FOOD PRODUCT COATINGS

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of the earlier filing date of U.S. Provisional Patent Application No. 62/452,897, filed on January 31, 2017, which is incorporated herein by reference in its entirety.

FIELD

[0002] Disclosed herein are embodiments of coating compositions and films for foodstuffs and methods of making and using the same.

BACKGROUND

[0003] Cavendish banana (Musa acuminate) is a rich source of vitamins and bioactive compounds (e.g. dietary fiber and phenolic compounds), and one of mostly consumed fruit worldwide. As a climacteric fruit, however, bananas have a relatively short shelf-life, regarding physiological disorder, postharvest diseases, and senescence. Bananas are just one example of foods that typically require an external modification to preserve shelf-life of the food. There remains a need in the art for improved compositions and coatings that can improve self-life and/or pre-harvest integrity of various food items, such as perishable foods, plants and plant parts.

SUMMARY

[0004] Disclosed herein are ~~embodiment~~examples of a coating composition, comprising a cellulose nanomaterial and an emulsion system, comprising a hydrophobic agent (e.g., a fatty acid) and a surfactant. The coating compositions can further comprise a functional agent, a plasticizer, or any combination thereof. In some ~~embodiment~~examples, the cellulose nanomaterial can comprise cellulose nanocrystals or cellulose nanofibrils. In one aspect, the present disclosure refers to a coating composition, comprising: a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and one or more emulsion droplets dispersed within a matrix comprising the cellulose nanomaterial, wherein the one or more emulsion droplets comprise a fatty acid component and a sucrose ester of a fatty acid component, wherein the fatty acid component is present in an amount ranging from 0.1% w/w wet basis to 5% w/w wet basis and the sucrose ester of a fatty acid component is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis and wherein the sucrose ester of a fatty acid component forms an outer hydrophilic region of the one or more emulsion droplets and the fatty acid component forms an internal hydrophobic region of the one or more emulsion droplets. In another aspect, the present disclosure refers to a coating composition, comprising: a cellulose nanomaterial comprising cellulose nanocrystals in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and an emulsion system, comprising a fatty acid that is a medium-chain fatty acid having an aliphatic tail comprising 6 to

12 carbon atoms or a long-chain fatty acid having an aliphatic tail comprising 13-21 carbon atoms and is present in an amount ranging from 0.1% w/w wet basis to 3% w/w wet basis, and a sucrose ester of a fatty acid component; and chitosan. In yet another aspect, the present disclosure refers to a coating composition, comprising: a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and an emulsion system, comprising a fatty acid and a surfactant, wherein the fatty acid is present in an amount ranging from 0.1% w/w wet basis to 5% w/w wet basis and the surfactant is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis.

[0005] Also disclosed herein are ~~embodiment~~examples of a dried (or substantially dried) coating comprising a cellulose nanomaterial and an emulsion system, comprising a hydrophobic agent and a surfactant and substantially free of moisture. In some ~~embodiment~~examples, the coating composition or the dried (or substantially) dried coating can be used to coat a foodstuff, such as a plant or plant part. In one aspect, the present disclosure refers to a substantially dried coating, comprising a cellulose nanomaterial and one or more emulsion droplets dispersed within a matrix comprising the cellulose nanomaterial, wherein the one or more emulsion droplets comprise a fatty acid component and a sucrose ester of a fatty acid component and wherein the sucrose ester of a fatty acid component forms an outer hydrophilic layer of the one or more emulsion droplets and the fatty acid component forms an internal hydrophobic region of the one or more emulsion droplets.

[0006] Also disclosed herein are ~~embodiment~~examples of a method, comprising coating or substantially coating a plant or plant part with a coating composition ~~embodiment~~example described herein. In one aspect, the present disclosure refers to a method, comprising coating or substantially coating a plant or a plant part with the coating composition disclosed herein. In one aspect, the present disclosure refers to a plant part, comprising the substantially dried coating disclosed herein.

[0007] The foregoing and other objects, features, and advantages of the present disclosure will become more apparent from the following detailed description, which proceeds with reference to the accompanying figures.

We claim:

1. A coating composition, comprising:

a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and

an emulsion system, comprising a fatty acid and a surfactant, wherein the fatty acid is present in an amount ranging from 0.1% w/w wet basis to 5% w/w wet basis and the surfactant is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis.

2. The coating composition of claim 1, wherein the cellulose nanomaterial comprises cellulose nanofibrils.

3. The coating composition of claim 2, wherein the cellulose nanofibrils are present in an amount ranging from 0.1% w/w wet basis to 0.5% w/w wet basis.

