



US009816046B2

(12) **United States Patent**
Bruheim et al.

(10) **Patent No.:** **US 9,816,046 B2**
(45) **Date of Patent:** ***Nov. 14, 2017**

(54) **BIOEFFECTIVE KRILL OIL COMPOSITIONS**

(71) Applicant: **AKER BIOMARINE ANTARCTIC AS, Stamsund (NO)**

(72) Inventors: **Inge Bruheim, Volda (NO); Snorre Tilseth, Bergen (NO); Daniele Mancinelli, Orsta (NO)**

(73) Assignee: **AKER BIOMARINE ANTARCTIC AS, Stamsund (NO)**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **15/589,572**

(22) Filed: **May 8, 2017**

(65) **Prior Publication Data**
US 2017/0240842 A1 Aug. 24, 2017

Related U.S. Application Data

(63) Continuation of application No. 15/180,431, filed on Jun. 13, 2016, now Pat. No. 9,644,169, which is a continuation of application No. 14/020,162, filed on Sep. 6, 2013, now Pat. No. 9,375,453, which is a (Continued)

(51) **Int. Cl.**
C11B 3/00 (2006.01)
A61K 31/202 (2006.01)

(52) **U.S. Cl.**
CPC **C11B 3/006** (2013.01); **A61K 31/202** (2013.01)

(58) **Field of Classification Search**
None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,652,235 A 9/1953 Samuelsen
4,036,993 A 7/1977 Ikeda
4,038,722 A 8/1977 Terasse et al.
(Continued)

FOREIGN PATENT DOCUMENTS

AU 2002322233 2/2003
BR 8701265 3/1987
(Continued)

OTHER PUBLICATIONS

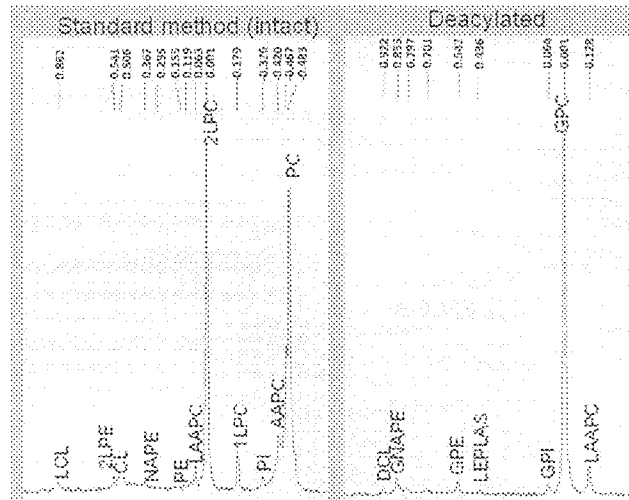
Action Closing Prosecution, 348 Patent, mailed May 14, 2013.
(Continued)

Primary Examiner — Yate K Cutliff
(74) *Attorney, Agent, or Firm* — Casimir Jones S.C.

(57) **ABSTRACT**

This invention discloses new krill oil compositions characterized by having high amounts of phospholipids, astaxanthin esters and/or omega-3 contents. The krill oils are obtained from krill meal using supercritical fluid extraction in a two stage process. Stage 1 removes the neutral lipid by extracting with neat supercritical CO₂ or CO₂ plus approximately 5% of a co-solvent. Stage 2 extracts the actual krill oils by using supercritical CO₂ in combination with approximately 20% ethanol. The krill oil materials obtained are compared with commercially available krill oil and found to be more bioeffective in a number of areas such as anti-inflammation, anti-oxidant effects, improving insulin resistances and improving blood lipid profile.

19 Claims, 19 Drawing Sheets



Related U.S. Application Data

continuation of application No. 12/057,775, filed on Mar. 28, 2008, now Pat. No. 9,034,388.

- (60) Provisional application No. 60/920,483, filed on Mar. 28, 2007, provisional application No. 60/975,058, filed on Sep. 25, 2007, provisional application No. 60/983,446, filed on Oct. 29, 2007, provisional application No. 61/024,072, filed on Jan. 28, 2008.

