasma postprandial cholecystokinin and peptide YY in the 14-g and 35-g oat oil lipid groups relative to the control group. Statistically significant increases were reported for glucagon-like peptide 1 in the 35-g oat oil lipid group and glucagon-like peptide 2 in the 14-g oat oil lipid group relative to the control groups. Energy intake was also reduced among women that consumed the yogurt containing 35 g oat oil lipids; however, the effect was not statistically significant. These findings suggest that consumption of large amounts of oat oil many times greater than the intended use level of Oat Oil PL40 results in minor, transient gastrointestinal disturbances and changes in postprandial blood biomarkers indicative of a lower glycemic state.

A randomized, single-blind crossover study was conducted to examine the effect of oat polar lipids (Oat Oil PL40) on postprandial and second meal glycemic regulation, blood lipids, gastrointestinal hormones, and subjective appetite. A group of 20 healthy adults (5 men, 15 women, aged 20 to 40 years with body mass index of 19 to 25 kg/m^2) were provided 4 test beverages in randomized order with a 1-week washout between each test substance (Hossain *et al.*, 2021). The test substance was provided in the morning as a liquid breakfast after an overnight fast, and consisted of an oat-based liquid preparation containing oat oil and no added lipids (control), 30 g of added oat oil with a concentration of 4% polar lipids, 30 g of Oat Oil PL40, or 30 g of rapeseed oil. Blood samples were collected 0 (baseline), 30, 45, 60, 90, 120, 210 (standard lunch provided), 240, 255, 270, 300, and 330 minutes after breakfast. No significant adverse effects were reported on fasting glucose, postprandial blood glucose, glucose area under the curve, fasting blood insulin, blood insulin prior to second meal, postprandial insulin response, insulin area under the curve, fasting triglycerides, postprandial triglycerides, fasting free fatty acids, postprandial free fatty acids, ghrelin, glucagon like peptide-1, peptide YY, gastric inhibitory peptide, or subjective appetite. The study did not include subjective measures of self-reported adverse effects; however, the study does support the short-term tolerability of very high intakes of Oat Oil PL40.

6.5 Allergenicity

Since Oat Oil PL40 is a refined plant oil, it is not anticipated to be a risk of allergenicity or hypersensitivity beyond that of oats themselves and certainly of no higher allergenic risk than common food allergens such as soya or egg, or products produced from common food allergens such as soy lecithin. Reviews of the published literature indicated that the refinement process involved in the manufacture of vegetable oils removes or considerably decreases the allergenicity of oils. Vegetable-derived oils demonstrate very little allergenic risk (Crevel *et al.*, 2000). However, it must be noted that Oat Oil PL40 is not a highly refined oil and contains some residual oat proteins.

Proteins have the potential to act as allergens if they possess epitopes for binding immunoglobulin E and epitopes that can induce a type 2 T-lymphocyte response. Other structural elements which permit resistance to digestion or confer some enzymatic activity may also contribute to allergenic potential (Huby *et al.*, 2000). The U.S. FDA (2006) has identified 8 whole foods or food groups (milk, eggs, fish, crustacean shellfish, tree nuts, peanuts, wheat, and soybeans) which account for 90% of food allergies and serious reactions to foods. In many instances the proteins responsible for the allergenic reactions have not been fully characterized. These proteins or structurally similar proteins could also be present in other foods or products thereof, such as edible oils containing residual protein (U.S. FDA, 2006).

While oats are not included in the list of major food allergens, case studies in the published literature indicate that individuals may be allergic to proteins in oats (Estrada-Reyes *et al.*, 2008; Inuo *et al.*, 2013; Ototake *et al.*, 2015; Prados-Castaño *et al.*, 2016; Tomás-Pérez *et al.*, 2020). The allergic reactions may be caused by cross-reactivity as a result of an allergy to a major food allergen or due to hypereosinophilia and hyper-immunoglobulin E syndrome, as in the case reported by Estrada-Reyes *et al.* (2008). Regardless, the potential for allergenicity cannot be excluded where oat protein is present, even though, based on the small number of case studies, the incidence of allergy appears rare.

The concentration of crude protein in Oat Oil PL40 is approximately 2.34%. Under the intended conditions of use of Oat Oil PL40 (Table 1.3-1), the estimated per-serving exposure to oat protein would be approximately 0.004[3] to 0.112[4] g, depending on the food. The concentration of protein in oats is approximately 12.5% according to the U.S. Department of Agriculture (USDA ARS, 2019). Based on the typical serving sizes for oat-containing products, the estimated consumption of oat protein may be up to 1.875[5] g/serving. Thus, the consumption of Oat Oil PL40 is expected to present a lower allergenic risk when compared to oats already consumed in the normal diet.

The FDA notes that there have been reports of individuals with celiac disease who are not able to tolerate oats, although there was no scientific consensus reached at the time of publication of the FDA's guidance (U.S. FDA, 2006). Naturex has conducted evaluations of Oat Oil PL40 gluten content demonstrating the absence of gluten from potential contamination of the raw material from gluten grain sources (*e.g.*, wheat, barley, rye) at concentrations below the 20 mg/kg limit for labelling food as gluten-free, and is therefore not expected to present a tolerance issue among persons with celiac disease or gluten intolerance (21 CFR §101.91 – U.S. FDA, 2021).

While Oat Oil PL40 is expected to have a lower potential for allergenicity compared to oats normally consumed in the diet, there is no evidence to definitely exclude its allergenic potential. Therefore, the ingredient is intended to be labelled using the word "oat" in the ingredient name so that consumers who may have oat allergies will be able to make informed decisions on the use of products containing Oat Oil PL40.