4. The coating composition of claim 1, wherein the cellulose nanomaterial comprises cellulose nanocrystals.

5. The coating composition of claim 4, wherein the cellulose nanocrystals are present in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis.

6. The coating composition of claim 1, wherein the fatty acid is oleic acid, capric acid, lauric acid, linoleic acid, α-Linolenic acid, palmitic acid, stearic acid, arachidic acid, and any combinations thereof.

7. The coating composition of claim 1, wherein the surfactant is a sucrose ester of a fatty acid or a polysorbate surfactant.

8. The coating composition of claim 1, further comprising a functional agent, a plasticizer, or a combination thereof.

9. The coating composition of claim 8, wherein the functional agent is chitosan.

10. The coating composition of claim 8, wherein the plasticizer is glycerol.

11. The coating composition of claim 8, wherein the composition comprises a functional agent and a plasticizer, wherein the functional agent is present in an amount ranging from 0.1% w/w wet

basis to 2% w/w wet basis and the plasticizer is present in an amount ranging from 0.02% w/w wet basis to 1% w/w wet basis.

12. A coating composition, comprising:

a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and

an emulsion system, comprising a oleic acid and a sucrose ester of a fatty acid, wherein the oleic acid is present in an amount ranging from 0.1% w/w wet basis to 5% w/w wet basis and the sucrose ester of a fatty acid is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis.

13. The coating composition of claim 12, wherein the cellulose nanomaterial comprises cellulose nanofibrils.

14. A coating composition, comprising:

a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and

an emulsion system, comprising a polysorbate surfactant present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis; and

a functional agent, a plasticizer, or a combination thereof.

15. The coating composition of claim 14, wherein the cellulose nanomaterial comprises cellulose nanocrystals.

16. The coating composition of claim 14, wherein the functional agent is chitosan and the plasticizer is glycerol.

17. A substantially dried coating, comprising a cellulose nanomaterial and an emulsion system, comprising a fatty acid and a surfactant.

18. The substantially dried coating of claim 17, wherein the cellulose nanomaterial is present in an amount ranging from 4.5% w/w dry basis to 9.8% w/w dry basis.

19. The substantially dried coating of claim 17, wherein the fatty acid is present in an amount ranging from 9.5% w/w dry basis to 23% w/w dry basis.

20. The substantially dried coating of claim 17, wherein the surfactant is present in an amount ranging from 9.5% w/w dry basis to 9.8% w/w dry basis.

~~21. The substantially dried coating of claim 17, wherein the cellulose nanomaterial comprises cellulose nanofibrils.~~

~~22. The substantially dried coating of claim 17, wherein the cellulose nanomaterial comprises cellulose nanocrystals.~~

~~23. The substantially dried coating of claim 22, further comprising chitosan in an amount ranging from 9.5% w/w dry basis to 9.8% w/w dry basis.~~

~~24. The substantially dried coating of claim 22, further comprising glycerol in an amount ranging from 2% w/w dry basis to 4.7% w/w dry basis.~~

~~25. A plant part, comprising a coating formed from the coating composition of claim 1.~~

~~26. A plant part, comprising the substantially dried coating of any one of claim 17.~~

~~27. The plant part of claim 26, wherein the plant part is a tropical fruit.~~

~~28. The plant part of claim 26, wherein the plant part is a banana, a papaya, an avocado, a melon, or a mango.~~

~~29. A method, comprising coating or substantially coating a plant or a plant part with a coating composition comprising a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and an emulsion system, comprising a fatty acid and a surfactant, wherein the fatty acid is present in an amount ranging from 0.1% w/w wet basis to 5% w/w wet basis and the surfactant is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis.~~

Article 34 amended claims

We claim:

1. A coating composition, comprising:
a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and
one or more emulsion droplets dispersed within the cellulose nanomaterial, wherein the one or more emulsion droplets comprise a fatty acid and a surfactant, wherein the fatty acid is present in an amount ranging from 0.1% w/w wet basis to 5% w/w wet basis and the surfactant is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis and wherein the surfactant forms an outer hydrophilic region of the one or more emulsion droplets and the fatty acid forms an internal hydrophobic region of the one or more emulsion droplets.

2. The coating composition of claim 1, wherein the cellulose nanomaterial comprises cellulose nanofibrils.

3. The coating composition of claim 2, wherein the cellulose nanofibrils are present in an amount ranging from 0.1% w/w wet basis to 0.5% w/w wet basis.

4. The coating composition of claim 1, wherein the cellulose nanomaterial comprises cellulose nanocrystals.

5. The coating composition of claim 4, wherein the cellulose nanocrystals are present in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis.

