reaction vessel. Carbon dioxide is introduced into the reacted mixture in the reaction vessel to form a carbonic acid within the reaction vessel. The carbonic acid and the reacted mixture is then mixed within the reaction vessel. The carbonic acid and reacted mixture is allowed to settle within the reaction vessel. An aqueous layer is drained from the reaction vessel.

In alternative embodiments, the carbon dioxide is introduced as a gaseous or liquid flow of carbon dioxide into the reaction vessel. In a second acidulation reaction, carbon dioxide can be introduced into the reacted mixture in the reaction vessel to form a second carbonic acid within the reaction vessel. The second carbonic acid can be mixed with the reacted mixture within the reaction vessel. The second carbonic acid and reacted mixture can be allowed to settle within the reaction vessel. A second aqueous layer (from the second acidulation reaction) can be drained from the reaction vessel.

In one aspect, provided is a method for generating free fatty acids from a mixed lipid feedstock using a thermal hydrolysis reaction, the method comprising:

(a) providing an aqueous solution or mixture comprising a mixed lipid feedstock, and

wherein optionally the mixed lipid feedstock comprises: a soapstock; a triglyceride comprising material; a saponifiable material, optionally a glyceride or a phospholipid; a tall oil, optionally a "liquid rosin" tall oil, a soapstock; a gums product, optionally a chemically or enzymatically derived gums product; a crude biodiesel; a fatty acid, optionally from a distillation bottom; a fat splitter emulsion, optionally purged from fat splitter due to accumulation when recycled; or, any combination thereof,

and optionally the mixed lipid feedstock comprises a soapstock, a wash-water comprising soaps or a combination thereof, optionally generated during the chemical refining of a crude natural oil,

and optionally the mixed lipid feedstock is derived from a biomass, a crude natural oil, or a plant or an animal source, optionally a tallow;

and optionally the mixed lipid feedstock is derived from enzymatic degumming of edible and inedible oils; and

(b) heating and pressurizing the aqueous solution or mixture comprising the mixed lipid feedstock in a thermal hydrolysis reaction under conditions comprising sufficient pressure and temperature to generate a first reaction mixture comprising a free fatty acid and/or a soap, optionally a fatty acid salt, and/or a glyceride, optionally a monoacylglycerol (MAG), a diacylglycerol (DAG), or a triacylglycerol (TAG),

wherein the thermal hydrolysis reaction is carried out at a temperature in the range of between about 20°C to about 600°C, and at a pressure of between about 300 to about 2000 psig (about 20.7 bar to about 137.9 bar), and for between about 1 second (sec) to about 3000 minutes (min), or between about 1 min to about 300 min, or between about 5 min to 200 min,

and optionally the amount of water in the thermal hydrolysis reaction is between about 2:1 water-to-total dissolved solids (TDS) present in the mixed lipid feedstock to about 15:1 TDS, or about 10:1 TDS; or between about 1:1 TDS present in the mixed lipid feedstock to about 100:1 TDS,

and optionally a solvent is added to the thermal hydrolysis reaction in an amount of between about 0.01:1 water-to-total dissolved solids (TDS) present in the mixed lipid feedstock to about 100:1 TDS, or about 10:1 TDS.

In alternative embodiments, provided are methods and processes for generating free fatty acids from a mixed lipid feedstock using a thermal hydrolysis reaction, the method or process comprising:

(a) providing an aqueous solution or mixture comprising a mixed lipid feedstock, and

wherein optionally the mixed lipid feedstock comprises: a soapstock; a triglyceride comprising material; a saponifiable material (optionally a glyceride or a phospholipid); a tall oil ("liquid rosin" or tall oil) soapstock; a gums product (optionally chemically or enzymatically derived); a crude biodiesel; a fatty acid (optionally from a distillation bottom); a fat splitter emulsion (optionally purged from fat splitter due to accumulation when recycled); or, any combination thereof,

and optionally the mixed lipid feedstock comprises a soapstock, a wash-water comprising soaps or a combination thereof, optionally generated during the chemical refining of a crude natural oil,

and optionally the mixed lipid feedstock is derived from a biomass, a crude natural oil, or a plant or an animal source (optionally a tallow);

and optionally the mixed lipid feedstock is derived from enzymatic degumming of edible and inedible oils; and

(b) heating and pressurizing the aqueous solution or mixture comprising the mixed lipid feedstock in a thermal hydrolysis reaction under conditions comprising sufficient pressure and temperature to generate a first reaction mixture comprising a free fatty acid and/or a soap (a fatty acid salt), and/or a glyceride (optionally monoacylglycerol (MAG), diacylglycerol (DAG), or triacylglycerol (TAG)),

and optionally a solvent is added to the thermal hydrolysis reaction in an amount of between about 0.01:1 water-to-total dissolved solids (TDS) present in the mixed lipid feedstock to about 100:1 TDS, or about 10:1 TDS.

2. The method of claim 1, further comprising:

(a) an acidification reaction that takes place after or during or simultaneous with the thermal hydrolysis step, comprising:

(1) providing an acid or an acid solution or a gas capable of forming an acid when mixed with water, optionally a carbon dioxide (CO_2) or a stack gas; and

(2) combining or mixing the first reaction mixture with the acid or acid solution or the gas, optionally CO_2, or mixing the first reaction mixture with the acid or acid solution or the gas, optionally CO_2, to have an acidulation reaction and to generate a second reaction mixture, wherein the first reaction mixture is combined or mixed with the acid or acid solution or the gas, optionally CO_2, for a sufficient amount of time to acidulate, optionally partially, or substantially all of, the soap in the first reaction mixture to generate free fatty acids from the acidulated soaps,

and optionally the pH of the acidulation reaction mixture is less than about pH 5, or is between about pH 1 to pH 6, or is about pH 1, 2, 3, 4, 5 or 6,

and optionally the amount of the gas is sufficient to increase the pressure of the reaction mixture, optionally in a reaction vessel, in which the acidulation reaction is being carried out to between about 0 and about 2000 psig.

(b) the method of (a), further comprising mixing the second reaction mixture with an alcohol to form a third reaction mixture comprising fatty acid alkyl esters,

wherein optionally the mixing is done under conditions comprising between about 240°C to about 350°C, or 200°C to 400°C, and a pressure of between about 1400 psi to about 3000 psi,

and optionally substantially all of the free fatty acids are esterified to generate fatty acid alkyl esters, optionally, fatty acid methyl esters,

and optionally the alcohol comprises methanol, ethanol or a mixture thereof;

(c) the method of (a) or (b), further comprising separating, isolating, and/or purifying the free fatty acids and/or the fatty acid alkyl esters into separate fractions; or