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(54) **METHODS OF TREATING OR PREVENTING
NONALCOHOLIC STEATOHEPATITIS
AND/OR PRIMARY BILIARY CIRRHOSIS**

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(57) **ABSTRACT**

In various embodiments, the present invention provides methods of treating and/or preventing NASH and/or PBC comprising administering to a subject in need thereof a pharmaceutical composition comprising eicosapentaenoic acid or a derivative thereof.

METHODS OF TREATING OR PREVENTING NONALCOHOLIC STEATOHEPATITIS AND/OR PRIMARY BILIARY CIRRHOSIS

PRIORITY CLAIM

[0001] This application claims priority to U.S. Provisional Patent Application No. 61/747,667, filed on Dec. 31, 2012, the entire contents of which are incorporated herein by reference and relied upon.

BACKGROUND

[0002] Nonalcoholic steatohepatitis (“NASH”) is characterized by fat, inflammation and damage in the liver in people who consume little or no alcohol. NASH can lead to liver cirrhosis. NASH tends to be diagnosed in overweight or obese middle-aged people who often have elevated blood lipid levels and diabetes or prediabetes. Primary biliary cirrhosis (“PBC”) is characterized by inflammation and damage to the bile ducts. PBC is believed to be an autoimmune condition, but is more common in people who have been exposed to chemicals or who have had an infection. However, the causes of NASH and PBC are not well understood. There are no specific approved therapies for NASH, and only one approved drug for treatment of PBC. A need exists for improved treatments for NASH and PBC.

SUMMARY

[0003] In various embodiments, the present invention provides methods of treating and/or preventing NASH and/or PBC in a subject and, in particular, a method of treating and/or preventing NASH and/or PBC in a subject comprising administering to a subject in need thereof a pharmaceutical composition comprising eicosapentaenoic acid (“EPA”) or a derivative thereof. In one embodiment, a pharmaceutical composition comprising about 1 to about 6 g of EPA or derivative thereof is administered to the subject daily. In one embodiment, the composition contains not more than 20% or not more than 10%, by weight, docosahexaenoic acid or derivative thereof, substantially no docosahexaenoic acid or derivative thereof, or no docosahexaenoic acid or derivative thereof. In another embodiment, eicosapentaenoic acid ethyl ester comprises at least 96%, by weight, of all fatty acids present in the composition; the composition contains not more than 4%, by weight, of total fatty acids other than eicosapentaenoic acid ethyl ester; and/or the composition contains about 0.1% to about 0.6% of at least one fatty acid other than eicosapentaenoic acid ethyl ester and docosahexaenoic acid (or derivative thereof).

[0004] In one embodiment, a pharmaceutical composition useful in accordance with the invention comprises, consists of or consists essentially of at least 95% by weight ethyl eicosapentaenoate (EPA-E), about 0.2% to about 0.5% by weight ethyl octadecatetraenoate (ODTA-E), about 0.05% to about 0.25% by weight ethyl nonadecapentaenoate (NDPA-E), about 0.2% to about 0.45% by weight ethyl arachidonate (AA-E), about 0.3% to about 0.5% by weight ethyl eicosatetraenoate (ETA-E), and about 0.05% to about 0.32% ethyl heneicosapentaenoate (HPA-E). In another embodiment, the composition is present in a capsule shell. In another embodiment, the composition contains substantially no or no amount of docosahexaenoic acid (DHA) or derivative thereof such as ethyl-DHA (DHA-E).

[0005] In another embodiment, the invention provides a method of treating moderate to severe hypertriglyceridemia comprising administering a composition as described herein to a subject in need thereof one to about four times per day.

[0006] These and other embodiments of the present invention will be disclosed in further detail herein below.

DETAILED DESCRIPTION

[0007] While the present invention is capable of being embodied in various forms, the description below of several embodiments is made with the understanding that the present disclosure is to be considered as an exemplification of the invention, and is not intended to limit the invention to the specific embodiments illustrated. Headings are provided for convenience only and are not to be construed to limit the invention in any manner. Embodiments illustrated under any heading may be combined with embodiments illustrated under any other heading.

[0008] The use of numerical values in the various quantitative values specified in this application, unless expressly indicated otherwise, are stated as approximations as though the minimum and maximum values within the stated ranges were both preceded by the word “about.” Also, the disclosure of ranges is intended as a continuous range including every value between the minimum and maximum values recited as well as any ranges that can be formed by such values. Also disclosed herein are any and all ratios (and ranges of any such ratios) that can be formed by dividing a disclosed numeric value into any other disclosed numeric value. Accordingly, the skilled person will appreciate that many such ratios, ranges, and ranges of ratios can be unambiguously derived from the numerical values presented herein and in all instances such ratios, ranges, and ranges of ratios represent various embodiments of the present invention.

[0009] In one embodiment, the invention provides a method for treatment and/or prevention of NASH and/or PBC in a subject and, in particular, a method of treating and/or preventing NASH and/or PBC in a subject comprising administering to a subject in need thereof a pharmaceutical composition comprising eicosapentaenoic acid or a derivative thereof.

[0010] In some embodiments, the subject also has a cardiovascular-related disease. The term “cardiovascular-related disease” herein refers to any disease or disorder of the heart or blood vessels (i.e. arteries and veins) or any symptom thereof. Non-limiting examples of cardiovascular-related disease and disorders include hypertriglyceridemia, hypercholesterolemia, mixed dyslipidemia, coronary heart disease, vascular disease, stroke, atherosclerosis, arrhythmia, hypertension, myocardial infarction, and other cardiovascular events.

[0011] The term “treatment” in relation to a given disease or disorder, includes, but is not limited to, inhibiting the disease or disorder, for example, arresting the development of the disease or disorder; relieving the disease or disorder, for example, causing regression of the disease or disorder; or relieving a condition caused by or resulting from the disease or disorder, for example, relieving, preventing or treating symptoms of the disease or disorder. The term “prevention” in relation to a given disease or disorder means: preventing the onset of disease development if none had occurred, preventing the disease or disorder from occurring in a subject that may be predisposed to the disorder or disease but has not yet

been diagnosed as having the disorder or disease, and/or preventing further disease/disorder development if already present.

[0012] In one embodiment, the present invention provides a method of treating and/or preventing NASH and/or PBC, the method comprising administering to a subject or subject group in need thereof a pharmaceutical composition as described herein. In some embodiments, the subject or subject group has one or more of: an elevated baseline alanine aminotransferase (“ALT”) level, an elevated baseline aspartate aminotransferase (“AST”) level, liver fibrosis, an elevated baseline gamma-glutamyl transferase level, an elevated baseline alkaline phosphatase level, an elevated baseline antimitochondrial antibody level, an elevated baseline antinuclear antibody level, an elevated total serum bilirubin level, and an elevated transaminase level. In some embodiments, the subject is orally administered about 2 g to about 4 g per day of a pharmaceutical composition comprising at least about 90%, by weight of all fatty acids present, ethyl eicosapentaenoate. In another embodiment, the subject is administered about 2 to about 4 capsules per day, each capsule comprising about 900 mg to about 1.1 g of ethyl eicosapentaenoate. In one embodiment, the capsule contains not more than about 20% docosahexaenoic acid or its esters, by weight of all fatty acids present.