References Cited

U.S. PATENT DOCUMENTS

4,119,619	A	10/1978	Rogozhin et al.
4,133,077	A	1/1979	Jasniewicz
4,251,557	A	2/1981	Shimose et al.
4,505,936	A	3/1985	Meyers et al.
4,714,571	A	12/1987	Kearns et al.
4,749,522	A	6/1988	Kamarei
4,814,111	A	3/1989	Kearns et al.
5,006,281	A	4/1991	Rubin et al.
5,266,564	A	11/1993	Modolell
5,434,183	A	7/1995	Larsson-Backstrom
6,214,396	B1	4/2001	Barrier
6,346,276	B1	2/2002	Tanouchi et al.
6,537,787	B1	3/2003	Breton
6,800,299	B1	10/2004	Beaudoin
7,488,503	B1	2/2009	Porzio et al.
7,666,447	B2	2/2010	Rockway
8,030,348	B2	10/2011	Sampalis
8,278,351	B2	10/2012	Sampalis
8,383,675	B2	2/2013	Sampalis
8,586,567	B2	11/2013	Sampalis
8,697,138	B2	4/2014	Bruheim et al.
2002/0076468	A1	6/2002	Saxby
2003/0044495	A1	3/2003	Kagan
2003/0113432	A1	6/2003	Yoshitomi
2004/0241249	A1	12/2004	Sampalis
2005/0003073	A1	1/2005	Pivovarov et al.
2006/0078625	A1	4/2006	Rockway
2006/0193962	A1	8/2006	Kamiya et al.
2008/0166419	A1	7/2008	Sones
2008/0166420	A1	7/2008	Sones
2008/0268117	A1	10/2008	Rubin et al.
2008/0274203	A1	11/2008	Bruheim et al.
2010/0143571	A1	6/2010	Breivik
2010/0160659	A1	6/2010	Catchpole
2010/0226977	A1	9/2010	Tilseth et al.
2011/0130458	A1	6/2011	Breivik
2011/0160161	A1	6/2011	Sampalis
2011/0223246	A1	9/2011	Opheim et al.
2011/0224450	A1	9/2011	Sclabos et al.
2011/0256216	A1	10/2011	Lefkowitz
2014/0274968	A1	9/2014	Berge et al.
2014/0370115	A1	12/2014	Hoem et al.

FOREIGN PATENT DOCUMENTS

CA	1098900	4/1981
CA	2251265	4/2000
CL	40348	7/1997
CN	102746941	1/2014
EP	0609078	8/1994
EP	0670306	6/1995
EP	1127497	8/2001
EP	1392623	3/2004
EP	1406641	4/2004
EP	1631280	4/2004
EP	1542670	6/2005
EP	0973532	9/2005
EP	1689413	8/2006
EP	1660071	1/2007
EP	1743531	1/2007

EP	1292294	3/2009
EP	1706106	7/2009
EP	1385500	7/2010
GB	2097014	10/1982
GB	921537	6/1999
JP	A-S51-125774	11/1976
JP	A-S52-114046	9/1977
JP	60-153779	8/1985
JP	61281159	12/1986
JP	S6323819	2/1988
JP	02049091	2/1990
JP	2215351	8/1990
JP	4012665	1/1992
JP	2963152	2/1992
JP	04057853	2/1992
JP	3081692	7/1994
JP	2524217	8/1996
JP	H08-231391	9/1996
JP	3344887	7/1997
JP	3611222	8/1997
JP	2909508	6/1999
JP	A-2001-158736	6/2001
JP	A-2003-003192	1/2003
JP	A-2003-048831	2/2003
JP	A-2003-146883	5/2003
JP	3467794	9/2003
JP	2003-530448	10/2003
JP	3486778	10/2003
JP	2004-534800	11/2004
JP	3678317	5/2005
JP	A-2005-245379	9/2005
JP	A-2006-069948	3/2006
JP	A-2006-083136	3/2006
JP	A-2006-290784	10/2006
JP	A-2006-316073	11/2006
JP	A-2006-328014	12/2006
JP	A-2007-126455	5/2007
JP	A-2007-246404	9/2007
SU	220741	1/1971
WO	WO 82/02819	9/1982
WO	WO 1986/06082	10/1986
WO	WO 89/01031	2/1989
WO	WO 89/10960	11/1989
WO	WO 1990/05765	5/1990
WO	WO 1993/24142	12/1993
WO	WO 97/38585	10/1997
WO	WO 1997/38585	10/1997
WO	WO 1997/39759	10/1997
WO	WO 98/34498	8/1998
WO	WO 1998/34498	8/1998
WO	WO 99/39589	8/1999
WO	WO 1999/39589	8/1999
WO	WO 2000/23546	4/2000
WO	WO 2000/25608	5/2000
WO	WO 2000/38708	7/2000
WO	WO 2001/028526	4/2001
WO	WO 01/76385	10/2001
WO	WO 2001/082928	11/2001
WO	WO 2002/083122	10/2002
WO	WO 2002-083122	10/2002
WO	WO 2002/092540	11/2002
WO	WO 02/102394	12/2002
WO	WO 2002/102394	12/2002
WO	WO 2003/011873	2/2003
WO	WO 2003/013497	2/2003
WO	WO 2004/028529	4/2004
WO	WO 2004/047554	6/2004
WO	WO 2004/112767	12/2004
WO	WO 05/004593	1/2005
WO	WO 2005-018632	3/2005
WO	WO 2005/037848	4/2005
WO	WO 2005/038037	4/2005
WO	WO 2005/070411	8/2005
WO	WO 2006/030552	3/2006
WO	WO 2004-100943	5/2006
WO	WO 06/111633	10/2006
WO	WO 07/080515	7/2007

