[0007] US-2010-0056833 A1, the disclosure of which is incorporated herein by reference, describes a process that attempts to address the aforementioned problems of gumming and contaminant removal from a composition that contains both animal fats and plant oils. The inventors here have discovered improvements on the teachings set forth in this publication.

SUMMARY OF THE INVENTION

[0008] Disclosed herein is a method of removing a contaminant from a contaminant-containing biological composition that includes animal fats and plant oils. The method generally includes mixing the contaminant-containing biological composition with a first mixture of a first aqueous solution having a pH less than about 7 and an acidic solution to produce an acid-rich biological composition. The acid-rich biological composition is centrifuged to produce a contaminant-deficient, acid-rich biological composition and an aqueous waste product containing a portion of the contaminant removed from the contaminant-containing biological composition. Thereafter, the contaminant-deficient, acid-rich biological composition is mixed with a second aqueous solution having a pH greater than that of the first aqueous solution to produce a second mixture. This second mixture is centrifuged to produce a contaminant-deficient biological composition and the first aqueous solution. The contaminant-deficient biological composition is then mixed with a pH-neutral aqueous solution to produce a third mixture. And this third mixture is then centrifuged to produce the second aqueous solution and a contaminant-depleted biological composition comprising the animal fats and plant oils. The contaminant-depleted biological composition can be used in downstream processes useful in the manufacture of a bio-based fuel (biofuel) product.

In one aspect of the invention, there is disclosed a method of removing a contaminant from a contaminant-containing biological composition comprising animal fats and plant oils, the method comprising: (a) mixing the contaminant-containing biological composition with a first mixture of a first aqueous solution having a pH less than about 7 and an acidic solution to produce an acid-rich biological composition; (b) centrifuging the acid-rich biological composition to produce a contaminant-deficient, acid-rich biological composition, an aqueous waste product containing a portion of the contaminant removed from the contaminant-containing biological composition, and a first rag component, and subsequently combining at least about 90% (by volume) of the first rag component with the contaminant-deficient, acid-rich biological composition and combining the remaining balance (by volume) of the first rag component with the aqueous waste product; (c) mixing the contaminant-deficient, acid-rich biological composition with a second aqueous solution to produce a second mixture, wherein the second aqueous solution has a pH less than about 7 but greater than the pH of the first aqueous solution; (d) centrifuging the second mixture to produce a contaminant-deficient biological composition and the first aqueous solution; (e) mixing the contaminant-deficient biological composition with a pH-neutral aqueous solution to produce a third mixture; and (f) centrifuging the third mixture to produce the second aqueous solution and a contaminant-depleted biological composition comprising the animal fats and plant oils

[0009] Additional features of the invention may become apparent to those skilled in the art from a review of the following detailed description, taken in conjunction with the drawings, the examples, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0010] For a more complete understanding of the disclosure, reference should be made to the following detailed description and accompanying drawing figures wherein:

[0011] Figure 1 is a process flow diagram of one embodiment of the disclosed, inventive method;

[0012] Figure 2 is a process flow diagram of another embodiment of the disclosed, inventive method; and,

What is Claimed is:

1. A method of removing a contaminant from a contaminant-containing biological composition comprising animal fats and plant oils, the method comprising:

(a) mixing the contaminant-containing biological composition with a first mixture of a first aqueous solution having a pH less than about 7 and an acidic solution to produce an acid-rich biological composition;

(b) centrifuging the acid-rich biological composition to produce a contaminant-deficient, acid-rich biological composition, an aqueous waste product containing a portion of the contaminant removed from the contaminant-containing biological composition, and a first rag component, and subsequently combining at least about 90% (by volume) of the first rag component with the contaminant-deficient, acid-rich biological composition and combining the remaining balance (by volume) of the first rag component with the aqueous waste product;

(c) mixing the contaminant-deficient, acid-rich biological composition with a second aqueous solution to produce a second mixture, wherein the second aqueous solution has a pH less than about 7 but greater than the pH of the first aqueous solution;

(d) centrifuging the second mixture to produce a contaminant-deficient biological composition and the first aqueous solution;

(e) mixing the contaminant-deficient biological composition with a pH-neutral aqueous solution to produce a third mixture; and

(f) centrifuging the third mixture to produce the second aqueous solution and a contaminant-depleted biological composition comprising the animal fats and plant oils.

2. The method of claim 1, wherein the first mixture comprises a portion of the second aqueous solution.

3. The method of claim 1, wherein the second aqueous solution further comprises the acidic solution.

4. The method of claim 1, wherein the contaminant is a material selected from the group consisting of a chlorine-containing compound, a nitrogen-containing compound, a phosphorous-containing compound, a sulfur-containing compound, a metal, and mixtures of any two or more thereof.

5. The method of claim 1, wherein the contaminant-containing biological composition comprises one or more of naturally-occurring fatty acids and naturally-occurring fatty acid esters.

6. The method of claim 5, wherein the contaminant-containing biological composition comprises a material selected from the group consisting of algae oils, beef tallow, brown grease, camelina oil, canola/rapeseed oil, castor oil, choice white grease, coconut oil, coffee bean oil, corn oil, fish oils, hemp oil, Jatropha oil, linseed oil, mustard oil, palm oil, poultry fat, soybean oil, sunflower oil, tall oil, tall oil fatty acid, Tung oil, used cooking oils, yellow grease, and mixtures of any two or more thereof.

7. The method of claim 6, wherein the contaminant-containing biological composition comprises a material selected from the group consisting of beef tallow, fish oils, poultry fat, used cooking oils, yellow grease, and mixtures of any two or more thereof.

8. The method of claim 1, wherein animal fats and plant oils are present in the contaminant-containing biological composition in a weight ratio of animal fats:plant oils of about 0.5:1 to about 99:1.

9. The method of claim 8, wherein the weight ratio is about 5:1 to about 90:1.

10. The method of claim 1, wherein the first aqueous solution has a pH of less than about 5.

11. The method of claim 1, wherein the acidic solution comprises an acid selected from the group consisting of citric acid, sulfuric acid, phosphoric acid, hydrochloric acid, nitric acid, acetic acid, carbonic acid, and mixtures of any two or more thereof.

12. The method of claim 14, wherein the acidic solution comprises about 20 wt.% to about 75 wt.% citric acid, based on the total weight of the acidic solution.

13. The method of claim 12, wherein the acidic solution comprises about 20 wt.% to about 40 wt.% citric acid, based on the total weight of the acidic solution.

14. The method of claim 1, wherein the contaminant-depleted biological composition comprises less than about 5 wt.% of the contaminant.

15. The method of claim 1, wherein the contaminant-containing biological composition and the first mixture are mixed in a mass ratio of about 5:1 to about 50:1.

16. The method of claim 1, wherein the contaminant-deficient, acid-rich biological composition and the second aqueous solution are mixed in a mass ratio of about 5:1 to about 50:1.

17. The method of claim 1, wherein the contaminant-deficient biological composition and pH-neutral aqueous solution are mixed in a mass ratio of about 5:1 to about 50:1.

18. The method of claim 1, wherein the step (d) further produces a second rag component, 10% (by volume) or less of which is combined with the contaminant-deficient, biological composition, and the balance (by volume) of which is combined with the first aqueous solution.

19. The method of claim 1, wherein the step (f) further produces a third rag component, 10% (by volume) or less of which is combined with the contaminant-depleted biological composition, and the balance (by volume) is combined with the second aqueous solution.

20. The method of claim 1, wherein steps (b), (d), and (f) are independently performed in a disc stack centrifuge.