[0013] Farnesoid X receptors (“FXR”), also referred to as bile acid receptor (“BAR”) or NR1H4 are known to be expressed in liver, intestine, kidney and adrenal tissues. Activated FXR translocates to the cell nucleus and forms a heterodimer with retinoid X receptor (“RXR”). The dimer binds to hormone response elements on DNA causing, among other effects, a suppression of cholesterol 7 alpha-hydroxylase (“CYP7A1”), the rate-limiting enzyme in bile acid synthesis from cholesterol, and stimulation of intestinal bile acid binding protein (“IBABP”). Both CYP7A1 and IBABP are involved in homeostasis of bile acid and cholesterol. Bile acids such as chenodeoxycholic acid (“CDCA”), lithocholic acid (“LCA”) and deoxycholic acid (“DCA”) are known to act as agonists of FXR. In one embodiment, the present invention provides a method of inhibiting FXR (e.g., agonizing) in a mammal, the method comprising administering to mammal a pharmaceutical composition as described herein. In some embodiments, the mammal has one or more of: an elevated baseline alanine aminotransferase (“ALT”) level, an elevated baseline aspartate aminotransferase (“AST”) level, liver fibrosis, an elevated baseline gamma-glutamyl transferase level, an elevated baseline alkaline phosphatase level, an elevated baseline antimitochondrial antibody level, an elevated baseline antinuclear antibody level, an elevated total serum bilirubin level, and an elevated transaminase level. In some embodiments, the mammal is orally administered about 2 g to about 4 g per day of a pharmaceutical composition comprising at least about 90%, by weight of all fatty acids present, ethyl eicosapentaenoate. In another embodiment, the mammal is administered about 2 to about 4 capsules per day, each capsule comprising about 900 mg to about 1 g of ethyl eicosapentaenoate and not more than about 20% docosahexaenoic acid or its esters, by weight of all fatty acids present.

[0014] *Novosphingobium aromaticivorans* is a gram-negative alphabacterium known to be strongly associated with PBC occurrence. The mechanism is not well understood, but appears to involve a cross reaction between the proteins of the bacterium and mitochondrial proteins of the liver cells. The

gene encoding CD101 (cluster of differentiation 101, also referred to as immunoglobulin superfamily, member 2 or IGSF2) may also play a role in host susceptibility to PBC. In one embodiment, the present invention provides a method of inhibiting *N. aromaticivorans* in a mammal, the method comprising administering to mammal a pharmaceutical composition as described herein. In some embodiments, the mammal has one or more of: an elevated baseline alanine aminotransferase (“ALT”) level, an elevated baseline aspartate aminotransferase (“AST”) level, liver fibrosis, an elevated baseline gamma-glutamyl transferase level, an elevated baseline alkaline phosphatase level, an elevated baseline antimitochondrial antibody level, an elevated baseline antinuclear antibody level, an elevated total serum bilirubin level, and an elevated transaminase level. In another embodiment, the mammal is administered about 2 to about 4 capsules per day, each capsule comprising about 900 mg to about 1 g of ethyl eicosapentaenoate and not more than about 20% docosahexaenoic acid or its esters, by weight of all fatty acids present.

[0015] In another embodiment, the subject or subject group also has hypertriglyceridemia, hypercholesterolemia, mixed dyslipidemia and/or very high triglycerides. In another embodiment, the subject or subject group being treated has a baseline triglyceride level (or median baseline triglyceride level in the case of a subject group), fed or fasting, of at least about 300 mg/dl, at least about 400 mg/dl, at least about 500 mg/dl, at least about 600 mg/dl, at least about 700 mg/dl, at least about 800 mg/dl, at least about 900 mg/dl, at least about 1000 mg/dl, at least about 1100 mg/dl, at least about 1200 mg/dl, at least about 1300 mg/dl, at least about 1400 mg/dl, or at least about 1500 mg/dl, for example about 400 mg/dl to about 2500 mg/dl, about 450 mg/dl to about 2000 mg/dl or about 500 mg/dl to about 1500 mg/dl.

[0016] In one embodiment, the subject or subject group being treated in accordance with methods of the invention has previously been treated with another active agent (e.g., Lovaza®, ursodeoxycholic acid (Actigall®, Watson Pharma, Inc.) and/or obeticholic acid (INT-747, Intercept Pharmaceuticals)) and has experienced (a) an increase in, or no decrease in, LDL-C levels and/or non-HDL-C levels, (b) hepatocellular carcinoma, (c) pruritus, (d) headache, and/or (e) constipation. In one such embodiment, therapy with the original active agent is discontinued and replaced by a method of the present invention.

[0017] In another embodiment, the subject or subject group being treated in accordance with methods of the invention exhibits a fasting baseline absolute plasma level of free EPA (or mean thereof in the case of a subject group) not greater than about 0.70 nmol/ml, not greater than about 0.65 nmol/ml, not greater than about 0.60 nmol/ml, not greater than about 0.55 nmol/ml, not greater than about 0.50 nmol/ml, not greater than about 0.45 nmol/ml, or not greater than about 0.40 nmol/ml. In another embodiment, the subject or subject group being treated in accordance with methods of the invention exhibits a baseline fasting plasma level (or mean thereof) of free EPA, expressed as a percentage of total free fatty acid, of not more than about 3%, not more than about 2.5%, not more than about 2%, not more than about 1.5%, not more than about 1%, not more than about 0.75%, not more than about 0.5%, not more than about 0.25%, not more than about 0.2% or not more than about 0.15%. In one such embodiment, free plasma EPA and/or total fatty acid levels are determined prior to initiating therapy.

[0018] In another embodiment, the subject or subject group being treated in accordance with methods of the invention exhibits a fasting baseline absolute plasma level of total fatty acid (or mean thereof) not greater than about 250 nmol/ml, not greater than about 200 nmol/ml, not greater than about 150 nmol/ml, not greater than about 100 nmol/ml, or not greater than about 50 nmol/ml.

[0019] In another embodiment, the subject or subject group being treated in accordance with methods of the invention exhibits a fasting baseline plasma, serum or red blood cell membrane EPA level not greater than about 70 µg/ml, not greater than about 60 µg/ml, not greater than about 50 µg/ml, not greater than about 40 µg/ml, not greater than about 30 µg/ml, or not greater than about 25 µg/ml.

[0020] In another embodiment, methods of the present invention comprise a step of measuring the subject's (or subject group's mean) baseline lipid profile prior to initiating therapy. In another embodiment, methods of the invention comprise the step of identifying a subject or subject group having one or more of the following: baseline non-HDL-C value of about 200 mg/dl to about 400 mg/dl, for example at least about 210 mg/dl, at least about 220 mg/dl, at least about 230 mg/dl, at least about 240 mg/dl, at least about 250 mg/dl, at least about 260 mg/dl, at least about 270 mg/dl, at least about 280 mg/dl, at least about 290 mg/dl, or at least about 300 mg/dl; baseline total cholesterol value of about 250 mg/dl to about 400 mg/dl, for example at least about 260 mg/dl, at least about 270 mg/dl, at least about 280 mg/dl or at least about 290 mg/dl; baseline vLDL-C value of about 140 mg/dl to about 200 mg/dl, for example at least about 150 mg/dl, at least about 160 mg/dl, at least about 170 mg/dl, at least about 180 mg/dl or at least about 190 mg/dl; baseline HDL-C value of about 10 to about 60 mg/dl, for example not more than about 40 mg/dl, not more than about 35 mg/dl, not more than about 30 mg/dl, not more than about 25 mg/dl, not more than about 20 mg/dl, or not more than about 15 mg/dl; and/or baseline LDL-C value of about 50 to about 300 mg/dl, for example not less than about 100 mg/dl, not less than about 90 mg/dl, not less than about 80 mg/dl, not less than about 70 mg/dl, not less than about 60 mg/dl or not less than about 50 mg/dl.