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

WO	WO 2007/108702	9/2007
WO	WO 07/123424	11/2007
WO	WO 2008/006607	1/2008
WO	WO 08/072563	6/2008
WO	WO 08/117062	10/2008
WO	WO 2008/117062	10/2008
WO	WO 2009/027692	3/2009
WO	WO 2010/097701	9/2010
WO	WO 2011/050474	5/2011
WO	WO 2012/139588	10/2012
WO	WO 2013/102792	7/2013
WO	WO 2014/013335	1/2014

OTHER PUBLICATIONS

Ali-Nehari et al., "Characterization of purified phospholipids from krill () residues deoiled by supercritical carbon dioxide", Korean Journal of Chemical Engineering, 2012, vol. 29, No. 7.

Allahpichay et al., "Extraction of Growth Promoting Fractions from Non-muscle Krill Meal of *Euphausia superba* and its Effect on Fish Growth," Bulletin of the Japanese Society of Scientific Fisheries, 1984, 50(5): 821-826.

Ando and Hatano, 1988, "Isolation of apolipoproteins from carotenoid-carrying lipoprotein in the serum of chum salmon, *Oncorhynchus keta*", J. Lipid Research, 29: 1264-1271.

Aoi et al., 2003, "Astaxanthin limits exercise-induced skeletal and cardiac muscle damage in mice", Antioxidants & Redox Signaling, 5(1): 139-44.

Apr. 2, 2012 Response to Office Action, '351 patent.

Balassa et al., Microencapsulation in the Food Industry, Critical Reviews in Food Technology, 2:2, 245-265 (1971)("Balassa").

Bell and Dick, Molecular Species Composition of the Major Diacyl Glycerophospholipids from Muscle, Liver, Retina and Brain of Cod (*Gadus morhua*), Lipids, vol. 26, No. 8, pp. 565-573 (1991) ("Bell and Dick").

Bell, Molecular Species Analysis of Phosphoglycerides from the Ripe Roes of Cod, Lipids, vol. 24, No. 7 (1989).

Bell, Molecular Species Composition of Phosphatidylcholine from *Cryptocodinium cohnii* in Relation to Growth Temperature Lipids 25, 115-118 (1990).

Bergelson (ed.), *Lipid Biochemical Preparations*, Chapter 1.1, pp. 1-13 (1980) ("Bergelson").

Bottino N.R., "Lipid Composition of Two Species of Antarctic Krill: *Euphausia superba* and *E. crystallorophias*," Comp. Biochem. Physiol., 1975, vol. 50B, pp. 479-484.

Britton, 1985, "General Carotenoid Methods", Methods in Enzymology, vol. 111, pp. 113-149.

Brzustowicz, Michael R., et al., "Controlling Membrane Cholesterol Content. A Role for Polyunsaturated (Docosahexaenoate) Phospholipids," Biochemistry (2002), 41, pp. 12509-12519.

Buchi R-220 Rotovapor® Manual, dated Nov. 16, 2009, pp. 1-50.

BUDA, Structural order of membranes and composition of phospholipids in fish brain cells during thermal acclimatization, Proc. Natl. Acad. Sci. USA vol. 91, pp. 8234-8238, Aug. 1994.

Budzinski, E., et al., "Possibilities of processing and marketing of products made from Antarctic Krill", FAO Fish. Tech. Pap. (268) 46 pages (1985) (Budzinski).

Bunea R., et al., "Evaluation of the Effects of Neptune Krill Oil on the Clinical Course of Hyperlipidemia," Alternative Medicine Review, Thorne Research Inc., Sandpoint, US, vol. 9, No. 4, Jan. 1, 2004.

Calder, 2006, "n-3 polyunsaturated fatty acids, inflammation, and inflammatory diseases", Am. J. Clin. Nutr., 83: 1505S.