6.6 GRAS Panel Evaluation

Naturex has concluded that Oat Oil PL40 is GRAS for use in conventional food and beverage products, including as an emulsifier in standardized chocolate, as described in Section 1.3, on the basis of scientific procedures. This GRAS conclusion is based on data generally available in the public domain pertaining to the safety of Oat Oil PL40, as discussed herein, and on consensus among a panel of experts (the GRAS Panel) who are qualified by training and experience to evaluate the safety of food ingredients. The GRAS Panel consisted of the following qualified scientific experts: Joseph Borzelleca, Ph.D. (Department of Pharmacology and Toxicology, VCU School of Medicine), Robert Nicolosi, Ph.D. (RJ Nicolosi Inc.), and Gary Williams, MD (Department of Pathology, New York Medical College).

The GRAS Panel, convened by Naturex, independently and critically evaluated all data and information presented herein, and also concluded that Oat Oil PL40 is GRAS for use in conventional food and beverage products, including standardized chocolate, as described in Section 1.3, based on scientific procedures. A summary of data and information reviewed by the GRAS Panel, and evaluation of such data as it pertains to the proposed GRAS uses of Oat Oil PL40, is presented in Appendix A.

[3] Calculation: ["Margarine, and Margarine-Like Spreads" use level of 1 g/100 g or 0.15 g/serving] * [2.34 % protein].
[4] Calculation: ["Non-Milk-Based Meal Replacement Beverages" use level of 2 g/100 g or 4.8 g/serving] * [2.34 % protein].
[5] [Reference Amounts Customarily Consumed per Eating Occasion (RACC) for "Cereals, dry instant" of 15 g] * [12.5% protein].

6.7 Conclusion

Based on the above data and information presented herein, Naturex has concluded that Oat Oil PL40 (oat polar lipids) is GRAS, on the basis of scientific procedures, for use in food and beverage products as described herein. General recognition of Naturex's GRAS conclusion is supported by the unanimous consensus rendered by an independent Panel of Experts, qualified by experience and scientific training, to evaluate the use of Oat Oil PL40 in food, who similarly concluded that the proposed uses of Oat Oil PL40 are GRAS on the basis of scientific procedures.

Oat Oil PL40 therefore may be marketed and sold for its intended purpose in the U.S. without the promulgation of a food additive regulation under Title 21, Section 170.3 of the *Code of Federal Regulations*.

Part 7. §170.255 List of Supporting Data and Information

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Part	Section §	Section Title
101—Food labeling	101.12	Reference amounts customarily consumed per eating occasion
	101.91	Gluten-free labeling of food
163—Cacao products	[Full Part]	
170—Food additives	170.3	Definitions
	170.30	Eligibility for classification as generally recognized as safe (GRAS)
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APPENDIX A

GRAS PANEL CONSENSUS STATEMENT

GRAS Panel Consensus Statement Concerning the Generally Recognized as Safe (GRAS) Status of Oat Oil PL40 for Use in Foods

4 April 2022

INTRODUCTION

At the request of Swedish Oat Fiber (acquired by Naturex [Part of Givaudan]), a panel of independent scientists (the "GRAS Panel"), qualified by their relevant national and international experience and scientific training to evaluate the safety of food ingredients, was specially convened on 15 August 2019 to conduct a critical and comprehensive evaluation of the available pertinent data and information and to determine whether, under the conditions of intended use as an ingredient in traditional foods, Oat Oil PL40 (oat polar lipids) would be Generally Recognized as Safe (GRAS), based on scientific procedures. The GRAS Panel consisted of the below-signed qualified scientific experts: Joseph F. Borzelleca, PhD. (Department of Pharmacology and Toxicology, VCU School of Medicine), Robert Nicolosi, PhD. (Emeritus Professor, Department of Clinical Laboratory & Nutrition Services, University of Massachusetts-Lowell.), and Gary Williams, MD (Department of Pathology, New York Medical College). Since the original GRAS evaluation was conducted, the intended uses of Oat Oil PL40 have been amended and the safety assessment has been updated. The original GRAS Panel was re-convened to confirm the GRAS status of Oat Oil PL40 under the amended conditions of use.

The GRAS Panel, independently and collectively, critically examined a comprehensive package of publicly available scientific information and data compiled from the literature and other published sources based on searches of the published scientific literature conducted through November 2021. In addition, the GRAS Panel evaluated other information deemed appropriate or necessary, including data and information provided by Naturex. The data evaluated by the GRAS Panel included information pertaining to the method of manufacture and product specifications, analytical data (batch and stability analyses), intended use levels in specified food products, consumption estimates for all intended uses, and comprehensive literature on the safety of Oat Oil PL40 and its individual constituents.

Following an independent, critical evaluation of such data and information, the GRAS Panel unanimously concluded that under the conditions of intended use in traditional foods described herein, Oat Oil PL40, meeting appropriate food-grade specifications and manufactured consistent with current Good Manufacturing Practices (cGMP), is GRAS based on scientific procedures. A summary of the basis for the GRAS Panel's conclusion, excluding confidential data and information, is provided below.

COMPOSITION, MANUFACTURING, AND SPECIFICATIONS

Oat Oil PL40 evaluated by the GRAS Panel is produced by Naturex and is marketed under the following synonyms and trade names: SWEOAT© Oil PL40; oat polar lipids; oat lipid extract; oat polar lipid extract; and vegetable oil (oat). Oat Oil PL40 is a yellow-brown oil with a typical oat cereal taste produced from the lipid extraction of oat (*Avena sativa*) kernels. Oat kernels typically contain 8.3% total lipid of which 21% of the oil is polar lipids (glycolipids and phospholipids).

INTENDED USE AND ESTIMATED EXPOSURE

Naturex intends to market Oat Oil PL40 as a vegetable oil that will fulfill similar roles as other vegetable oils currently on the market in the U.S. Oat Oil PL40 may be used as an ingredient in foods as a source of oat phospholipids and may either be added to existing products or may replace other vegetable oils within those products. As a nutrient source, the inclusion of Oat Oil PL40 will be reflected in amendments to the nutrition facts labelling of food, as necessary. It will be used across multiple food and beverage categories as described in Table A-1. Oat Oil PL40 is intended to be used as an emulsifier in standardized chocolate due to limitations on the optional additives permitted in chocolate under the relevant standard of identification in the U.S. *Code of Federal Regulations* (CFR)[1]. Studies have been completed which demonstrate the functionality of Oat Oil PL40 as an emulsifier in chocolate and other foods and beverages.