[0021] In a related embodiment, upon treatment in accordance with the present invention, for example over a period of about 1 to about 200 weeks, about 1 to about 100 weeks, about 1 to about 80 weeks, about 1 to about 50 weeks, about 1 to about 40 weeks, about 1 to about 20 weeks, about 1 to about 15 weeks, about 1 to about 12 weeks, about 1 to about 10 weeks, about 1 to about 5 weeks, about 1 to about 2 weeks or about 1 week, the subject or subject group exhibits one or more of the following outcomes:

[0022] (a) reduced triglyceride levels compared to baseline or placebo control;

[0023] (b) reduced Apo B levels compared to baseline or placebo control;

[0024] (c) increased HDL-C levels compared to baseline or placebo control;

[0025] (d) no increase in LDL-C levels compared to baseline or placebo control;

[0026] (e) a reduction in LDL-C levels compared to baseline or placebo control;

[0027] (f) a reduction in non-HDL-C levels compared to baseline or placebo control;

[0028] (g) a reduction in vLDL levels compared to baseline or placebo control;

[0029] (h) an increase in apo A-I levels compared to baseline or placebo control;

[0030] (i) an increase in apo A-I/apo B ratio compared to baseline or placebo control;

[0031] (j) a reduction in lipoprotein A levels compared to baseline or placebo control;

[0032] (k) a reduction in LDL particle number compared to baseline or placebo control;

[0033] (l) an increase in LDL size compared to baseline or placebo control;

[0034] (m) a reduction in remnant-like particle cholesterol compared to baseline or placebo control;

[0035] (n) a reduction in oxidized LDL compared to baseline or placebo control;

[0036] (o) no change or a reduction in fasting plasma glucose (FPG) compared to baseline or placebo control;

[0037] (p) a reduction in hemoglobin A_{1c} (HbA_{1c}) compared to baseline or placebo control;

[0038] (q) a reduction in homeostasis model insulin resistance compared to baseline or placebo control;

[0039] (r) a reduction in lipoprotein associated phospholipase A2 compared to baseline or placebo control;

[0040] (s) a reduction in intracellular adhesion molecule-1 compared to baseline or placebo control;

[0041] (t) a reduction in interleukin-6 compared to baseline or placebo control;

[0042] (u) a reduction in plasminogen activator inhibitor-1 compared to baseline or placebo control;

[0043] (v) a reduction in high sensitivity C-reactive protein (hsCRP) compared to baseline or placebo control;

[0044] (w) an increase in serum or plasma EPA compared to baseline or placebo control;

[0045] (x) an increase in red blood cell (RBC) membrane EPA compared to baseline or placebo control;

[0046] (y) a reduction or increase in one or more of serum phospholipid and/or red blood cell content of docosahexaenoic acid (DHA), docosapentaenoic acid (DPA), arachidonic acid (AA), palmitic acid (PA), stearidonic acid (SA) or oleic acid (OA) compared to baseline or placebo control;

[0047] (z) a reduction or no increase in serum or plasma alanine aminotransferase (ALT) compared to baseline or placebo control;

[0048] (aa) a reduction or no increase in serum or plasma aspartate aminotransferase (AST) compared to baseline or placebo control;

[0049] (bb) a reduction or no increase in serum or plasma gamma-glutamyl transpeptidase (GGT) compared to baseline or placebo control;

[0050] (cc) a reduction in or no increase in serum or plasma alkaline phosphatase (AP) compared to baseline or placebo control;

[0051] (dd) a reduction or no increase in serum or plasma antimitochondrial antibody compared to baseline or placebo control;

[0052] (ee) a reduction or no increase in serum or plasma antinuclear antibody compared to baseline or placebo control;

[0053] (ff) a reduction or no increase in serum or plasma conjugated bilirubin compared to baseline or placebo control;

[0054] (gg) prevention or reduction of liver scar tissue buildup and/or liver fibrosis compared to baseline or placebo control;

[0055] (hh) an increase in or no decrease in serum or plasma fibroblast growth factor-19 (FGF-19) compared to baseline or placebo control; and/or

[0056] (ii) a reduction or no increase in serum or plasma immunoglobulin M ("IgM") compared to baseline or placebo control.

[0057] In one embodiment, upon administering a composition of the invention to a subject, the subject exhibits a decrease in triglyceride levels, an increase in the concentrations of EPA and DPA (n-3) in red blood cells, and an increase of the ratio of EPA:arachidonic acid in red blood cells. In a related embodiment the subject exhibits substantially no or no increase in RBC DHA.

[0058] In one embodiment, methods of the present invention comprise measuring baseline levels of one or more markers set forth in (a)-(ii) above prior to dosing the subject or subject group. In another embodiment, the methods comprise administering a composition as disclosed herein to the subject after baseline levels of one or more markers set forth in (a)-(ii) are determined, and subsequently taking an additional measurement of said one or more markers.

[0059] In another embodiment, upon treatment with a composition of the present invention, for example over a period of about 1 to about 200 weeks, about 1 to about 100 weeks, about 1 to about 80 weeks, about 1 to about 50 weeks, about 1 to about 40 weeks, about 1 to about 20 weeks, about 1 to about 15 weeks, about 1 to about 12 weeks, about 1 to about 10 weeks, about 1 to about 5 weeks, about 1 to about 2 weeks or about 1 week, the subject or subject group exhibits any 2 or more of, any 3 or more of, any 4 or more of, any 5 or more of, any 6 or more of, any 7 or more of, any 8 or more of, any 9 or more of, any 10 or more of, any 11 or more of, any 12 or more of, any 13 or more of, any 14 or more of, any 15 or more of, any 16 or more of, any 17 or more of, any 18 or more of, any 19 or more of, any 20 or more of, any 21 or more of, any 22 or more of, any 23 or more of, any 24 or more of, any 25 or more of, any 26 or more of, any 27 or more of, any 28 or more of, any 29 or more of, any 30 or more of, any 31 or more of, any 32 or more of, any 33 or more of, any 34 or more of, or all 35 of outcomes (a)-(ii) described immediately above.

[0060] In another embodiment, upon treatment with a composition of the present invention, the subject or subject group exhibits one or more of the following outcomes:

[0061] (a) a reduction in triglyceride level of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, at least about 55% or at least about 75% (actual % change or median % change) as compared to baseline or placebo control;

[0062] (b) a less than 30% increase, less than 20% increase, less than 10% increase, less than 5% increase or no increase in non-HDL-C levels or a reduction in non-HDL-C levels of at least about 1%, at least about 3%, at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, at least about 55% or at least about 75% (actual % change or median % change) as compared to baseline or placebo control;

[0063] (c) substantially no change in HDL-C levels, no change in HDL-C levels, or an increase in HDL-C levels of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least

about 50%, at least about 55% or at least about 75% (actual % change or median % change) as compared to baseline or placebo control;

[0064] (d) a less than 60% increase, a less than 50% increase, a less than 40% increase, a less than 30% increase, less than 20% increase, less than 10% increase, less than 5% increase or no increase in LDL-C levels or a reduction in LDL-C levels of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, at least about 55%, at least about 55% or at least about 75% (actual % change or median % change) as compared to baseline or placebo control;

[0065] (e) a decrease in Apo B levels of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, at least about 55% or at least about 75% (actual % change or median % change) as compared to baseline or placebo control;

[0066] (f) a reduction in vLDL levels of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0067] (g) an increase in apo A-I levels of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0068] (h) an increase in apo A-I/apo B ratio of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0069] (i) a reduction in lipoprotein (a) levels of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0070] (j) a reduction in mean LDL particle number of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0071] (k) an increase in mean LDL particle size of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0072] (l) a reduction in remnant-like particle cholesterol of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0073] (m) a reduction in oxidized LDL of at least about 5%, at least about 10%, at least about 15%, at least about 20%,

at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0074] (n) substantially no change, no significant change, or a reduction (e.g. in the case of a diabetic subject) in fasting plasma glucose (FPG) of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0075] (o) substantially no change, no significant change or a reduction in hemoglobin A_{1c} (HbA_{1c}) of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, or at least about 50% (actual % change or median % change) compared to baseline or placebo control;

[0076] (p) a reduction in homeostasis model index insulin resistance of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0077] (q) a reduction in lipoprotein associated phospholipase A2 of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0078] (r) a reduction in intracellular adhesion molecule-1 of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0079] (s) a reduction in interleukin-6 of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0080] (t) a reduction in plasminogen activator inhibitor-1 of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0081] (u) a reduction in high sensitivity C-reactive protein (hsCRP) of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0082] (v) an increase in serum, plasma and/or RBC EPA of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, at least about 100%, at least about 200% or

at least about 400% (actual % change or median % change) compared to baseline or placebo control;