Certificate of translation of Ex. 1072: Fisheries Agency, General Report on Research and Development of Techniques in Processing and Utilization of Marine Products, Chapter 6, Development of technology for recovery of valuable substances (astaxanthin) from

Certificate of translation of Ex. 1074: Japanese Patent No. 60-153779, entitled "Nutritional Supplement".

Certificate of translation of Ex. 1076: Japanese Patent Publication No. H08-231391, entitled "Medicine for Improvement of Dementia Symptoms".

Certification of translation of Ex. 1070: Japanese Unexamined Patent Application Publication No. 02-215351.

Certified translation of Ex. 1070: Japanese Unexamined Patent Application Publication No. 02-215351, titled Krill Phospholipids Fractioning Method ("Maruyama,"); Certificate of Translation provided as Ex. 1071; dated Jul. 9, 2013, 1 page.

Certified translation of Ex. 1072: Fisheries Agency, General Report on Research and Development of Techniques in Processing and Utilization of Marine Products, Chapter 6, Development of technology for recovery of valuable substances (astaxanthin) from krill, by Takao Fujita, pp. 273-307 (Mar. 1985) ("Fujita"); Certificate of Translation provided as Ex. 1073.

Certified translation of Ex. 1074: Japanese Patent No. 60-153779, entitled "Nutritional Supplement" ("Fukuoka"); Certificate of Translation provided as Ex. 1075, dated Aug. 16, 2013.

Certified translation of Ex. 1076: Japanese Patent Publication No. H08-231391, entitled "Medicine for Improvement of Dementia Symptoms" ("Yasawa"); Certificate of Translation provided as Ex. 1077, dated Aug. 16, 2013, 1 page.

Charest et al., 2001, "Astaxanthin Extraction from Crawfish Shells by Supercritical CO2 with Ethanol as Cosolvent", J. Aquatic Food Product Technology, 10(3): 79-93.

Chen and Meyers, 1982, "Extraction of Astaxanthin Pigment from Crawfish Waste Using a Soy Oil Process", J. Food Sci., 47: 892-896.

Clarke, 1980, "The Biochemical Composition of Krill, *Euphausia superba* dana, from South Georgia", J. Exp. Mar. Biol. Ecol., 43: 221-236.

CN Office Action dated Apr. 27, 2012, JP Patent Application No. 200880112125.6 (and English translation).

CRC 2013-2014, 94th ed., pp. 6-231-6-235.

Czczuga, 1974, "Comparative Studies of Carotenoids in the Fauna of the Gullmar Fjord (Bohuslan, Sweden). II. Crustacea: *Eupagurus bernhardus*, *Hyas coarctatus* and *Upogebia deltaura*", Marine Biology, 28: 95-98.

Database FSTA [Online] International Food Information Service, Frankfurt-Main; Shibata N. "Effect of fishing season on lipid content and composition of Antarctic krill (translated)" Database accession No. FS-1985-04-r-0091, abstract only.

Database WPI Week 200682, Thomson Scientific, London, GB, 2006.

De Ritter and Purcell, 1981, "Carotenoid Analytical Methods", Carotenoids as Colorants and Vitamin A Precursors: Technological and Nutritional Applications, pp. 815-882.

Dec. 8, 2011 Office Action, KR Patent Application No. 10-2010-7006897 and its English translation.

Declaration of Bjorn Ole Haugsgjerd in support of Inter Partes Review of U.S. Pat. No. 8,278,351 ("Haugsgjerd"), dated Sep. 30, 2013, 12 pages.

Deutch, 1995, "Menstrual pain in Danish women correlated with low n-3 polyunsaturated fatty acid intake", Eur. J. Clin. Nutr., 49(7): 508-16.

Diez et al., 2003, "The role of the novel adipocyte-derived hormone adiponectin in human disease", Eur. J. Endocrinol., 148(3): 293-300.

Eicherg, "Lecithin—It Manufacture and Use in the Fat and Oil Industry," Oils and Soap 51-54, 1939 ("Eichberg").

Ellingsen et al., 1987, "Biochemistry of the autolytic processes in Antarctic krill post mortem. Autoproteolysis." Biochem. J. 245, 295-305.

Emodi, 1978, "Carotenoids: Properties and Applications", Food Technology, 32(5): 38.

EP Opposition filed Feb. 13, 2014 by Olympic Seafood AS, EP Patent Application No. EP08718910I6.