The GRAS Panel reviewed the estimates for the intake of Oat Oil PL40 which were generated using the maximum use level indicated for each intended food use, as presented in Table A-1, together with food consumption data available from the 2017-2018 cycle of the U.S. National Center for Health Statistics (NCHS)'s National Health and Nutrition Examination Survey (NHANES). On a consumer-only basis, the resulting mean and 90th percentile intakes of Oat Oil PL40 by the total U.S. population from proposed food uses in the U.S., were estimated to be 0.71 g/person/day (11.2 mg/kg body weight/day) and 1.43 g/person/day (25.9 mg/kg body weight/day), respectively. Among the individual population groups, male adults were determined to have the highest mean and 90th percentile intakes of Oat Oil PL40 at 0.79 g/person/day (9.0 mg/kg body weight/day) and 1.80 g/person/day (19.2 mg/kg body weight/day), respectively. Children aged 2 to 5 years had the lowest mean and 90th percentile consumer-only intakes of 0.43 and 0.83 g/person/day (25.3 and 55.8 mg/kg body weight/day), respectively, on an absolute basis. When expressed on a body weight basis, this group had the highest daily mean and 90th percentile intakes. Although younger populations were identified as the groups having higher exposures to Oat Oil PL40 on a body weight basis, the GRAS Panel noted that products containing Oat Oil PL40 will not serve as their primary source of fat or nutrients in the diet. Estimates described herein assume *all* products, including those consumed by younger individuals, would contain Oat Oil PL40 at the maximum intended use levels. In actuality, these products would, in the worst case, only be consumed incidentally, and intakes described in the older populations (*i.e.*, not more than 10.3 and 25.7 mg/kg body weight/day at the mean and 90th percentile, respectively) are expected to be more accurate estimates of dietary exposure among the intended population.

The intakes of polyunsaturated fatty acids (PUFAs), monounsaturated fatty acids (MUFAs), and saturated fatty acids (SFAs) from the consumption of Oat Oil PL40 were estimated using the average content of each fatty acid group in 4 batches of Oat Oil PL40. The GRAS Panel noted that the highest intakes (*i.e.*, 90th percentile) of these substances in male adults were negligible and contributed less than 1 g/day to the background intake of each substance. The cumulative intake of these fatty acids in the U.S. population is not expected to be impacted significantly. The GRAS Panel reviewed the data and information on the intended food uses and estimated exposures and concluded that the use of Oat Oil PL40 as an alternative to existing vegetable oils will not increase consumption of lipid constituents.

[1] In standardized chocolate, oat oil is intended to be used only as an emulsifier due to the limitations on the types of optional additives permitted under Title 21 §163 of the CFR (U.S. FDA, 2021). In sweet chocolate, milk chocolate, buttermilk chocolate, skim milk chocolate, and mixed dairy products, the total combined emulsifying agent content may not exceed 1.0% by weight (U.S. FDA, 2021). Additionally, emulsifying agents may not exceed a total of 1.5% by weight in white chocolate (U.S. FDA, 2021). Oat Oil PL40 is not intended to be used under the U.S. standard of identity for chocolate for any purpose outside of emulsification.

Oats also contain epoxy- and hydroxy- fatty acids at concentrations in the total oil of up to 3.3% and 0.4%, respectively (Leonova *et al.*, 2008). Hydroxy- and epoxy-fatty acids are produced by an endogenous enzymatic process that commonly uses oleic acid as a substrate, although linoleic and linolenic acids may also be used by the oat plant (Leonova *et al.*, 2008; Doehlert *et al.*, 2010; Meesapyodsuk and Qiu, 2011). Hydroxy fatty acids are commonly reported in the polar lipid fraction while epoxy fatty acids are mainly present in the neutral lipid fraction of the total fats (Leonova *et al.*, 2008; Doehlert *et al.*, 2010; Meesapyodsuk and Qiu, 2011). There is evidence that these hydroxy and epoxy fatty acids have been consumed as part of the normal diet, either from oats or from other foods. Beyond dietary occurrence, epoxides of fatty acids have also been reported to be naturally produced in the nervous system *via* cytochrome P450 enzymes (Morisseau *et al.*, 2010). Under the intended conditions of use of Oat Oil PL40, the estimated exposure to hydroxy- and epoxy- fatty acids is expected to be similar to that from consumption of oats and other commercial edible and frying oils in the normal diet.

The GRAS Panel concluded that the constituents of Oat Oil PL40 are naturally occurring substances which are commonly found in other foods and that none of these constituents are predicted to give rise to safety concerns under the intended conditions of use.

Consumption of oats is widespread in the U.S. The GRAS Panel reviewed background consumption of oats by the U.S. population as estimated using data from the 2017-2018 NHANES survey combined with the oat content identified in the Food and Nutrient Database for Dietary Studies for each of the relevant food codes (USDA ARS, 2021a,b). A total of 89 food codes were identified as containing oats in the NHANES 2017-2018 database. Based on the estimated intake of oat-containing foods, the consumer-only intakes of oat oil from the background diet were calculated assuming an oil content of 8.3% in oats and compared to the consumer-only intakes of Oat Oil PL40. The results for the intake of Oat Oil PL40 on an absolute and body weight-basis across all population groups were lower than the intake of oat oil from the consumption of oats. The intake of polar lipids from the consumption of oats in the background diet was also calculated assuming a polar lipid content of 1.7% in oats (Doehlert *et al.*, 2010) and compared to the intake of polar lipids from Oat Oil PL40 based on the mean polar lipid content of 43% from 4 representative batches. The results indicated that consumption of polar lipids from both sources were comparable. Based on the intake estimates, the intake of Oat Oil PL40 from the proposed uses is not expected to pose a safety concern in consumers.