[0083] (w) an increase in serum phospholipid and/or red blood cell membrane EPA of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, at least about 100%, at least about 200%, or at least about 400% (actual % change or median % change) compared to baseline or placebo control;

[0084] (x) a reduction or increase in one or more of serum phospholipid and/or red blood cell DHA, DPA, AA, PA and/or OA of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, at least about 55% or at least about 75% (actual % change or median % change) compared to baseline or placebo control;

[0085] (y) a reduction in total cholesterol of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, at least about 55% or at least about 75% (actual % change or median % change) compared to baseline or placebo control;

[0086] (z) a reduction in ALT of at least about 5%, at least about 10%, at least about 15%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 37%, at least about 39%, at least about 40%, at least about 41%, at least about 45%, at least about 50%, at least about 55%, at least about 60%, at least about 65%, at least about 70%, at least about 75%, at least about 80%, at least about 85%, at least about 90%, at least about 95%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0087] (aa) a reduction in AST of at least about 1%, at least about 2%, at least about 3%, at least about 4%, at least about 5%, at least about 6%, at least about 7%, at least about 8%, at least about 9%, at least about 10%, at least about 12%, at least about 14%, at least about 16%, at least about 18%, at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, or at least about 50% (actual % change or median % change) compared to baseline or placebo control;

[0088] (bb) a reduction in GGT of at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 40%, at least about 45%, at least about 50%, at least about 55%, at least about 60%, at least about 62%, at least about 65%, at least about 70%, at least about 73%, at least about 75%, at least about 80%, at least about 85%, at least about 90%, at least about 95%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0089] (cc) a reduction in AP of at least about 20%, at least about 25%, at least about 30%, at least about 35%, at least about 38%, at least about 40%, at least about 45%, at least about 50%, at least about 55%, at least about 60%, at least about 65%, at least about 70%, at least about 75%, at least about 80%, at least about 85%, at least about 90%, at least about 95%, or at least about 100% (actual % change or median % change) compared to baseline or placebo control;

[0090] (dd) a reduction in conjugated bilirubin of at least about 50%, at least about 60%, at least about 70%, at least about 80%, at least about 90%, at least about 100%, at least about 110%, at least about 120%, at least about 130%, at least

about 138%, at least about 140%, at least about 150%, at least about 160%, at least about 170%, at least about 180%, at least about 188%, at least about 190%, or at least about 200% (actual % change or median % change) compared to baseline or placebo control;

[0091] (ee) an increase in FGF-19 of at least about 50%, at least about 60%, at least about 70%, at least about 80%, at least about 90%, at least about 100%, at least about 110%, at least about 111%, at least about 120%, at least about 121%, at least about 130%, at least about 140%, at least about 150%, at least about 160%, at least about 170%, at least about 180%, at least about 190%, at least about 200%, at least about 210%, at least about 220%, at least about 230%, at least about 238%, at least about 240%, at least about 248%, at least about 250%, at least about 260%, at least about 270%, at least about 280%, at least about 290%, at least about 300% (actual % change or median % change) compared to baseline or placebo control; and/or

[0092] (ff) a reduction in IgM of at least about 0.1 g/L, 0.2 g/L, at least about 0.3 g/L, at least about 0.4 g/L, at least about 0.5 g/L, at least about 0.6 g/L, at least about 0.7 g/L, at least about 0.8 g/L, at least about 0.9 g/L, at least about 1 g/L, at least about 1.1 g/L, at least about 1.2 g/L, at least about 1.3 g/L, at least about 1.4 g/L, or at least about 1.5 g/L (actual or median change), or at least about 500%, at least about 600%, at least about 700%, at least about 800%, at least about 900%, at least about 1000%, at least about 1100%, at least about 1200%, at least about 1300%, at least about 1400%, at least about 1500% (actual % change or median % change) compared to baseline or placebo control.

[0093] In one embodiment, methods of the present invention comprise measuring baseline levels of one or more markers set forth in (a)-(ff) prior to dosing the subject or subject group. In another embodiment, the methods comprise administering a composition as disclosed herein to the subject after baseline levels of one or more markers set forth in (a)-(ff) are determined, and subsequently taking a second measurement of the one or more markers as measured at baseline for comparison thereto.

[0094] In another embodiment, upon treatment with a composition of the present invention, for example over a period of about 1 to about 200 weeks, about 1 to about 100 weeks, about 1 to about 80 weeks, about 1 to about 50 weeks, about 1 to about 40 weeks, about 1 to about 20 weeks, about 1 to about 15 weeks, about 1 to about 12 weeks, about 1 to about 10 weeks, about 1 to about 5 weeks, about 1 to about 2 weeks or about 1 week, the subject or subject group exhibits any 2 or more of, any 3 or more of, any 4 or more of, any 5 or more of, any 6 or more of, any 7 or more of, any 8 or more of, any 9 or more of, any 10 or more of, any 11 or more of, any 12 or more of, any 13 or more of, any 14 or more of, any 15 or more of, any 16 or more of, any 17 or more of, any 18 or more of, any 19 or more of, any 20 or more of, any 21 or more of, any 22 or more of, any 23 or more of, any 24 or more of, any 24 or more of, any 25 or more of, any 26 or more of, any 27 or more of, any 28 or more of, any 29 or more of, any 30 or more of, or all 31 of outcomes (a)-(ff) described immediately above.

[0095] Parameters (a)-(ii) can be measured in accordance with any clinically acceptable methodology. For example, triglycerides, total cholesterol, HDL-C and fasting blood sugar can be sample from serum and analyzed using standard photometry techniques. VLDL-TG, LDL-C and VLDL-C can be calculated or determined using serum lipoprotein fractionation by preparative ultracentrifugation and subsequent quan-

titative analysis by refractometry or by analytic ultracentrifugal methodology. Apo A1, Apo B and hsCRP can be determined from serum using standard nephelometry techniques. Lipoprotein (a) can be determined from serum using standard turbidimetric immunoassay techniques. LDL particle number and particle size can be determined using nuclear magnetic resonance (NMR) spectrometry. Remnants lipoproteins and LDL-phospholipase A2 can be determined from EDTA plasma or serum and serum, respectively, using enzymatic immunoseparation techniques. Oxidized LDL, intercellular adhesion molecule-1 and interleukin-6 levels can be determined from serum using standard enzyme immunoassay techniques. These techniques are described in detail in standard textbooks, for example Tietz Fundamentals of Clinical Chemistry, 6th Ed. (Burtis, Ashwood and Bortor Eds.), WB Saunders Company.

[0096] In one embodiment, subjects fast for up to 12 hours prior to blood sample collection, for example about 10 hours.

[0097] In another embodiment, the present invention provides a method of treating or preventing NASH in a subject in need thereof, comprising administering to the subject one or more compositions as disclosed herein. In another embodiment, the present invention provides a method of treating or preventing NASH while lowering triglycerides.

[0098] In another embodiment, the present invention provides a method of treating or preventing PBC in a subject in need thereof, comprising administering to the subject one or more compositions as disclosed herein. In another embodiment, the present invention provides a method of treating or preventing PBC while lowering triglycerides.

[0099] In another embodiment, the present invention provides a method of treating or preventing primary hypercholesterolemia and/or mixed dyslipidemia (Fredrickson Types Ha and Hb) in a subject in need thereof, comprising administering to the subject one or more compositions as disclosed herein. In a related embodiment, the present invention provides a method of reducing triglyceride levels in a subject or subjects when treatment with a statin or niacin extended-release monotherapy is considered inadequate (Frederickson type IV hyperlipidemia).

[0100] In another embodiment, the present invention provides a method of treating or preventing risk of recurrent nonfatal myocardial infarction in a subject with a history of myocardial infarction, comprising administering to the subject one or more compositions as disclosed herein.

[0101] In another embodiment, the present invention provides a method of slowing progression of or promoting regression of atherosclerotic disease in a subject in need thereof, comprising administering to a subject in need thereof one or more compositions as disclosed herein.