EP Opposition filed May 8, 2015 by Olympic Seafood AS, EP Patent No. 2144618 includes: ENGE, "Declaration" Mackenzie, "Certificate of Analysis"—Callahan Innovation.

(56)

References Cited

OTHER PUBLICATIONS

- Evidence in Support of Opposition, Rimfrost AS, Australian Patent Application No. 2013227998, filed Sep. 22, 2016, 22 pages.
- Farkas, Composition and Physical State of Phospholipids in Calanoid Copepods from India and Norway, *Lipids*, vol. 23, No. 6 (1988).
- Felix-Valenzuela et al., 2001, "Supercritical CO₂/Ethanol Extraction of Astaxanthin from Blue Crab (*Callinectes sapidus*) Shell Waste", *Journal of Food Process Engineering*, 24: 101-112. Final Prospectus dated May 11, 2001 ("Final Prospectus").
- Fisheries Agency, General Report on Research and Development of Techniques in Processing and Utilization of Marine Products, Chapter 6, Development of technology for recovery of valuable substances (astaxanthin) from krill, by Takao Fujita, pp. 273-307 (Mar. 1985); Japanese language document.
- Folch, et al., A Simple Method for the Isolation and Purification of Total Lipids from Animal Tissues. *J. Biol. Chem.*, 226, 497-509 (1957).
- Fox and Scheer, 1941, "Comparative Studies of the Pigments of Some Pacific Coast Echinoderms", *The Biological Bulletin*, 441-455.
- Fricke, et al., 1-O-Alkylglycerolipids in Antarctic Krill (*Euphausia superba* Dana), *Comp. Biochem. Physiol.* (1986) 85B(1): 131-134.
- Fricke, et al., Lipid, Sterol and Fatty Acid Composition of Antarctic Krill (*Euphausia superba* Dana), *Lipids* (1984) 19(11): 821-827.
- Geusens et al., 1994, "Long-term effect of omega-3 fatty acid supplementation in active rheumatoid arthritis. A 12-month, double-blind, controlled study", *Arthritis Rheum.*, 37(6): 824-9.
- Gigliotti et al., "Extraction and characterisation of lipids from Antarctic krill (*Euphausia superba*)", *Food Chemistry*, 2011, vol. 125, No. 3, pp. 1028-1036.
- Gilchrist and Green, 1960, "The Pigments of Artemia", *Proceedings of the Royal Society, Series B Biological Sciences*, vol. 152 No. 946, pp. 118-136.
- Goodwin and Srisukh, 1949, "Some Observations on Astaxanthin Distribution in Marine Crustacea", *Department of Biochemistry, University of Liverpool*, pp. 268-270.
- Gordeev, K.Y., et al. "Fatty Acid Composition of the Main Phospholipids of the Antarctic Krill, *Euphausia superba*," *Chem. Nat. Compds.* (1990) 26(2), pp. 143-147.
- Gordeev, K.Y., et al. "Fatty Acid Composition of the Main Phospholipids of the Antarctic Krill, *Euphausia superba*," *Khim. Prirod. Soed.* 2 (1990), pp. 181-187.
- Grant of Request for Ex parte Reexamination of the '351 patent. Grantham (1977) Southern Ocean Fisheries Survey Programme, FAO Rome, GLO/SO/77/3: 1-61.
- Grit et al., Hydrolysis of phosphatidylcholine in aqueous liposome dispersions, *Int. J. Pharmaceutics* 50:1-6 (1989).
- Gulyaev and Bugrova, 1976 Removing fats from the protein paste "Okean". *Konservnaya I Ovoshchesushil'naya Promyshlennost*, (4), 37-8.
- Hardardottir and Kinsella, 1988, "Extraction of Lipid and Cholesterol from Fish Muscle with Supercritical Fluids" *Journal of Food Science*, 53(6): 1656-1658.
- Henderson et al., Lipid Composition of the Pineal Organ from Rainbow Trout (*Oncorhynchus mykiss*), *Lipids*, vol. 29, No. 5, pp. 311-317 (1994) ("Henderson").
- Herman and Groves, The Influence of Free Fatty Acid Formation on the pH of Phospholipid-Stabilized Triglyceride Emulsions, *Pharmaceutical Research* 10(5):774-776 (1993).
- Hvattum, Erlend, et al., "Effect of soybean oil and fish oil on individual molecular species of Atlantic salmon . . .", *Journal of Chromatography B*, 748 (2000) 137-149.
- Igarashi, Daisuke, et al., "Positional Distribution of DHA and EPA in Phosphatidylcholine and Phosphatidylethanolamine from Different Tissues of Squids," *J. Oleo Sci.* vol. 50, No. 9 (2001).