Metabolic Fate

The GRAS Panel evaluated the metabolic fate of Oat Oil PL40 and its constituents (triglycerides, phospholipids, and glycolipids) following consumption in the diet. The constituents are expected to exhibit similar metabolic fates to that of other edible vegetable oils and fatty acids derived from common sources. According to the Institute of Medicine (IOM, 2005), when ingested, dietary lipids are hydrolyzed by buccal, gastric, pancreatic, and intestinal lipases. Lipases catalyze the breakdown of triglycerides into free fatty acids and acylglycerols. The long chain fatty acid lipids are digested in the upper portion of the small intestine before the breakdown products are absorbed.

chromosomal aberration test is a viable alternative to the *in vitro* mammalian cell micronucleus test, as it also evaluates clastogenic potential. There was no reported evidence of genotoxicity at up to the highest test concentrations used (5,000 µg/plate and 5,000 µg/mL for the bacterial reverse mutation assay and chromosomal aberration assay, respectively). These genotoxicity studies corroborate the safety of Oat Oil PL40.

Published Preclinical Studies

Oat oil preparations have been investigated in mice and rats to examine its potential protective effects against certain pathological states. These studies, although not designed to investigate safety, provide additional support that administration of Oat Oil PL40 is safe. The oat oils tested in these studies were not Oat Oil PL40 and have different ratios of polar lipids to triglycerides.

In a 35-day repeated dose study in male Swiss mice, animals were administered deltamethrin alone or in combination with a hexane-extracted oat oil, or the oat oil alone without deltamethrin to evaluate the effect of oat oil on reproductive parameters (Ben Halima *et al.*, 2014). There were no statistically significant effects of the oat oil on sperm parameters. Co-administration of the oat oil ameliorated testicular biochemical markers of toxicity and the histopathological changes in the testes caused by deltamethrin exposure.

In a 30-day study, the effect of a supercritical carbon dioxide extract from oat fiber was evaluated in Wistar-Lewis rats fed a hypercholesteremic diet supplemented with 70-g/kg diet of the oat extract or soybean oil to evaluate the effect of the extract on diet-induced hypercholesteremia (Tong *et al.*, 2014). There was no statistically significant adverse effect of the oat extract on body weight, body weight gain, food intake, or liver weight relative to the soybean oil control group. Oat extract reduced total adipose tissue and white adipose tissue sites without any effect on brown adipose tissue, relative to the control group. Liver cholesterol, free cholesterol, cholesterol ester, and liver triglycerides were statistically significantly decreased relative to the control group.

A study was conducted on the modulation of liver preneoplastic lesions in which female Sprague-Dawley rats were administered diets containing 10% corn oil or 10% oat lipids during a 4-week tumor initiation phase and a 5-month tumor promotion phase (Li *et al.*, 1999). There were no differences in body weight, liver weights, or growth between the oat lipid and corn oil groups. Oat lipid consumption exerted a protective effect against the formation of pre-neoplastic hepatic foci. I-compounds ("indigenous compounds"), endogenously produced bulky DNA modifications which occur in response to dietary restriction or consumption of certain unprocessed foods, were increased in the oat lipid group. The study investigators in this study and previously (Li *et al.*, 1992) attributed the increase in I-compounds in rats to a sterol present in the oat oil. There is no indication in this study or elsewhere in the literature that suggests these endogenous compounds could form carcinogenic adducts.

Published Clinical Studies

In a single-dose study, subjects (10 male and 9 female healthy adults with mean body mass index of 25 and mean age of 42 years) consumed in the first phase yogurt with 35 g milk fat (control) or oat oil lipids and in the second phase, yogurt with 35 g milk fat (control), 14 g oat oil lipids with 21 g milk fat, or 1.8 g oat oil lipids with 33.2 g milk fat (Ohlsson *et al.*, 2014). Subjects reported that 14 g oat lipids were not very palatable and there were reports of gastrointestinal discomfort in the first few hours after exposure. There were statistically significant reductions in plasma postprandial cholecystokinin, glucagon-like peptides 1 and 2, and peptide YY in the 14 g and 35 g oat oil lipid groups. Energy intake was also reduced among women

SUMMARY

We, the members of the GRAS Panel, have, independently and collectively, critically evaluated the data and information summarized above that is pertinent to the safety of the proposed use in foods and beverages, including standardized chocolate, of Oat Oil PL40. We unanimously conclude that the proposed use of Oat Oil PL40 manufactured by Naturex, consistent with good manufacturing practice (cGMP) and meeting appropriate food-grade specifications is Generally Recognized as Safe (GRAS) based on scientific procedures.

It is our professional opinion that other qualified experts would also concur with these conclusions.

[redacted]

Professor Emeritus Joseph F. Borzelleca, Ph.D.
Virginia Commonwealth University School of Medicine

16 April 2022
Date

[redacted]

Professor Emeritus Robert J. Nicolosi, Ph.D.
University of Massachusetts Lowell

25 April 2022
Date

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Professor Gary Williams, MD
New York Medical College

22 April 2022
Date

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Attachment A Intended Uses and Use Levels for Oat Oil PL40

Table A-1 Summary of the Individual Proposed Food Uses and Use Levels for Oat Oil PL40 in the U.S.

Food Category (21 CFR §170.3) (U.S. FDA, 2021b)	Food Uses	RACC[a] (g or mL)	Oat Oil Use Levels (g/100 g)
Baked Goods and Baking Mixes	Cakes		
	Heavy weight cakes	125	1.0
	Medium weight cakes	80	1.0
	Light weight cakes	55	1.0
	Muffins	110	1.0
	Biscuits	55	1.0
Beverages and Beverage Bases	Non-Milk-Based Meal Replacement Beverages	240	2.0
Dairy Product Analogs	Coffee/Tea Whiteners[b]	15	3.0
Fats and Oils	Margarine and Margarine-Like Spreads	15 (or 1 tbsp)	1.0
Nuts and nut products	Nut spreads	30 (or 2 tbsp)	2.0
Soft Candy	Chocolate[c]	30	1.0
	White chocolate[c]	30	1.5

CFR = *Code of Federal Regulations*; RACC = Reference Amounts Customarily Consumed per Eating Occasion; U.S. = United States.