[0102] In another embodiment, the present invention provides a method of treating or preventing very high serum triglyceride levels (e.g. Types IV and V hyperlipidemia) in a subject in need thereof, comprising administering to the subject one or more compositions as disclosed herein.

[0103] In another embodiment, the present invention provides a method of treating subjects having very high serum triglyceride levels (e.g. greater than 1000 mg/dl or greater than 2000 mg/dl) and that are at risk of developing pancreatitis, comprising administering to the subject one or more compositions as disclosed herein.

[0104] In another embodiment, a composition of the invention does not include a bile acid derivative or analog.

[0105] In another embodiment, the subject or subject group is not administered obeticholic acid (also referred to as 6-ECDA, 6 α -ethyl chenodeoxycholic acid or INT-747).

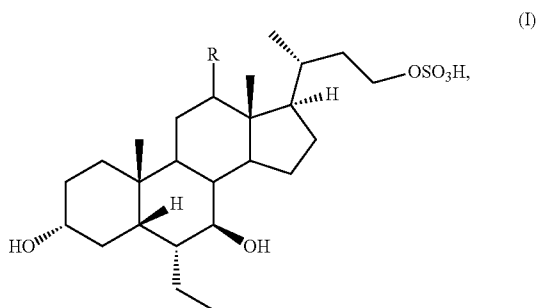
[0106] In another embodiment, the subject or subject group is not administered chenodeoxycholic acid (also referred to as CDCA or INT-767).

[0107] In another embodiment, the subject or subject group is not administered L-alanine or salts thereof.

[0108] In another embodiment, the subject or subject group is not administered ursodeoxycholic acid or a derivative thereof.

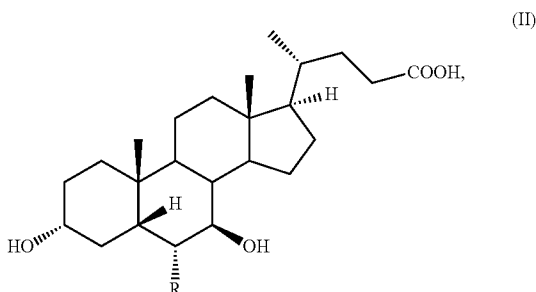
[0109] In another embodiment, the subject or subject group is not administered 23-N-carbaccinnamyloxy-3 α ,7 α -dihydroxy-5 β -norcholanylamine or a derivative thereof.

[0110] In another embodiment, the subject or subject group is not administered a bile acid derivative of formula (I):



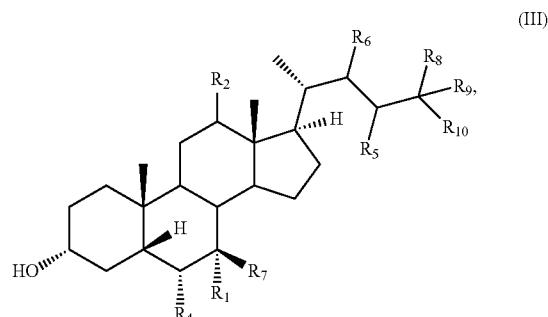
[0111] wherein R is H or α -hydroxy and the hydroxyl group at position 7 is in the α - or β -position, or pharmaceutically acceptable salts, solvates or amino acid conjugates thereof.

[0112] In another embodiment, the subject or subject group is not administered a bile acid derivative of formula (II):



[0113] wherein R is ethyl, propyl or allyl.

[0114] In another embodiment, the subject or subject group is not administered a bile acid derivative of formula (III):



[0115] wherein R₁ is hydrogen, hydroxy, substituted or unsubstituted alkyl, or halogen; R₂ is hydrogen or α -hydroxy; R₃ is hydrogen, hydroxy, NH(CH₂)_mSO₃H, or NH(CH₂)_nCO₂H; R₄ is hydrogen, substituted or unsubstituted alkyl, or halogen; R₅ is unsubstituted or substituted alkyl, or aryl; R₆ is hydrogen, unsubstituted or substituted alkyl, or R₅ and R₆ taken together with the carbons to which they are attached form a ring of size 3, 4, 5, or 6 atoms; R₇ is hydrogen, substituted or unsubstituted alkyl, or hydroxy; R₈ is hydrogen, substituted or unsubstituted alkyl; R₉ is hydrogen, substituted or unsubstituted alkyl or taken together R₈ and R₉ form a carbonyl; R₁₀ is R₃ or SO₃H; m is an integer 0, 1, 2, 3, 4, or 5; and n is an integer 0, 1, 2, 3, 4, or 5.

[0116] In another embodiment, the subject or subject group is not administered chenodeoxycholic acid (CDCA), deoxycholic acid (DCA), lithocholic acid (LCA), and/or taurine and/or glycine conjugates thereof.

[0117] In another embodiment, the subject or subject group is not administered organic or inorganic selenium, β -carotene and/or vitamin A.

[0118] In one embodiment, a composition of the invention is administered to a subject in an amount sufficient to provide a daily dose of eicosapentaenoic acid of about 1 mg to about 10,000 mg, 25 about 5000 mg, about 50 to about 3000 mg, about 75 mg to about 2500 mg, or about 100 mg to about 1000 mg, for example about 1 mg, about 2 mg, about 3 mg, about 4 mg, about 5 mg, about 6 mg, about 7 mg, about 8 mg, about 9 mg, about 10 mg, about 15 mg, about 20 mg, about 25 mg, about 30 mg, about 35 mg, about 40 mg, about 45 mg, about 50 mg, about 75 mg, about 100 mg, about 125 mg, about 150 mg, about 175 mg, about 200 mg, about 225 mg, about 250 mg, about 275 mg, about 300 mg, about 325 mg, about 350 mg, about 375 mg, about 400 mg, about 425 mg, about 450 mg, about 475 mg, about 500 mg, about 525 mg, about 550 mg, about 575 mg, about 600 mg, about 625 mg, about 650 mg, about 675 mg, about 700 mg, about 725 mg, about 750 mg, about 775 mg, about 800 mg, about 825 mg, about 850 mg, about 875 mg, about 900 mg, about 925 mg, about 950 mg, about 975 mg, about 1000 mg, about 1025 mg, about 1050 mg, about 1075 mg, about 1100 mg, about 1025 mg, about 1050 mg, about 1075 mg, about 1200 mg, about 1225 mg, about 1250 mg, about 1275 mg, about 1300 mg, about 1325 mg, about 1350 mg, about 1375 mg, about 1400 mg, about 1425 mg, about 1450 mg, about 1475 mg, about 1500 mg, about 1525 mg, about 1550 mg, about 1575 mg, about 1600 mg, about 1625 mg, about 1650 mg, about 1675 mg, about 1700 mg, about 1725 mg, about 1750 mg, about 1775

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[0119] In another embodiment, a composition of the invention does not include a bile acid derivative or analog.

[0120] In another embodiment, a composition of the invention does not include obeticholic acid (also referred to as 6-ECDCa, 6 α -ethyl chenodeoxycholic acid or INT-747).

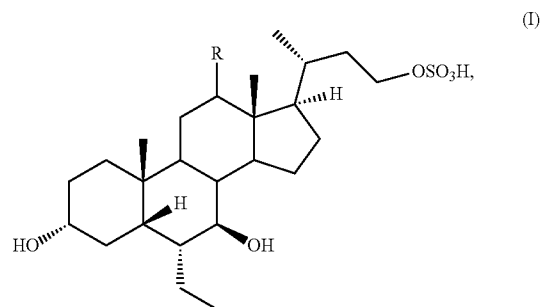
[0121] In another embodiment, a composition of the invention does not include chenodeoxycholic acid (also referred to as CDCA or INT-767).

[0122] In another embodiment, a composition of the invention does not include L-alanine or salts thereof.

[0123] In another embodiment, a composition of the invention does not include ursodeoxycholic acid or a derivative thereof.