- International Aqua Feed, 2006, vol. 9.
- International Search Report and Written Opinion for PCT/IB2010/000512; dated Jun. 24, 2010.
- International Search Report and Written Opinion, International Patent Application No. PCT/IB2014/002130, dated Feb. 3, 2015.
- International Search Report for PCT/IB2007/000098, dated: Jun. 26, 2007.
- International Search Report, International Patent Application No. PCT/IB2016/000208, dated May 13, 2016.
- Itano Refrigerated Food Co., Ltd., Bio & High Technology Announcement and Natural Astaxanthin & Krill Lecithin, pp. 1-16 (on or before Dec. 28, 1994) ("Itano").
- Itoh et al., 2007; "Increased adiponectin secretion by highly purified eicosapentaenoic acid in rodent models of obesity and human obese subjects", *Arteriosclerosis, Thrombosis, and Vascular Biology*; 27(9): 1918-1925.
- Johnson and Lucas, Comparison of Alternative Solvents for Oils Extraction, *JAACS* 60(2):229-242 (1983).
- Johnson et al., 1978, "Simple Method for the Isolation of Astaxanthin from the Basidiomycetous Yeast *Phaffia rhodozyma*", *Applied and Environmental Microbiology*, 35(6): 1155-1159.
- Jong-Ho Lee, "A Review: Antioxygenic and Peroxide-decomposing Activities of Antarctic Krill Lipids," *J. Korean Soc. Food Nutr.* 13(3) pp. 326-333 (1984).
- JP Office Action dated Feb. 23, 2012, JP Patent Application No. 2010-522444 (and English translation).
- Ki Woong Cho, et al., "Lipid and Fatty Acid Composition of the Antarctic Krill *Euphausia superba*," *Ocean Research* 21(2): 109-116 (1999).
- Kolakowska, 1989, "Krill lipids after frozen storage of about one year in relation to storage time before freezing", *Die Nahrung Food*, 33(3): 241-244.
- Kolakowski and Gajowiecki, "Optimization of autolysis to obtain and edible product 'precipitate' from Antarctic krill," *Seafood Science and Technology*, pp. 331-336.
- Kris-Etherton et al., 2002, "Fish Consumption, Fish Oil, Omega-3 Fatty Acids, and Cardiovascular Disease", *Circulation*, 106:2747-2757.
- Kristensen et al., 1989, "Dietary supplementation with n-3 polyunsaturated fatty acids and human platelet function: a review with particular emphasis on implications for cardiovascular disease", *J. Intern. Med. Suppl.* 731:141-50.
- Kunesova et al., 2006, "The influence of n-3 polyunsaturated fatty acids and very low calorie diet during a short-term weight reducing regimen on weight loss and serum fatty acid composition in severely obese women", *Physiol Res.*; 55(1):63-72.
- Kyun-Ku Kim, et al., "Effects of Cooking and Drying Methods on the Polar Lipids Composition of Shrimp," *Korean J. Food Sci. Technol.* vol. 21, No. 1, pp. 25-30 (1989).
- Laight et al., 1999, "F₂-isoprostane evidence of oxidant stress in the insulin resistant, obese Zucker rat: effects of vitamin E", *Eur. J. Pharmacol.* 377(1): 89-92.
- Lambertson and Braekkan, 1971, "Method of Analysis of Astaxanthin and its Occurrence in some Marine Products," *J. Sci. Food. Agr.*, vol. 22(2): 99-101.
- Le Grandois et al., Investigation of Natural Phosphatidylholine Sources: Separation and Identification by Liquid Chromatography—Electrospray Ionization-Tandem Mass Spectrometry (LC-ESI-MS²) of Molecular Species, *J. Agric. Food Chem.*, 57, 6014-20 (2009) ("Le Grandois").
- Libby et al., 2006, "Inflammation and Atherothrombosis: From Population Biology and Bench Research to Clinical Practice", *J. Amer. Coll. Card.*, 48 (9, Suppl. A): A33-A46.
- Lin et al., Effect of Dietary N-3 Fatty Acids Upon the PhospholipidMolecular Species of the Monkey Retina, *Invest Ophthalmol Vis Sci.* 1994;35:794-803.
- Lopez et al., 2004, "Selective extraction of astaxanthin from crustaceans by use of supercritical carbon dioxide", *Talanta*, 64: 726-731.
- Mandeville, 1991, "Isolation and Identification of Carotenoid Pig-

(56)

