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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Published:

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- with sequence listing part of description (Rule 5.2(a))

(88) Date of publication of the international search report:
24 June 2010

(54) Title: FOOD COMPOSITIONS OF MICROALGAL BIOMASS

(57) Abstract: The invention provides algal biomass, algal oil, food compositions comprising microalgal biomass, whole microalgal cells, and/or microalgal oil in combination with one or more other edible ingredients, and methods of making such compositions by combining algal biomass or algal oil with other edible ingredients. In preferred embodiments, the microalgal components are derived from microalgal cultures grown and propagated heterotrophically in which the algal cells comprise at least 10% algal oil by dry weight.



WO 2010/045368 A3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/60692

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - C12P 7/64; C12N 1/12 (2010.01) USPC - 435/134; 435/257.1 According to International Patent Classification (IPC) or to both national classification and IPC</p>																				
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) USPC-435/134; 435/257.1</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched USPC-435/135 435/158 435/257.3</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PubWEST(PGPB,USPT,USOC,EPAB,JPAB), Google Scholar: Prototheca wickerhamii, Prototheca wickerhamii oil, Prototheca wickerhamii food, alga monounsaturated, alga % free sugars, Cryptocodium cohnii % total "dietary fiber", total carotenoids, hollandaise. GenCore 6.3: SEQ ID NO:1, 3, 4, 9, 13, 14, 20, and 27</p>																				
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X --- Y</td> <td>US 5,547,699 A (HIZUKA et al.) 20 August 1996 (20.08.1996) col 1, ln 63-66; col 2, ln 59-60; col 3, table 1, ln 64-67; col 4, ln 1-2, 46-55, 63-67; col 5, ln 1-5, 26-29, 48-52, 56-59; col 6, ln 17-25, 39-41, 51; col 7, ln 31-33, 43-45; col 8, ln 10-13; col 9, ln 11-67; col 10, ln 1-67; col 11, ln 1-10</td> <td>1, 6-7, 9, 15-23, 25-26, 29, 31, 33, 35-41, 46, 52, 56-59, 100-106 ----- 2-5, 8, 10-14, 24, 27-28, 30, 32, 34, 42-45, 47-51, 53-55, 111-127, 136-139, 151,153b</td> </tr> <tr> <td>X --- Y</td> <td>US 5,71,983 A (KYLE et al.) 27 January 1998 (27.01.1998) col 4, ln 1-15, 44-46, 57-58; col 5, ln 49-52; col 6, ln 18-25</td> <td>129 ----- 2, 34, 53-54,119, 130-132, 136-139</td> </tr> <tr> <td>X ---- Y</td> <td>US 6,338, 866 B1 (CRIGGALL et al.) 15 January 2002 (15.01.2002) col 6, ln 41-45</td> <td>133, 135 ----- 134</td> </tr> <tr> <td>Y</td> <td>KENYON, Fatty Acid Composition of Unicellular Strains of Blue-Green Algae. JOURNAL OF BACTRIOLOGY 1972, 109(2):827-834; pg 830, Table 3</td> <td>3-4</td> </tr> <tr> <td>Y</td> <td>US 5,518,918 A (BARCLAY et al.) 21 May 1996 (21.05.1996) abstract; col 4, ln 29-36; col 11-12, Table 2</td> <td>5, 151, 153B</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X --- Y	US 5,547,699 A (HIZUKA et al.) 20 August 1996 (20.08.1996) col 1, ln 63-66; col 2, ln 59-60; col 3, table 1, ln 64-67; col 4, ln 1-2, 46-55, 63-67; col 5, ln 1-5, 26-29, 48-52, 56-59; col 6, ln 17-25, 39-41, 51; col 7, ln 31-33, 43-45; col 8, ln 10-13; col 9, ln 11-67; col 10, ln 1-67; col 11, ln 1-10	1, 6-7, 9, 15-23, 25-26, 29, 31, 33, 35-41, 46, 52, 56-59, 100-106 ----- 2-5, 8, 10-14, 24, 27-28, 30, 32, 34, 42-45, 47-51, 53-55, 111-127, 136-139, 151,153b	X --- Y	US 5,71,983 A (KYLE et al.) 27 January 1998 (27.01.1998) col 4, ln 1-15, 44-46, 57-58; col 5, ln 49-52; col 6, ln 18-25	129 ----- 2, 34, 53-54,119, 130-132, 136-139	X ---- Y	US 6,338, 866 B1 (CRIGGALL et al.) 15 January 2002 (15.01.2002) col 6, ln 41-45	133, 135 ----- 134	Y	KENYON, Fatty Acid Composition of Unicellular Strains of Blue-Green Algae. JOURNAL OF BACTRIOLOGY 1972, 109(2):827-834; pg 830, Table 3	3-4	Y	US 5,518,918 A (BARCLAY et al.) 21 May 1996 (21.05.1996) abstract; col 4, ln 29-36; col 11-12, Table 2	5, 151, 153B
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<p><input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/></p>																				
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<p>Date of the actual completion of the international search 8 April 2010 (08.04.2010)</p>		<p>Date of mailing of the international search report 22 APR 2010</p>																		
<p>Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201</p>		<p>Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774</p>																		