[a] RACC based on values established in 21 CFR §101.12 (U.S. FDA, 2021c). RACCs are included for reference; however, the assessment was conducted based on use levels expressed per liter.

[b] No RACC available; the RACC for cream included as a surrogate.

[c] In standardized chocolate, oat oil is intended to be used only as an emulsifier due to the limitations on the types of optional additives permitted under Title 21 §163 of the CFR (U.S. FDA, 2021d). In sweet chocolate, milk chocolate, buttermilk chocolate, skim milk chocolate, and mixed dairy products, the total combined emulsifying agent content may not exceed 1.0% by weight (U.S. FDA, 2021). Additionally, emulsifying agents may not exceed a total of 1.5% by weight in white chocolate (U.S. FDA, 2021). Oat Oil PL40 is not intended to be used under the U.S. standard of identity for chocolate for any purpose outside of emulsification.

APPENDIX B

CERTIFICATES OF ANALYSIS

NAME

PRODUCT CODE

DESCRIPTION

An oat oil with a yellowish brown colour and oat cereal taste. Contains natural antioxidants and is rich in polar lipids (phospho- and galactolipids)

BATCH #	MANUFACTURE DATE
PL40-20170102	6-Jan-2017
ORDER # CUSTOMER	ANALYSIS DATE
	9-Jan-2017
ORDER # SOF	BEST BEFORE DATE
	8-Jul-2018

ITEM	STANDARD	RESULT	METHOD
Sensorial characteristics	Oat cereal taste.	Complies	Sensorial
Appearance	Oil with a yellowish brown colour	Complies	Visual
Polar lipids	>35%	44,0%	Internal method
Water	<2%	0,3%	Karl Fischer
[1]Ethanol residue	<500ppm	59ppm	16 M 54 5141 9 GC-FID
Acid value	<30mg KOH/g	NA	Metler Toledo application, M621-2012
Peroxide value	<10 meq O_2/kg fat	1,8%	Metler Toledo application, M624-2012
[1] Moulds	< 100 cfu/g	Complies	NMKL98,2005
[1]Yeast	< 100 cfu/g	Complies	NMKL98,2005
[1]Aerobic plate count	< 1000 cfu/g	Complies	3M 01/01-09/89
[1]Enterobacteriaceae	< 10 cfu/g	Complies	NMKL 144
[1]Aerobic spores	<1 cfu/g	Complies	Internal method
[2]Mycotoxins	According to EU regulation 1881/2006	Complies	LC-MS/MS
[2]Pesticide residues	According to EU regulation 396/2005	Complies	SLVM917, SLVK1f4m016.1

[1] Spot checks of batches

[2] Spot checks when we start using new harvest

Date
9-Jan-2017

Ellen Hedrén
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NAME

PRODUCT CODE

DESCRIPTION

An oat oil with a yellowish brown colour and oat cereal taste. Contains natural antioxidants and is rich in polar lipids (phospho- and galactolipids)

BATCH #	MANUFACTURE DATE
PL40-20170106	10-Jan-2017
ORDER # CUSTOMER	ANALYSIS DATE
	13-Jan-2017
ORDER # SOF	BEST BEFORE DATE
	12-Jul-2018

ITEM	STANDARD	RESULT	METHOD
Sensorial characteristics	Oat cereal taste.	Complies	Sensorial
Appearance	Oil with a yellowish brown colour	Complies	Visual
Polar lipids	>35%	41,9%	Internal method
Water	<2%	0,3%	Karl Fischer
[1]Ethanol residue	<500ppm	79,4ppm	16 M 54 5141 9 GC-FID
Acid value	<30mg KOH/g	NA	Metler Toledo application, M621-2012
Peroxide value	<10 meq O_2/kg fat	1,1%	Metler Toledo application, M624-2012
[1] Moulds	< 100 cfu/g	Complies	NMKL98,2005
[1]Yeast	< 100 cfu/g	Complies	NMKL98,2005
[1]Aerobic plate count	< 1000 cfu/g	Complies	3M 01/01-09/89
[1]Enterobacteriaceae	< 10 cfu/g	Complies	NMKL 144
[1]Aerobic spores	<1 cfu/g	Complies	Internal method
[2]Mycotoxins	According to EU regulation 1881/2006	Complies	LC-MS/MS
[2]Pesticide residues	According to EU regulation 396/2005	Complies	SLVM917, SLVK1f4m016.1

[1] Spot checks of batches

[2] Spot checks when we start using new harvest

Date
13-Jan-2017

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NAME

PRODUCT CODE

DESCRIPTION

An oat oil with a yellowish brown colour and oat cereal taste. Contains natural antioxidants and is rich in polar lipids (phospho- and galactolipids)

BATCH #	MANUFACTURE DATE
40FO-071216	16-Dec-2016
ORDER # CUSTOMER	ANALYSIS DATE
	19-Dec-2016
ORDER # SOF	BEST BEFORE DATE
	17-Jun-2018

ITEM	STANDARD	RESULT	METHOD
Sensorial characteristics	Oat cereal taste.	Complies	Sensorial
Appearance	Oil with a yellowish brown colour	Complies	Visual
Polar lipids	>35%	44,7%	Internal method
Water	<2%	0,7%	Karl Fischer
[1]Ethanol residue	<500ppm	79,1ppm	16 M 54 5141 9 GC-FID
Acid value	<30mg KOH/g	9,8%	Metler Toledo application, M621-2012
Peroxide value	<10 meq O_2/kg fat	0,5%	Metler Toledo application, M624-2012
[1] Moulds	< 100 cfu/g	Complies	NMKL98,2005
[1]Yeast	< 100 cfu/g	Complies	NMKL98,2005
[1]Aerobic plate count	< 1000 cfu/g	Complies	3M 01/01-09/89
[1]Enterobacteriaceae	< 10 cfu/g	Complies	NMKL 144
[1]Aerobic spores	<1 cfu/g	Complies	Internal method
[2]Mycotoxins	According to EU regulation 1881/2006	Complies	LC-MS/MS
[2]Pesticide residues	According to EU regulation 396/2005	Complies	SLVM917, SLVK1f4m016.1