References Cited

OTHER PUBLICATIONS

- Medina et al., C Nuclear Magnetic Resonance Monitoring of Free Fatty Acid Release After Fish Thermal Processing, *J. Amer. Oil Chem. Soc.* 71(5):479-82 (1994).
- Meyers and Bligh, 1981, "Characterization of Astaxanthin Pigments from Heat-Processed Crawfish Waste", *J. Agric. Food Chem.*, 29: 505-508.
- Meyers, 1977, "Using Crustacean Meals and Carotenoid-Fortified Diets", *Feedstuffs*, vol. 49(19).
- Meyers, 1994, "Developments in world aquaculture, feed formulations, and role of carotenoids", *Pure & Appl. Chem.*, vol. 66(5): 1069-1076.
- Mills et al., 1989, "Dietary N-6 and N-3 fatty acids and salt-induced hypertension in the borderline hypertensive rat", *Lipids*, 24(1): 17-24.
- Moates and Van Bentem, 1990, "Separating out the value", *Food Science and Technology Today*, 4(4): 213-214.
- Neptune krill Oil's Unique Properties, Internet Citation, 2011, URL:<http://www.nowfoods.com/Products/ProductFAQs/081008/htm>.
- Neptune Technologies & Bioresources Soon to Obtain a Major Patent in Over 30 Countries ("2001 Press Release,").
- Nikolaeva, 1967 "Amino acid composition of protein-coagulate in krill", *VNIRO*, 63:161-4.
- Notice of Acceptance of Application, Australian Patent Application No. 2013227998, dated Oct. 5, 2016, 2 pages.
- Oct. 24, 2012 Office Action, '675 patent.
- Office Action dated Jan. 5, 2012, '351 patent.
- Phleger, et al. (2002) "Interannual and between species comparison in the lipids, fatty acids, and sterols of Antarctic krill from the US AMLR Elephant Island survey area: 1997 and 1998". *Comp Biochem Physiol* 131B:733-747.
- Takahashi et al., Compositional Changes in Molecular Species of Fish Muscle Phosphatidylcholine During Storage, *Bull. Fac. Fish. Hokkaido Univ.* 37(1), 80-84 1986.
- Takahashi et al., Molecular Species of Fish Muscle Lecithin, *Bulletin of the Japanese Society of Scientific Fisheries* 48(12), 1803-1814 (1982).
- Takahashi et al., Prediction of Relative Retention Value of the Individual Molecular Species of Diacyl Glycerolipid on High Performance Liquid Chromatography, *Bull. Fac. Fish. Hokkaido Univ.* 38(4), 398-404. 1987.
- Takaichi et al., 2003, "Fatty Acids of astaxanthin esters in krill determined by mild mass spectrometry", *Comparative Biochemistry and Physiology Part B, Biochemistry and Molecular Biology*, Elsevier, Oxford, vol. 136, Jan. 1, 2003, p. 317-322.
- Tanaka et al., 2004, "Extraction of Phospholipids from Salmon Roe with Supercritical Carbon Dioxide and an Entrainer", *J. Oleo Sci*, 53(9): 417-424.
- Tanaka et al., 2005, "Extraction of Phospholipids from Unused Natural Resources with Supercritical Carbon Dioxide and an Entrainer", *Journal of Oleo Science*, vol. 54(11): 569-576.
- Tanaka, Biosynthesis of 1,2-dieicosapentaenoyl-sn-glycero-3-phosphocholine in *Caenorhabditis elegans*, *Eur. J. Biochem.* 263, 189±194 (1999).
- Tanaka, T., et al., Platelet-activating Factor (PAF)-like Phospholipids Formed during Peroxidation of Phosphatidylcholines from Different Foodstuffs, *Biosci. Biotech. Biochem.* (1995) 59 (8), pp. 1389-1393.
- Third Party Observation against corresponding AU Patent Application No. 2013227998, filed Jul. 15, 2016, 6 pages.
- Third Party Observation against corresponding AU Patent Application No. 2014256345, filed May 23, 2016, 50 pages.
- Tocher, Chapter 6, Glycerophospholipid metabolism, *Biochemistry and molecular biology of fishes*, vol. 4, Hochachka and Mommsen (eds.) (1995).
- Tochizawa, Kaoru, et al., "Effects of Phospholipids Containing Docosahexaenoic Acid on Differentiation and Growth of HL-60 Todoric et al., 2006, "Adipose tissue inflammation induced by high-fat diet in obese diabetic mice is prevented by n-3 polyunsaturated fatty acids", *Diabetologia*, 49(9): 2109-2119.