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/60692

Box No. 1 Nucleotide and/or amino acid sequence(s) (Continuation of item 1.c of the first sheet)

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of a sequence listing filed or furnished:

a. (means)

on paper

in electronic form

b. (time)

in the international application as filed

together with the international application in electronic form

subsequently to this Authority for the purposes of search

2. In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

3. Additional comments:

GenCore 6.3: SEQ ID NO:1, 3, 4, 9, 13, 14, 20, and 27

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/60692

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

- 1. [] Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:
2. [] Claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. [] Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Group I+: claims 1-59, 100-106, 111-139, 151-155, drawn to a food composition comprising at least 0.1 % w/w algal biomass and one or more other edible ingredients, wherein the algal biomass comprises at least 16% algal oil by dry weight. The first invention encompasses the algal biomass is derived from algae having at least 90% 23S rRNA genomic sequence identity to (SEQ ID NO:1, 3-4, 9, 13-14, 20, and 27). Should an additional fee(s) be paid, Applicant is invited to elect an additional SEQ ID NO(s) to be searched. The exact claims searched will depend on the specifically elected SEQ ID NO(s).

Group II+, claims 60-99, 107-110, 140-150, drawn to a method of making a food composition comprising at least 10% algal oil by dry weight. Should an additional fee(s) be paid, Applicant is invited to elect a SEQ ID NO(s) to be searched. Please note that SEQ ID NO:1, 3-4, 9, 13-14, 20, and 27 will be searched for a single additional fee.

***** See Supplemental Sheet *****

- 1. [] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. [] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. [] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. [X] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-59, 100-106, 111-139, 151-155, restricted to SEQ ID NOS: 1, 3-4, 9, 13-14, 20 and 27

- Remark on Protest [] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
[] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
[] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/60692