[1] Spot checks of batches

[2] Spot checks when we start using new harvest

Date
19-Dec-2016

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NAME

PRODUCT CODE

DESCRIPTION
An oat oil with a yellowish brown colour and oat cereal taste. Contains natural antioxidants and is rich in polar lipids (phospho- and galactolipids)

CERTIFICATE OF ANALYSIS

BATCH #	MANUFACTURE DATE
40FO-131216	22-Dec-2016
ORDER # CUSTOMER	ANALYSIS DATE
	25-Dec-2016
ORDER # SOF	BEST BEFORE DATE
	23-Jun-2018

ITEM	STANDARD	RESULT	METHOD
Sensorial characteristics	Oat cereal taste.	Complies	Sensorial
Appearance	Oil with a yellowish brown colour	Complies	Visual
Polar lipids	>35%	42,4%	Internal method
Water	<2%	0,2%	Karl Fischer
[1]Ethanol residue	<500ppm	54,9ppm	16 M 54 5141 9 GC-FID
Acid value	<30mg KOH/g	NA	Metler Toledo application, M621-2012
Peroxide value	<10 meq O_2/kg fat	2,5%	Metler Toledo application, M624-2012
[1] Moulds	< 100 cfu/g	Complies	NMKL98,2005
[1]Yeast	< 100 cfu/g	Complies	NMKL98,2005
[1]Aerobic plate count	< 1000 cfu/g	Complies	3M 01/01-09/89
[1]Enterobacteriaceae	< 10 cfu/g	Complies	NMKL 144
[1]Aerobic spores	<1 cfu/g	Complies	Internal method
[2]Mycotoxins	According to EU regulation 1881/2006	Complies	LC-MS/MS
[2]Pesticide residues	According to EU regulation 396/2005	Complies	SLVM917, SLVK1f4m016.1

[1] Spot checks of batches

[2] Spot checks when we start using new harvest

Date
25-Dec-2016

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eurofins

Rapport utfärdad av ackrediterat laboratorium

Report issued by Accredited Laboratory

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AR-17-SB-070825-01

EUSEJO2-00256131

Client code:: LW1000416

Reference:
006-10511-134525

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ANALYTICAL REPORT

Sample code:	**527-2017-11150359**
Client Sample:	PL40-20170102
Received:	2017-11-15
Report finished:	2017-11-23
Start of analysis	2017-11-16 13:41
Client sample code	PL40-20170102

	Analysis	Result Unit	Num	Method	Lab
UMF50	Aerobic Plate Count 30°C	**< 3.0** log cfu/g	< 1000	3M 01/01-09/89	*EUSEJO2*
UMD53	Enterobacteriaceae 37°C	**< 1.0** log cfu/g	< 10	NMKL 144	*EUSEJO2*
UMN88	Yeast	**< 2.0** log cfu/g	< 100	NMKL 98	*EUSEJO2*
UMP73	Moulds	**< 2.0** log cfu/g	< 100	NMKL 98	*EUSEJO2*
UMY2U *	Spore-forming Aerobic Mesophilic Count	**< 1** cfu/g		Internal Method	*EUSEJO2*

Copy to:
Pia Waldefelt (p.w@sweoat.se)

Emma Berglind, ASM
Contact: mikro.asm@eurofins.se

This test report has been created electronically and has been verified and authorised.

Test was performed by

EUSEJO2 Eurofins Food & Feed Testing Sweden (Jönköping)

The laboratory/laboratories are accredited by the respective national accreditation body. Non-accredited tests are marked *.

Symbol description:
* Not accredited

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Rapport utfärdad av ackrediterat laboratorium

Report issued by Accredited Laboratory

SWEDAC ACKREDITERING 1977 ISO/IEC 17025

Eurofins Food & Feed Testing Sweden (Jönköping)
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SE-55115 Jönköping
www.eurofins.se

Swedish Oat Fiber
Pia Waldefelt
Båtafjordsvägen 12
432 63 BUA

AR-17-SB-070826-01

EUSEJO2-00256131

Client code:: LW1000416

Reference:
006-10511-134525

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ANALYTICAL REPORT

Sample code:	**527-2017-11150360**
Client Sample:	PL40-20170106
Received:	2017-11-15
Report finished:	2017-11-23
Start of analysis	2017-11-16 13:41
Client sample code	PL40-20170106

	Analysis	Result	Unit	Num	Method	Lab
UMF50	Aerobic Plate Count 30°C	**< 3.0**	log cfu/g	< 1000	3M 01/01-09/89	*EUSEJO2*
UMD53	Enterobacteriaceae 37°C	**< 1.0**	log cfu/g	< 10	NMKL 144	*EUSEJO2*
UMN88	Yeast	**< 2.0**	log cfu/g	< 100	NMKL 98	*EUSEJO2*
UMP73	Moulds	**< 2.0**	log cfu/g	< 100	NMKL 98	*EUSEJO2*
UMY2U *	Spore-forming Aerobic Mesophilic Count	**< 1**	cfu/g		Internal Method	*EUSEJO2*

Copy to:
Pia Waldefelt (p.w@sweoat.se)

Emma Berglind, ASM
Contact: mikro.asm@eurofins.se

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Test was performed by

EUSEJO2 Eurofins Food & Feed Testing Sweden (Jönköping)

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EUSEJO2-00256131

Client code:: LW1000416

Reference:
006-10511-134525

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ANALYTICAL REPORT

Sample code:	**527-2017-11150361**
Client Sample:	40FO-071216
Received:	2017-11-15
Report finished:	2017-11-23
Start of analysis	2017-11-16 13:41
Client sample code	40FO-071216