6. The coating composition of claim 1, wherein the fatty acid is oleic acid, capric acid, lauric acid, linoleic acid, α-Linolenic acid, palmitic acid, stearic acid, arachidic acid, and any combinations thereof.

7. The coating composition of claim 1, wherein the surfactant is a sucrose ester of a fatty acid or a polysorbate surfactant.

8. The coating composition of claim 1, further comprising a functional agent, a plasticizer, or a combination thereof.

9. The coating composition of claim 8, wherein the functional agent is chitosan.

10. The coating composition of claim 8, wherein the plasticizer is glycerol.

11. The coating composition of claim 8, wherein the composition comprises a functional agent and a plasticizer, wherein the functional agent is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis and the plasticizer is present in an amount ranging from 0.02% w/w wet basis to 1% w/w wet basis.

Article 34 amended claims

12. A coating composition, comprising:
a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and
one or more emulsion droplets dispersed within the cellulose nanomaterial, wherein the one or more emulsion droplets comprise oleic acid and a sucrose ester of a fatty acid, wherein the oleic acid is present in an amount ranging from 0.1% w/w wet basis to 5% w/w wet basis and the sucrose ester of a fatty acid is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis and wherein the sucrose ester of the fatty acid forms an outer hydrophilic region of the one or more emulsion droplets and the oleic acid forms an internal hydrophobic region of the one or more emulsion droplets.

13. The coating composition of claim 12, wherein the cellulose nanomaterial comprises cellulose nanofibrils.

14. A coating composition, comprising:
a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and
an emulsion system, comprising a polysorbate surfactant present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis; and
a functional agent and a plasticizer.

15. The coating composition of claim 14, wherein the cellulose nanomaterial comprises cellulose nanocrystals.

16. The coating composition of claim 14, wherein the functional agent is chitosan and the plasticizer is glycerol.

17. A substantially dried coating, comprising a cellulose nanomaterial and one or more emulsion droplets dispersed within the cellulose nanomaterial, wherein the one or more emulsion droplets comprise a fatty acid and a surfactant and wherein the surfactant forms an outer hydrophilic layer of the one or more emulsion droplets and the fatty acid forms an internal hydrophobic region of the one or more emulsion droplets.

18. The substantially dried coating of claim 17, wherein the cellulose nanomaterial is present in an amount ranging from 4.5% w/w dry basis to 9.8% w/w dry basis.

19. The substantially dried coating of claim 17, wherein the fatty acid is present in an amount ranging from 9.5% w/w dry basis to 23% w/w dry basis.

20. The substantially dried coating of claim 17, wherein the surfactant is present in an amount ranging from 9.5% w/w dry basis to 9.8% w/w dry basis.

~~Article 34 amended claims~~

~~21. The substantially dried coating of claim 17, wherein the cellulose nanomaterial comprises cellulose nanofibrils.~~

~~22. The substantially dried coating of claim 17, wherein the cellulose nanomaterial comprises cellulose nanocrystals.~~

~~23. The substantially dried coating of claim 22, further comprising chitosan in an amount ranging from 9.5% w/w dry basis to 9.8% w/w dry basis.~~

~~24. The substantially dried coating of claim 22, further comprising glycerol in an amount ranging from 2% w/w dry basis to 4.7% w/w dry basis.~~

~~25. A plant part, comprising a coating formed from the coating composition of claim 1.~~

~~26. A plant part, comprising the substantially dried coating of any one of claim 17.~~

~~27. The plant part of claim 26, wherein the plant part is a tropical fruit.~~

~~28. The plant part of claim 26, wherein the plant part is a banana, a papaya, an avocado, a melon, or a mango.~~

~~29. A method, comprising coating or substantially coating a plant or a plant part with a coating composition comprising a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and one or more emulsion droplets dispersed within the cellulose nanomaterial, wherein the one or more emulsion droplets comprise a fatty acid and a surfactant, wherein the fatty acid is present in an amount ranging from 0.1% w/w wet basis to 5% w/w wet basis and the surfactant is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis and wherein the surfactant forms an outer hydrophilic layer of the one or more emulsion droplets and the fatty acid forms an internal hydrophobic region of the one or more emulsion droplets.~~

1. A coating composition, comprising:

a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and

one or more emulsion droplets dispersed within a matrix comprising the cellulose nanomaterial, wherein the one or more emulsion droplets comprise a fatty acid component and a sucrose ester of a fatty acid component, wherein the fatty acid component is present in an amount ranging from 0.1% w/w wet basis to 5% w/w wet basis and the sucrose ester of a fatty acid component is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis and wherein the sucrose ester of a fatty acid component forms an outer hydrophilic region of the one or more emulsion droplets and the fatty acid component forms an internal hydrophobic region of the one or more emulsion droplets.