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	SPOLARE et al. Commercial Applications of Microalgae. JOURNAL OF BIOSCIENCE AND BIOENGINEERING 2006, 101(2):87-96; pg 88, left col, para 3, ln 12-13	8
Y	LAHAYE, Marina Algae as Sources of Fibres: Determination of Soluble and Insoluble Dietary Fibre Contents in Some 'Sea Vegetable. J Sci Food Agric 1991, 54:587-594; abstract; pg 592, Table 1	10-12, 113-115
Y	KRINSKY et al. The Appearance of Neoxanthin during the Regreening of Dark-grown Euglena. Plant Physiol, May 1964, 39(3):441-445; pg 441, left col, para 2, ln 14-24, para 3; right col para 1; pg 442, Table 1; pg 443, left col, para 6	13-14
Y	US 2007/0009988 A1 (MONOD et al.) 11 January 2007 (11.01.2007) para [0057]	24, 27-28
Y	US 2006/0286205 A1 (FICHTALI et al.) 21 December 2006 (21.12.2006) abstract; para [0025], [0090]	30
Y	US 2008/0107776 A1 (PRAKASH et al.) 8 May 2008 (08.05.2008) para [0856]	32
Y	US 2006/0122410 A1 (FICHTALI et al.) 8 June 2006 (08.06.2008) para [0027]	42
Y	US 2005/0170479 A1 (WEAVER et al.) 4 August 2005 (04.08.2005) para [0027]	43
Y	HENDERSON et al., LIPID COMPOSITION AND BIOSYNTHESIS IN THE MARINE DINOFLAGELLATE CRYPTHECODZINZUM COHNII. Phytochemistry 1988, 27(6):1679-1683; pg 1680, Table 1	44-45
Y	BROWN et al. The amino-acid and sugar composition of 16 species of microalgae used in mariculture. J. Exp. Mar. Biol. Ecol. 1991,145:79-99; abstract; pg 89, Table III	47
Y	US 5,792,631 A (RUNNING) 11 August 1998 (11.08.1998) col 2, ln 64-67	48-49
Y	GenBank Direct submission L42851. Prototheca wickerhamii large subunit ribosomal RNA (rrnL) gene, partial sequence; chloroplast gene for chloroplast product. 21 November 2001. [Retrieved from the Internet 23 December 2009: < http://www.ncbi.nlm.nih.gov/nuccore/17028073 >]; in entirety	50-51
Y	CURTAIN. PLANT BIOTECHNOLOGY- The growth of Australia.s algal b-carotene industry. Australasian Biotechnology 2000, 10(3):19-23. [Retrieved from the Internet 5 April 2010: < http://www.bioline.org.br/request?au00032 >]; pg 4, para 3	55, 120, 128
Y	LUBITZ. The Protein Quality, Digestibility, and Composition of Algae, Chlorella 71105. Journal of Food Science 1963, 28(2):229-232; abstract	111-128, 153B
Y	WO 2007/117511 A2 (COLBY et al.) 18 October 2007 (18.10.2007) para [0060], [0066]; Table 6, 8	130-132, 134
Y	LORD. Taurine is essential for cats; 27 January 2008. [Retrieved from the Internet 6 April 2010: < http://www.vetlord.org/taurine-is-essential-for-cats >]; pg 1, para 1, ln 3-4	132

***** Supplemental Sheet *****

Continuation of Box No. III

The inventions listed as Groups I+ and II+ do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The inventions of Groups I+ and II+ share the technical feature of a food composition comprising at least 0.1 % w/w algal biomass and one or more other edible ingredients, wherein the algal biomass comprises at least 16% algal oil by dry weight. However, this shared technical feature is obvious over prior art, as follows:

1) an article titled "Biosynthesis of arachidonic acid in the oleaginous microalga *Parietochloris incisa* (Chlorophyceae): Radiolabeling studies" by Bigogno, et al. (Lipids 2002, 37(2):209-216) discloses that the fresh-water green alga *Parietochloris incisa* is the richest plant source of the PUFA arachidonic acid (Abstract), wherein the arachidonic acid (AA) content exceeds 20% of dry weight (pg 1, right col), and

2) further discloses that "various health authorities recommend incorporation of both AA and DHA into baby formula, and the U.S. FDA has recently approved its use" (pg 1, left col). As said food composition was obvious at the time of the invention, this cannot be considered a special technical feature that would otherwise unify the groups.

An additional special technical feature of the inventions listed as Group I+ and II+ is the specific nucleic acid sequence recited therein. The inventions do not share a special technical feature, because 1) no significant structural similarities can readily be ascertained among the sequences, and 2) GenBank Direct submission L42851 titled "Prototheca wickerhamii large subunit ribosomal RNA (rrnL) gene, partial sequence; chloroplast gene for chloroplast product" (21-NOV-2001) [Retrieved from the Internet 23 December 2009: <<http://www.ncbi.nlm.nih.gov/nuccore/17028073>>] discloses 2715 bp DNA comprising a nucleotide sequence 96.3% identical to the claimed SEQ ID NO:1, 3, 4, 9, 13, 14, 20, and 27 (nucleotides 598-1162). Without a shared special technical feature, the inventions lack unity with one another.

Groups I+ and II+ therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.