	Analysis	Result Unit	Num	Method	Lab
UMF50	Aerobic Plate Count 30°C	< 3.0 log cfu/g	< 1000	3M 01/01-09/89	*EUSEJO2*
UMD53	Enterobacteriaceae 37°C	< 1.0 log cfu/g	< 10	NMKL 144	*EUSEJO2*
UMN88	Yeast	< 2.0 log cfu/g	< 100	NMKL 98	*EUSEJO2*
UMP73	Moulds	< 2.0 log cfu/g	< 100	NMKL 98	*EUSEJO2*
UMY2U *	Spore-forming Aerobic Mesophilic Count	< 1 cfu/g		Internal Method	*EUSEJO2*

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AR-002 MI v61

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EUSEJO2-00256131

Client code:: LW1000416

Reference:
006-10511-134525

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ANALYTICAL REPORT

Sample code:	**527-2017-11150362**
Client Sample:	40FO-131216
Received:	2017-11-15
Report finished:	2017-11-23
Start of analysis	2017-11-16 08:44
Client sample code	40FO-131216

	Analysis	Result Unit	Num	Method	Lab
UMF50	Aerobic Plate Count 30°C	**< 3.0** log cfu/g	< 1000	3M 01/01-09/89	*EUSEJO2*
UMD53	Enterobacteriaceae 37°C	**< 1.0** log cfu/g	< 10	NMKL 144	*EUSEJO2*
UMN88	Yeast	**< 2.0** log cfu/g	< 100	NMKL 98	*EUSEJO2*
UMP73	Moulds	**< 2.0** log cfu/g	< 100	NMKL 98	*EUSEJO2*
UMY2U *	Spore-forming Aerobic Mesophilic Count	**< 1** cfu/g		Internal Method	*EUSEJO2*

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Emma Berglind, ASM
Contact: mikro.asm@eurofins.se

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AR-002 MI v61

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432 63 BUA

AR-17-LW-064973-01

EUSELI-00177469

Client code:: LW1000416

Reference:
006-10511-134530

ANALYTICAL REPORT

Sample code:	**525-2017-11170024**
Client Sample:	PL40-20170102
Received:	2017-11-17
Report finished:	2017-11-29
Client sample code	PL40-20170102
Start of analysis	2017-11-17

		Analysis	Result	MRL	Unit	Uncert.	Method	Lab
SL403		Lead (Pb)	**< 0.040**		mg/kg	± 25%	NMKL No 161 1998 mod	*EUSELI2*
SL404		Cadmium (Cd)	**< 0.020**		mg/kg	± 25%	NMKL No 161 1998 mod	*EUSELI2*
J5012		Deoxynivalenol (Vomitoxin)	**<20**		µg/kg		Internal method	*EUHAWE3*
LP152	*	Ethanol	**59.0**		mg/kg	± 10%	Internal Method - GC-FID	*EUSELI*

LP110: No pesticide residue detected (NMKL 195 mod.).

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Pia Waldefelt (p.w@sweoat.se)

Mariana Eriksson, ASM

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Test was performed by

EUHAWE3	Eurofins WEJ Contaminants GmbH (Hamburg)
EUSELI	Eurofins Food & Feed Testing Sweden (Lidköping)
EUSELI2	Eurofins Environment Sweden, Lidköping

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AR-004 v27

Uncert: Measurement uncertainty
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Performing laboratory if nothing else is stated: Eurofins Food & Feed Testing Sweden (Lidköping)

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AR-17-LW-064974-01

EUSELI-00177469

Client code:: LW1000416

Reference:
006-10511-134530

ANALYTICAL REPORT

Sample code:	**525-2017-11170026**
Client Sample:	PL40-20170106
Received:	2017-11-17
Report finished:	2017-11-29
Client sample code	PL40-20170106
Start of analysis	2017-11-17

		Analysis	Result	MRL	Unit	Uncert.	Method	Lab
SL403		Lead (Pb)	**< 0.040**		mg/kg	± 25%	NMKL No 161 1998 mod	*EUSELI2*
SL404		Cadmium (Cd)	**< 0.020**		mg/kg	± 25%	NMKL No 161 1998 mod	*EUSELI2*
J5012		Deoxynivalenol (Vomitoxin)	**<20**		µg/kg		Internal method	*EUHAWE3*
LP152	*	Ethanol	**79.4**		mg/kg	± 10%	Internal Method - GC-FID	*EUSELI*

LP110: No pesticide residue detected (NMKL 195 mod.).

Copy to:
Pia Waldefelt (p.w@sweoat.se)

Mariana Eriksson, ASM

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Test was performed by

EUHAWE3	Eurofins WEJ Contaminants GmbH (Hamburg)
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EUSELI2	Eurofins Environment Sweden, Lidköping

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AR-004 v27

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AR-17-LW-064975-01

EUSELI-00177469

Client code:: LW1000416

Reference:
006-10511-134530

ANALYTICAL REPORT

Sample code:	**525-2017-11170027**
Client Sample:	40FO-071216
Received:	2017-11-17
Report finished:	2017-11-29
Client sample code	40FO-071216
Start of analysis	2017-11-17

		Analysis	Result	MRL	Unit	Uncert.	Method	Lab
SL403		Lead (Pb)	**< 0.040**		mg/kg	± 25%	NMKL No 161 1998 mod	*EUSELI2*
SL404		Cadmium (Cd)	**< 0.020**		mg/kg	± 25%	NMKL No 161 1998 mod	*EUSELI2*
J5012		Deoxynivalenol (Vomitoxin)	**<20**		µg/kg		Internal method	*EUHAWE3*
LP152	*	Ethanol	**79.1**		mg/kg	± 10%	Internal Method - GC-FID	*EUSELI*

LP110: No pesticide residue detected (NMKL 195 mod.).