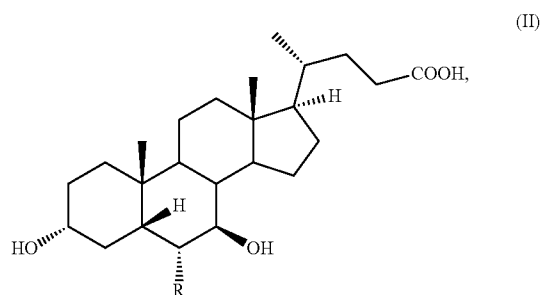
[0124] In another embodiment, a composition of the invention does not include 23-N-carbaccinnamyloxy-3 α ,7 α -dihydroxy-5 β -norcholanylamine or a derivative thereof.

[0125] In another embodiment, a composition of the invention does not include a bile acid derivative of formula (I):



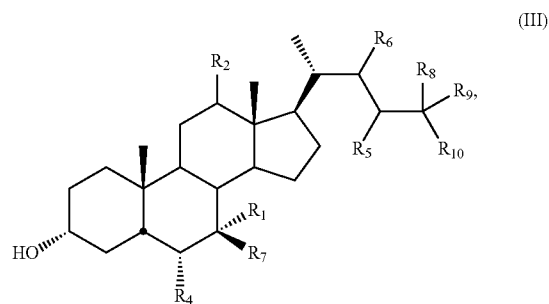
[0126] wherein R is H or alpha-hydroxy and the hydroxyl group at position 7 is in the alpha- or beta-position, or pharmaceutically acceptable salts, solvates or amino acid conjugates thereof.

[0127] In another embodiment, a composition of the invention does not include a bile acid derivative of formula (II):



[0128] wherein R is ethyl, propyl or allyl.

[0129] In another embodiment, a composition of the invention does not include a bile acid derivative of formula (III):



[0130] wherein R₁ is hydrogen, hydroxy, substituted or unsubstituted alkyl, or halogen; R₂ is hydrogen or α -hydroxy; R₃ is hydrogen, hydroxy, NH(CH₂)_mSO₃H, or NH(CH₂)_nCO₂H; R₄ is hydrogen, substituted or unsubstituted alkyl, or halogen; R₅ is unsubstituted or substituted alkyl, or aryl; R₆ is hydrogen, unsubstituted or substituted alkyl, or R₅ and R₆

taken together with the carbons to which they are attached form a ring of size 3, 4, 5, or 6 atoms; R_7 is hydrogen, substituted or unsubstituted alkyl, or hydroxy; R_8 is hydrogen, substituted or unsubstituted alkyl; R_9 is hydrogen, substituted or unsubstituted alkyl or taken together R_8 and R_9 form a carbonyl; R_{10} is R_3 or SO_3H ; m is an integer 0, 1, 2, 3, 4, or 5; and n is an integer 0, 1, 2, 3, 4, or 5.

[0131] In another embodiment, a composition of the invention does not include chenodeoxycholic acid (CDCA), deoxycholic acid (DCA), lithocholic acid (LCA), and/or taurine and/or glycine conjugates thereof.

[0132] In another embodiment, a composition of the invention does not include organic or inorganic selenium, β -carotene and/or vitamin A.

[0133] In another embodiment, any of the methods disclosed herein are used in treatment or prevention of a subject or subjects that consume a traditional Western diet. In one embodiment, the methods of the invention include a step of identifying a subject as a Western diet consumer or prudent diet consumer and then treating the subject if the subject is deemed a Western diet consumer. The term "Western diet" herein refers generally to a typical diet consisting of, by percentage of total calories, about 45% to about 50% carbohydrate, about 35% to about 40% fat, and about 10% to about 15% protein. A Western diet may alternately or additionally be characterized by relatively high intakes of red and processed meats, sweets, refined grains, and desserts, for example more than 50%, more than 60% or more or 70% of total calories come from these sources.

[0134] In one embodiment, a composition for use in methods of the invention comprises eicosapentaenoic acid, or a pharmaceutically acceptable ester, derivative, conjugate or salt thereof, or mixtures of any of the foregoing, collectively referred to herein as "EPA." The term "pharmaceutically acceptable" in the present context means that the substance in question does not produce unacceptable toxicity to the subject or interaction with other components of the composition.

[0135] In one embodiment, the EPA comprises all-cis eicosa-5,8,11,14,17-pentaenoic acid. In another embodiment, the EPA comprises an eicosapentaenoic acid ester. In another embodiment, the EPA comprises a C_1 - C_5 alkyl ester of eicosapentaenoic acid. In another embodiment, the EPA comprises eicosapentaenoic acid ethyl ester, eicosapentaenoic acid methyl ester, eicosapentaenoic acid propyl ester, or eicosapentaenoic acid butyl ester. In one embodiment, the EPA comprises all-cis eicosa-5,8,11,14,17-pentaenoic acid ethyl ester.

[0136] In another embodiment, the EPA is in the form of ethyl-EPA, lithium EPA, mono-, di- or triglyceride EPA or any other ester or salt of EPA, or the free acid form of EPA. The EPA may also be in the form of a 2-substituted derivative or other derivative which slows down its rate of oxidation but does not otherwise change its biological action to any substantial degree.

[0137] In another embodiment, EPA is present in a composition useful in accordance with methods of the invention in an amount of about 50 mg to about 5000 mg, about 75 mg to about 2500 mg, or about 100 mg to about 1000 mg, for example about 50 mg, about 75 mg, about 100 mg, about 125 mg, about 150 mg, about 175 mg, about 200 mg, about 225 mg, about 250 mg, about 275 mg, about 300 mg, about 325 mg, about 350 mg, about 375 mg, about 400 mg, about 425 mg, about 450 mg, about 475 mg, about 500 mg, about 525 mg, about 550 mg, about 575 mg, about 600 mg, about 625

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[0138] In another embodiment, a composition useful in accordance with the invention contains not more than about 10%, not more than about 9%, not more than about 8%, not more than about 7%, not more than about 6%, not more than about 5%, not more than about 4%, not more than about 3%, not more than about 2%, not more than about 1%, or not more than about 0.5%, by weight, docosahexaenoic acid (DHA), if any. In another embodiment, a composition of the invention contains substantially no docosahexaenoic acid. In still another embodiment, a composition useful in the present invention contains no docosahexaenoic acid and/or derivative thereof.

[0139] In another embodiment, EPA comprises at least 70%, at least 80%, at least 90%, at least 95%, at least 96%, at

least 97%, at least 98%, at least 99%, or 100%, by weight, of all fatty acids present in a composition that is useful in methods of the present invention.

[0140] In one embodiment, a composition of the invention comprises ultra-pure EPA. The term “ultra-pure” as used herein with respect to EPA refers to a composition comprising at least 95% by weight EPA (as the term “EPA” is defined and exemplified herein). Ultra-pure EPA comprises at least 96% by weight EPA, at least 97% by weight EPA, or at least 98% by weight EPA, wherein the EPA is any form of EPA as set forth herein.

[0141] In another embodiment, a composition useful in accordance with methods of the invention contains less than 10%, less than 9%, less than 8%, less than 7%, less than 6%, less than 5%, less than 4%, less than 3%, less than 2%, less than 1%, less than 0.5% or less than 0.25%, by weight of the total composition or by weight of the total fatty acid content, of any fatty acid other than EPA. Illustrative examples of a “fatty acid other than EPA” include linolenic acid (LA), arachidonic acid (AA), docosahexaenoic acid (DHA), alpha-linolenic acid (ALA), stearadonic acid (STA), eicosatrienoic acid (ETA) and/or docosapentaenoic acid (DPA). In another embodiment, a composition useful in accordance with methods of the invention contains about 0.1% to about 4%, about 0.5% to about 3%, or about 1% to about 2%, by weight, of total fatty acids other than EPA and/or DHA.