- Tou et al., 2007, "Krill for human consumption: nutritional value and potential health benefits.", *Nutrition Rev* 65(2):63-77.
- Trayhurn et al., 2004, "Adipokines: inflammation and the pleiotropic role of white adipose tissue", *Br. J. Nutrition*, 92(3): 347-355.
- Popp-Snijders et al., 1987, "Dietary supplementation of omega-3 polyunsaturated fatty acids improves insulin sensitivity in non-insulin-dependent diabetes", *Diabetes Res.* 4(3): 141-7.
- U.S. Appl. No. 60/307,842 (Priority document for the '351 patent).
- Raventos et al., Application and Possibilities of Supercritical CO2 Extraction in Food Processing Industry: An Overview, *Food Science and Technology International* (2002)8: 269-284.
- Sachindra, 2006, "Recovery of carotenoids from shrimp waste in organic solvents", *Waste Management*, 26: 1092-1098.
- Saether et al., 1986, "Lipids of North Atlantic krill", *J Lipid Res.*, 27(3):274-85.
- Shahidi et al., 1998, "Carotenoid Pigments in Seafoods and Aquaculture" *Critical Reviews in Food Science*, 38(1): 1-67.
- Shon, Mi-Yae, et al., "Effects of Krill and Cadmium on Lipid Composition of Plasma in Cholesterol-Fed Rats," *J. Korean Soc. Food Nutr.* 23(1), 38-43 (1994).
- Sidehu et al., 1970, "Biochemical Composition and Nutritive Value of Krill (*Euphausia superba* dana)", *J. Sci Food Agr.*, vol. 21, 293-296.
- Sikorski, E., "The Utilization of Krill for Food," *Food Process Eng.*, 1:845-855 (1980).
- Simopoulos, 1991, "Omega-3 fatty acids in health and disease and in growth and development", *Am. Clin. Nutr.* 54:438-63.
- Somiya, 1982, "'Yellow lens' eyes of a stomiatoid deep-sea fish, *Malacosteus niger*", *Proc. R. Soc. Lond.*, 215: 481-489.
- Statement of Grounds and Particulars, Rimfrost AS, filed Jun. 10, 2016, Australian Patent Application No. 2014203179, 22 pages.
- Summons Materials downloaded from ESPACE on Dec. 16, 2014 for EP Patent Application No. 08 718 910.6.
- Supplemental Declaration of Bjorn Ole Haugsgjerd submitted during inter partes reexamination of parent U.S. Pat. No. 8,030,348 ("Haugsgjerd '348 Supp. Decl.>").
- Supplemental Declaration of Dr. Earl White submitted during inter partes reexamination of parent U.S. Pat. No. 8,030,348 ("White Supp. Reexam. Decl.>").
- Supplemental Declaration of Dr. Earl White submitted during prosecution of parent U.S. Pat. No. 8,278,351 ("White Supp. Decl.>").
- Supplemental Declaration of Dr. Thomas Gundersen submitted during inter partes reexamination of parent U.S. Pat. No. 8,030,348 ("Gundersen Supp. Decl.>").
- Suzuki, T. and Shibata, N., "The utilization of Antarctic krill for human food," *Food Rev. Int'l*, 6:1, 119-147 (1990) ("Suzuki").
- Petition for Inter Partes Review, U.S. Pat. No. 9,078,905, Case No. IPR2017-00747, filed Jan. 27, 2017.
- Petition for Inter Partes Review, U.S. Pat. No. 9,028,877, Case No. IPR2017-00746, filed Feb. 3, 2017.
- Petition for Inter Partes Review, U.S. Pat. No. 9,028,877, Case No. IPR2017-00748, filed Feb. 3, 2017.
- Respondents' Notice of Prior Art, United States International Trade Commission, Investigation No. 337-TA-1019, dated Feb. 1, 2017.
- Notice of Opposition, Rimfrost AS, AU Patent Application No. 2014256345, filed Mar. 1, 2017.
- Notice of Opposition, Enzymotec Ltd., AU Patent Application No. 2014256345, filed Mar. 1, 2017.
- Respondents' Motion for Leave to Amend Their Response to the Complaint and Notice of Investigation, United States International Trade Commission, Investigation No. 337-TA-1019, dated Mar. 14, 2017.
- Trebbles et al., 2003, "Inhibition of tumour necrosis factor-alpha and interleukin 6 production by mononuclear cells following dietary fish-oil supplementation in healthy men and response to antioxidant co-supplementation", *Br. J. Nutrition*, 90(2): 405-412.

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.