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Pia Waldefelt (p.w@sweoat.se)

Mariana Eriksson, ASM

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432 63 BUA

AR-17-LW-064976-01

EUSELI-00177469

Client code:: LW1000416

Reference:
006-10511-134530

ANALYTICAL REPORT

Sample code:	**525-2017-11170028**
Client Sample:	40FO-131216
Received:	2017-11-17
Report finished:	2017-11-29
Client sample code	40FO-131216
Start of analysis	2017-11-17

		Analysis	Result	MRL	Unit	Uncert.	Method	Lab
SL403		Lead (Pb)	**< 0.040**		mg/kg	± 25%	NMKL No 161 1998 mod	*EUSELI2*
SL404		Cadmium (Cd)	**< 0.020**		mg/kg	± 25%	NMKL No 161 1998 mod	*EUSELI2*
J5012		Deoxynivalenol (Vomitoxin)	**<20**		µg/kg		Internal method	*EUHAWE3*
LP152	*	Ethanol	**54.9**		mg/kg	± 10%	Internal Method - GC-FID	*EUSELI*

LP110: No pesticide residue detected (NMKL 195 mod.).

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Mariana Eriksson, ASM

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432 63 Bua

AR-15-SB-064039-01

EUSEJO2-00168498

Client code:: LW1000416

Reference:
EOL 6960-109911

ANALYTICAL REPORT

Sample code:	**527-2015-11240612**
Client Sample:	PL40FG - FG40-210915
Received:	2015-11-24
Report finished:	2015-12-03
Start of analysis	2015-11-25 09:59
Client sample code	PL40FG - FG40-210915

	Analysis	Result Unit	Num	Method	Lab
UMF50	Aerobic Plate Count 30°C	< 3.0 log cfu/g	< 1000	3M 01/01-09/89	*EUSEJO2*
UMD53	Enterobacteriaceae 37°C	< 1.0 log cfu/g	< 10	NMKL 144	*EUSEJO2*
UMP73	Moulds	< 2.0 log cfu/g	< 100	NMKL 98	*EUSEJO2*
UMN88	Yeast	< 2.0 log cfu/g	< 100	NMKL 98	*EUSEJO2*
UMY2U *	Spore-forming Aerobe Mesophilic Count	< 1 cfu/g		Internal Method	*EUSEJO2*

Copy to:
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Katrin Peterson, ASM Telefon: +46 10 490 8352

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Symbol description:
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AR-002 Mi v51

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			acids		GC-FID	
LP056	C 17:1 n-7 (Heptadecenoic acid)	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 18:0 (Stearic acid)	1.7	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 18:1 n-9 (Oleic acid)	37.7	% of fatty acids	± 10%	Internal Method - GC-FID	EUSELI
LP056	C 18:2 n-6 (Linoleic acid)	38.4	% of fatty acids	± 10%	Internal Method - GC-FID	EUSELI
LP056	C 18:3 n-3 (α-Linolenic acid)	1.3	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 18:3 n-6 (γ-Linolenic acid)	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 18:4 n-3 (Octadecatetraenoic acid)	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 20:0 (Arachidic acid)	0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 20:1 n-9 (Gadoleic acid)	0.6	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 20:2 n-6 (Eicosadien acid)	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 20:3 n-6	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 20:3 n-3	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 20:4 n-6 (Aracidonic acid)	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 20:4 n-3	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 20:5 n-3 (EPA)	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 22:0 (Behenic acid)	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 22:1	0.2	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 22:2 n-6 (Docosadienoic acid)	0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 22:4 n-6	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 22:5 n-6	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 22:5 n-3 (Docosapentaenoic acid)	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 22:6 n-3 (DHA)	<0.1	% of fatty acids	± 20%	Internal Method - GC-FID	EUSELI
LP056	C 24:0 (Lignoceric acid)	<0.1	% of fatty	± 20%	Internal Method -	EUSELI

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AR-004 v25

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Performing laboratory if nothing else is stated: Eurofins Food & Feed Testing Sweden (Lidköping)

SL402	Arsenic (As)	< 0.050	mg/kg	± 35%	NMKL No 161 1998 mod	*EUSELI2*
SL399	Mercury (Hg)	< 0.020	mg/kg	± 30%	EN 16277:2012	*EUSELI2*
LP072	Energy value kJ (calculated)	3291	kJ/100 g		(EU) No 1169/2011	*EUSELI*
LP072	Energy value kcal (calculated)	787	kcal/100 g		(EU) No 1169/2011	*EUSELI*
LP130: No pesticide residue detected (NMKL 195 mod.).						

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Per-Olov Södergren, ASM

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Test was performed by

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EUSELI2	Eurofins Environment Sweden, Lidköping

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AR-004 v25

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Swedish Oat Fiber
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432 63 Bua

AR-16-LW-028384-01

EUSELI-00128339

Client code:: LW1000416

Reference:
EOL 8556-112996

ANALYTICAL REPORT

Sample code:	525-2016-05250211
Client Sample:	PL40 FG - 100615
Received:	2016-05-25
Report finished:	2016-06-03
Client sample code	PL40 FG - 100615
Start of analysis	2016-05-25 08:00:12

	Analysis	Result	Unit	Uncert.	Method	Lab
LW0PB	Gluten	<7.0	mg/kg	± 40%	ELISA Ridascreen	*EUSELI*

Report comments:
The limit for gluten-free products is 20 mg/kg and products with very low level 100 mg/kg according to 2009/41/EG.
ELISA-method (gluten) with monoclonal antibody R5. Reacts with gliadins from wheat and corresponding prolamins from rye and barley.

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Björn Sahlberg, ASM

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* Not accredited

AR-003 v78
1.75 130516

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Stability Study Oat Oil PL40		start	month 3	month 6	month 9	month 12	month 15	month 18	month 21	month 24
PL40FG 20170426 RT	PV meq/kg	0.3		3.17		8.63	11.85	14.51		
PL40FG 20170426 4C	PV meq/kg	0.3		1.37		2.61	4.82	7.66		

start H2O	PL	ins	FFA
2870ppm	44.80%	0.30%	