[0142] In another embodiment, a composition useful in accordance with the invention has one or more of the following features: (a) eicosapentaenoic acid ethyl ester represents at least about 96%, at least about 97%, or at least about 98%, by weight, of all fatty acids present in the composition; (b) the composition contains not more than about 4%, not more than about 3%, or not more than about 2%, by weight, of total fatty acids other than eicosapentaenoic acid ethyl ester; (c) the composition contains not more than about 0.6%, not more than about 0.5%, or not more than about 0.4% of any individual fatty acid other than eicosapentaenoic acid ethyl ester; (d) the composition has a refractive index (20° C.) of about 1 to about 2, about 1.2 to about 1.8 or about 1.4 to about 1.5; (e) the composition has a specific gravity (20° C.) of about 0.8 to about 1.0, about 0.85 to about 0.95 or about 0.9 to about 0.92; (f) the composition contains not more than about 20 ppm, not more than about 15 ppm or not more than about 10 ppm heavy metals, (g) the composition contains not more than about 5 ppm, not more than about 4 ppm, not more than about 3 ppm, or not more than about 2 ppm arsenic, and/or (h) the composition has a peroxide value of not more than about 5 meq/kg, not more than about 4 meq/kg, not more than about 3 meq/kg, or not more than about 2 meq/kg.

[0143] In another embodiment, a composition useful in accordance with the invention comprises, consists of or consists essentially of at least 95% by weight ethyl eicosapentaenoate (EPA-E), about 0.2% to about 0.5% by weight ethyl octadecatetraenoate (ODTA-E), about 0.05% to about 0.25% by weight ethyl nonadecapentaenoate (NDPA-E), about 0.2% to about 0.45% by weight ethyl arachidonate (AA-E), about 0.3% to about 0.5% by weight ethyl eicosatetraenoate (ETA-E), and about 0.05% to about 0.32% ethyl heneicosapentaenoate (HPA-E). In another embodiment, the composition is present in a capsule shell.

[0144] In another embodiment, compositions useful in accordance with the invention comprise, consist essentially of, or consist of at least 95%, 96% or 97%, by weight, ethyl eicosapentaenoate, about 0.2% to about 0.5% by weight ethyl

octadecatetraenoate, about 0.05% to about 0.25% by weight ethyl nonadecapentaenoate, about 0.2% to about 0.45% by weight ethyl arachidonate, about 0.3% to about 0.5% by weight ethyl eicosatetraenoate, and about 0.05% to about 0.32% ethyl heneicosapentaenoate. Optionally, the composition contains not more than about 0.06%, about 0.05%, or about 0.04%, by weight, DHA or derivative thereof such as ethyl-DHA. In one embodiment the composition contains substantially no or no amount of DHA or derivative thereof such as ethyl-DHA. The composition further optionally comprises one or more antioxidants (e.g. tocopherol) or other impurities in an amount of not more than about 0.5% or not more than 0.05%. In another embodiment, the composition comprises about 0.05% to about 0.4%, for example about 0.2% by weight tocopherol. In another embodiment, about 500 mg to about 1 g of the composition is provided in a capsule shell.

[0145] In another embodiment, compositions useful in accordance with the invention comprise, consist essentially of, or consist of at least 96% by weight ethyl eicosapentaenoate, about 0.22% to about 0.4% by weight ethyl octadecatetraenoate, about 0.075% to about 0.20% by weight ethyl nonadecapentaenoate, about 0.25% to about 0.40% by weight ethyl arachidonate, about 0.3% to about 0.4% by weight ethyl eicosatetraenoate and about 0.075% to about 0.25% ethyl heneicosapentaenoate. Optionally, the composition contains not more than about 0.06%, about 0.05%, or about 0.04%, by weight, DHA or derivative thereof such as ethyl-DHA. In one embodiment the composition contains substantially no or no amount of DHA or derivative thereof such as ethyl-DHA. The composition further optionally comprises one or more antioxidants (e.g. tocopherol) or other impurities in an amount of not more than about 0.5% or not more than 0.05%. In another embodiment, the composition comprises about 0.05% to about 0.4%, for example about 0.2% by weight tocopherol. In another embodiment, the invention provides a dosage form comprising about 500 mg to about 1 g of the foregoing composition in a capsule shell. In one embodiment, the dosage form is a gel or liquid capsule and is packaged in blister packages of about 1 to about 20 capsules per sheet.

[0146] In another embodiment, compositions useful in accordance with the invention comprise, consist essentially of, or consist of at least 96%, 97% or 98%, by weight, ethyl eicosapentaenoate, about 0.25% to about 0.38% by weight ethyl octadecatetraenoate, about 0.10% to about 0.15% by weight ethyl nonadecapentaenoate, about 0.25% to about 0.35% by weight ethyl arachidonate, about 0.31% to about 0.38% by weight ethyl eicosatetraenoate, and about 0.08% to about 0.20% ethyl heneicosapentaenoate. Optionally, the composition contains not more than about 0.06%, about 0.05%, or about 0.04%, by weight, DHA or derivative thereof such as ethyl-DHA. In one embodiment the composition contains substantially no or no amount of DHA or derivative thereof such as ethyl-DHA. The composition further optionally comprises one or more antioxidants (e.g. tocopherol) or other impurities in an amount of not more than about 0.5% or not more than 0.05%. In another embodiment, the composition comprises about 0.05% to about 0.4%, for example about 0.2% by weight tocopherol. In another embodiment, the invention provides a dosage form comprising about 500 mg to about 1 g of the foregoing composition in a capsule shell.

[0147] In another embodiment, a composition as described herein is administered to a subject once or twice per day. In another embodiment, 1, 2, 3 or 4 capsules, each containing

about 1 g of a composition as described herein, are administered to a subject daily. In another embodiment, 1 or 2 capsules, each containing about 1 g of a composition as described herein, are administered to the subject in the morning, for example between about 5 am and about 11 am, and 1 or 2 capsules, each containing about 1 g of a composition as described herein, are administered to the subject in the evening, for example between about 5 pm and about 11 pm.

[0148] In one embodiment, a subject being treated in accordance with methods of the invention is not otherwise on lipid-altering therapy, for example statin, fibrate, niacin and/or ezetimibe therapy.

[0149] In another embodiment, compositions useful in accordance with methods of the invention are orally deliverable. The terms “orally deliverable” or “oral administration” herein include any form of delivery of a therapeutic agent or a composition thereof to a subject wherein the agent or composition is placed in the mouth of the subject, whether or not the agent or composition is swallowed. Thus “oral administration” includes buccal and sublingual as well as esophageal administration. In one embodiment, the composition is present in a capsule, for example a soft gelatin capsule.

[0150] A composition for use in accordance with the invention can be formulated as one or more dosage units. The terms “dose unit” and “dosage unit” herein refer to a portion of a pharmaceutical composition that contains an amount of a therapeutic agent suitable for a single administration to provide a therapeutic effect. Such dosage units may be administered one to a plurality (i.e. 1 to about 10, 1 to 8, 1 to 6, 1 to 4 or 1 to 2) of times per day, or as many times as needed to elicit a therapeutic response.

[0151] In another embodiment, the invention provides use of any composition described herein for treating NASH and/or PBC along with moderate to severe hypertriglyceridemia in a subject in need thereof, comprising: providing a subject having a fasting baseline triglyceride level of about 500 mg/dl to about 1500 mg/dl and administering to the subject a pharmaceutical composition as described herein. In one embodiment, the composition comprises about 1 g to about 4 g of eicosapentaenoic acid ethyl ester, wherein the composition contains substantially no docosahexaenoic acid.

[0152] In one embodiment, compositions of the invention, upon storage in a closed container maintained at room temperature, refrigerated (e.g. about 5 to about 5-10° C.) temperature, or frozen for a period of about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, or 12 months, exhibit at least about 90%, at least about 95%, at least about 97.5%, or at least about 99% of the active ingredient(s) originally present therein.

