for quantifying residual karanjin and pongamol in pongamia seedcake after extraction treatments, these methods are often inaccurate and/or imprecise.

**[0006]** The majority of analytical methods measure karanjin and pongamol concentrations in pongamia compositions by determining the concentrations of these chemical components present in the corresponding methanol or hexane solvent extracts, thus providing an estimate of the concentrations in the pongamia composition by proxy. However, because such methods rely upon the efficiency of the methanol or hexane extraction, and such efficiency will vary for each method depending upon the nature of the material being analyzed and its prior treatment history, these methods report inaccurate values of karanjin and other chemical compounds in pongamia seedcake. Moreover, different analytical methods report varying oil, karanjin and pongamol concentrations for the same pongamia seedcake sample, and often do not provide an internally consistent reference scale across different treatments. Consequently, a meaningful comparison of different treatment methods based on existing analytical methods has been difficult in the art.

**[0007]** Thus, there is a need not only for pongamia compositions having low concentrations of residual oil, karanjin and pongamol and alternative methods to produce such pongamia compositions, but also for more accurate methods for analyzing pongamia compositions produced by various treatment methods in general.

## BRIEF SUMMARY

**[0007a]** In an aspect of the present disclosure, there is provided a method, comprising:
combining a pongamia composition with an alkyl alkanoate solvent to provide an extraction mixture;
irradiating the extraction mixture with microwave radiation to provide an irradiated mixture;
separating the irradiated mixture into an extracted pongamia composition and an alkyl alkanoate extract; and
measuring a karanjin concentration in the alkyl alkanoate extract.

**[0008]** In one example, provided herein is a method, comprising: combining a pongamia composition with an alkyl alkanoate solvent, to provide an extraction mixture; irradiating the extraction mixture with microwave radiation to provide an irradiated mixture; separating the irradiated mixture into an extracted pongamia composition and an alkyl alkanoate extract; and measuring a karanjin concentration in the alkyl alkanoate extract.

**[0009]** In another example, provided herein is a method, comprising: providing a first pongamia composition, wherein the first pongamia composition is a deoiled pongamia seedcake obtained by mechanical extraction and comprises 8-30% oil by weight; combining the first pongamia composition with an alkyl alkanoate solvent to provide an extraction mixture; and separating the extraction mixture into a miscella and a second pongamia composition, wherein the second pongamia composition has (i) a karanjin concentration that is

less than 20% of the karanjin concentration in the first pongamia composition or (ii) a karanjin concentration that is less than or equal to 100 ppm.

**[0010]** In still another example, provided herein is a pongamia composition, comprising: karanjin; and at least one or more components selected from the group consisting of carbohydrates, proteins, fiber, ash, tannins, trypsin inhibitors, other furanoflavonoids, and chalcones. In some variations, the pongamia composition has a karanjin concentration of less than or equal to 100 ppm. In certain variations, the karanjin concentration is determined by processing the pongamia composition with an alkyl alkanoate solvent under microwave irradiation.

**[0011]** In certain examples, provided are pongamia compositions produced according to the methods herein. In another example, provided herein is a feed composition, comprising any of the pongamia compositions described herein.

**[0012]** In yet other examples, provided is a method of feeding a ruminant, comprising providing any of the pongamia compositions as described herein or a feed composition as described herein to the ruminant.

## DESCRIPTION OF THE FIGURES

**[0013]** The present application can be understood by reference to the following description taken in conjunction with the accompanying figures.

**[0014]** **FIG. 1** depicts an exemplary process for analyzing a pongamia composition.

**[0015]** **FIG. 2** depicts an exemplary process for preparing a pongamia composition having a karanjin concentration less than or equal to 100 ppm.

**[0016]** **FIGS. 3A** and **3B** depict bar charts comparing the total concentration of karanjin and pongamol (in ppm, adjusted for starting material amount) extracted from deoiled pongamia seedcake using various methanol-based extraction methods.

**[0017]** **FIGS. 4A** and **4B** depict bar charts comparing the total concentration of karanjin and pongamol (in ppm, adjusted for starting material amount) extracted from deoiled pongamia seedcake using various solvents (methyl tert-butyl ether, ethanol, hexane, toluene, and ethyl acetate) in combination with various extraction methods.

CLAIMS

What is claimed is:

1. A method, comprising:

combining a pongamia composition with an alkyl alkanoate solvent to provide an extraction mixture;

irradiating the extraction mixture with microwave radiation to provide an irradiated mixture;

separating the irradiated mixture into an extracted pongamia composition and an alkyl alkanoate extract; and

measuring a karanjin concentration in the alkyl alkanoate extract.

2. The method of claim 1, wherein the alkyl alkanoate solvent comprises ethyl acetate.

3. The method of claim 1 or 2, wherein the pongamia composition is a deoiled pongamia seedcake.

4. The method of any one of claims 1 to 3, wherein the pongamia composition is obtained by mechanical extraction, solvent extraction, or a combination thereof.

5. The method of any one of claims 1 to 4, wherein measuring the karanjin concentration in the alkyl alkanoate extract comprises determining the karanjin concentration by high performance liquid chromatography (HPLC).