[0153] In one embodiment, the invention provides use of a composition as described herein in manufacture of a medication for treatment of NASH and/or PBC and optionally a cardiovascular-related disease. In another embodiment, the subject is diabetic.

[0154] In one embodiment, a composition as set forth herein is packaged together with instructions for using the composition to treat NASH and/or PBC.

What is claimed is:

1. A method of treating or preventing non-alcoholic fatty liver disease (“NASH”) or primary biliary cirrhosis (“PBC”) in a subject, of inhibiting *Novosphingobium aromaticivorans* in a mammal, or of inhibiting Farnesoid X receptors (FXR) in a mammal, the method comprising administering orally to the subject or to the mammal ethyl eicosapentaenoate.

2. The method of claim 1, wherein the method comprises administering orally to the subject or mammal about 2 g to about 4 g per day of the ethyl eicosapentaenoate.

3. The method of claim 1, wherein the method comprises administering orally to the subject or mammal about 2 to about 4 capsules per day, each capsule comprising about 900 mg to about 1.1 g of ethyl eicosapentaenoate and not more than about 20% docosahexaenoic acid or its esters, by weight of all fatty acids present.

4. The method of claim 1, wherein prior to administration of ethyl eicosapentaenoate, the subject or mammal has one or more of: an elevated baseline alanine aminotransferase (“ALT”) level, an elevated baseline aspartate aminotransferase (“AST”) level, liver fibrosis, an elevated baseline gamma-glutamyl transferase level, an elevated baseline alkaline phosphatase level, an elevated baseline antimitochondrial antibody level, an elevated baseline antinuclear antibody level, an elevated total serum bilirubin level, and/or an elevated transaminase level.

5. The method of claim 1, wherein after administration of the ethyl eicosapentaenoate for a period of time, the subject or mammal has one or more of: a reduced alanine aminotransferase (“ALT”) level, a reduced aspartate aminotransferase (“AST”) level, reduced liver fibrosis, a reduced gamma-glutamyl transferase level, a reduced alkaline phosphatase level, a reduced antimitochondrial antibody level, a reduced antinuclear antibody level, a reduced total serum bilirubin level, and a reduced transaminase level compared to baseline, to a second subject who has not received ethyl eicosapentaenoate, or to placebo control.

6. The method of claim 5, wherein a triglyceride level, an IgM level, and/or a C-reactive protein level is reduced in the subject or mammal compared to baseline, compared to a second subject who has not received the ethyl eicosapentaenoate, or compared to placebo control.

7. The method of claim 6, wherein the subject or mammal exhibits one or more of: a reduction in an IgM level of at least about 0.5 g/L compared to baseline and a reduction in C-reactive protein of at least about 30% compared to baseline.

8. The method of claim 1, wherein the subject or mammal is administered the ethyl eicosapentaenoate daily for a period of at least 2 weeks.

9. The method of claim 1, wherein the ethyl eicosapentaenoate is administered in a pharmaceutical composition wherein the ethyl eicosapentaenoate comprises at least about 80% or at least about 90%, by weight, of all fatty acids present in the composition.

10. The method of claim 9, wherein the pharmaceutical composition comprises at least about 96%, by weight of all fatty acids present, ethyl eicosapentaenoate.

11. The method of claim 10, wherein the pharmaceutical composition comprises less than about 10%, by weight of all fatty acids present, docosahexaenoic acid or its esters.

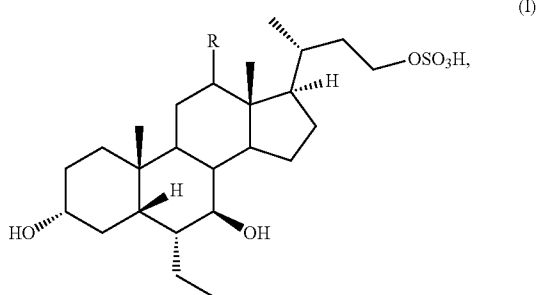
12. The method of claim 11, wherein the pharmaceutical composition comprises less than about 3%, by weight of all fatty acids present, docosahexaenoic acid or its esters.

13. The method of claim 12, wherein the pharmaceutical composition comprises substantially no docosahexaenoic acid or its esters.

14. The method of claim 1, wherein the subject or mammal is not administered an additional NASH or primary biliary cirrhosis therapeutic agent.

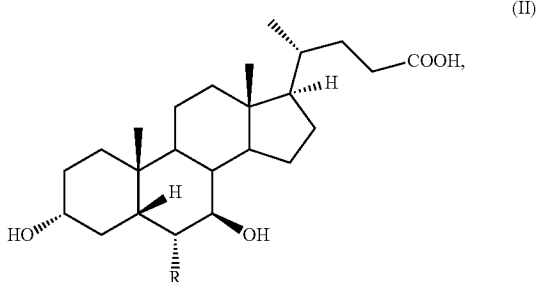
15. The method of claim 14, wherein the additional NASH or primary biliary cirrhosis therapeutic agent is selected from the group consisting of:

L-alanine and pharmaceutically acceptable salts thereof;
 obeticholic acid or a pharmaceutically acceptable salt, ester, glycine conjugate or taurine conjugate thereof;
 ursodeoxycholic acid or a pharmaceutically acceptable derivative thereof;
 23-N-carbaccinnamyloxy-3 α ,7 α -dihydroxy-5 β -norcholan-ylamine;
 a bile acid derivative of formula (I):



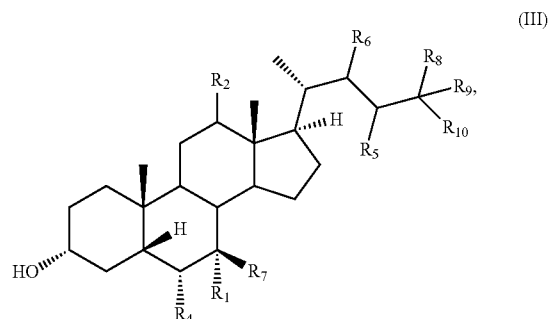
wherein R is H or α -hydroxy and the hydroxyl group at position 7 is in the α - or β -position, or pharmaceutically acceptable salts, solvates or amino acid conjugates thereof;

a bile acid derivative of formula (II):



wherein R is ethyl, propyl or allyl;

a bile acid derivative of formula (III):



wherein R₁ is hydrogen, hydroxy, substituted or unsubstituted alkyl, or halogen; R₂ is hydrogen or α -hydroxy; R₃ is hydrogen, hydroxy, NH(CH₂)_mSO₃H, or NH(CH₂)_nCO₂H; R₄ is hydrogen, substituted or unsubstituted alkyl, or halogen; R₅ is unsubstituted or substituted alkyl, or aryl; R₆ is hydrogen, unsubstituted or substituted alkyl, or R₅ and R₆ taken together with the carbons to which they are attached form a ring of size 3, 4, 5, or 6 atoms; R₇ is hydrogen, substituted or unsubstituted alkyl, or hydroxy; R₈ is hydrogen, substituted or unsubstituted alkyl; R₉ is hydrogen, substituted or unsubstituted alkyl or taken together R₈ and R₉ form a carbonyl; R₁₀ is R₃ or SO₃H; m is an integer 0, 1, 2, 3, 4, or 5; and n is an integer 0, 1, 2, 3, 4, or 5;

chenodeoxycholic acid (CDCA), deoxycholic acid (DCA), lithocholic acid (LCA), and/or the taurine and/or glycine conjugates thereof; and

organic or inorganic selenium, β -carotene and/or vitamin A.

16. The method of claim 1, wherein the subject or mammal is administered about 3.5 to about 4.5 g of ethyl eicosapentaenoate per day.

17. The method of claim 3, wherein the subject or mammal is administered about 4 capsules per day.

18. The method of claim 1, wherein the primary biliary cirrhosis is associated with *Novosphingobium aromaticivorans* bacterium.

19. The method of claim 1, wherein the subject or mammal consumes a Western diet.

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