2. The coating composition of claim 1, wherein the cellulose nanomaterial comprises cellulose nanofibrils.

3. The coating composition of claim 2, wherein the cellulose nanofibrils are present in an amount ranging from 0.1% w/w wet basis to 0.5% w/w wet basis.

4. The coating composition of claim 1, wherein the cellulose nanomaterial comprises cellulose nanocrystals.

5. The coating composition of claim 4, wherein the cellulose nanocrystals are present in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis.

6. The coating composition of any one of claims 1-5, wherein the fatty acid component is oleic acid, capric acid, lauric acid, linoleic acid, α-Linolenic acid, palmitic acid, stearic acid, arachidic acid, and any combinations thereof.

7. The coating composition of any one of claims 1-6, further comprising a functional agent, a plasticizer, an additional surfactant, or a combination thereof.

8. The coating composition of claim 7, wherein the functional agent is chitosan and wherein the plasticizer is glycerol and/or the additional surfactant is a polysorbate, a sorbitan, or any combination thereof.

9. The coating composition of claim 7, wherein the composition comprises the functional agent and the plasticizer, wherein the functional agent is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis and the plasticizer is present in an amount ranging from 0.02% w/w wet basis to 1% w/w wet basis.

10. The coating composition of claim 1, wherein:
the cellulose nanomaterial comprises cellulose nanofibrils; and
the fatty acid component is oleic acid.

11. The coating composition of any one of claims 1-10, wherein a portion of the cellulose

nanomaterial comprises cellulose microfibrils, cellulose microcrystals, or a combination thereof.

12. The coating composition of claim 11, wherein the portion of the cellulose nanomaterial comprises the cellulose microfibrils.

13. A coating composition, comprising:

a cellulose nanomaterial comprising cellulose nanocrystals in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and

an emulsion system, comprising a fatty acid that is a medium-chain fatty acid having an aliphatic tail comprising 6 to 12 carbon atoms or a long-chain fatty acid having an aliphatic tail comprising 13-21 carbon atoms and is present in an amount ranging from 0.1% w/w wet basis to 3% w/w wet basis, and a sucrose ester of a fatty acid component; and

chitosan.

14. The coating composition of claim 13, wherein a portion of the cellulose nanomaterial comprises cellulose microfibrils, cellulose microcrystals, or a combination thereof.

15. The coating composition of claim 14, wherein the portion of the cellulose nanomaterial comprises the cellulose microfibrils.

16. The coating composition of claim 14 or claim 15, wherein an amount of the cellulose microfibrils present in the coating composition is reduced or increased by (i) modifying an extraction method used to make the cellulose nanomaterial; and/or (ii) varying a cellulose-containing species from which the cellulose microfibrils are extracted.

17. A substantially dried coating, comprising a cellulose nanomaterial and one or more emulsion droplets dispersed within a matrix comprising the cellulose nanomaterial, wherein the one or more emulsion droplets comprise a fatty acid component and a sucrose ester of a fatty acid component and wherein the sucrose ester of a fatty acid component forms an outer hydrophilic layer of the one or more emulsion droplets and the fatty acid component forms an internal hydrophobic region of the one or more emulsion droplets.

18. The substantially dried coating of claim 17, wherein the cellulose nanomaterial is present in an amount ranging from 4.5% w/w dry basis to 9.8% w/w dry basis, or wherein the fatty acid component is present in an amount ranging from 9.5% w/w dry basis to 23% w/w dry basis, or wherein the sucrose ester of a fatty acid component is present in an amount ranging from 9.5% w/w dry basis to 9.8% w/w dry basis, or any combination thereof.

19. The substantially dried coating of claim 17 or claim 18, wherein the cellulose nanomaterial comprises cellulose nanofibrils or cellulose nanocrystals.

20. The substantially dried coating of any one of claims 17-19, further comprising chitosan in an amount ranging from 9.5% w/w dry basis to 9.8% w/w dry basis, glycerol in an amount ranging from 2% w/w dry basis to 4.7% w/w dry basis, or any combination thereof.

21. The substantially dried coating of any one of claims 17-20, wherein a portion of the cellulose nanomaterial comprises cellulose microfibrils, cellulose microcrystals, or a combination thereof.

22. The substantially dried coating of claim 21, wherein the portion of the cellulose nanomaterial comprises the cellulose microfibrils.

23. A plant part, comprising the substantially dried coating of any one of claims 17-22.

24. The plant part of claim 23, wherein the plant part is a tropical fruit.

25. The plant part of claim 23 or claim 24, wherein the plant part is a banana, a papaya, an avocado, a melon, or a mango.

26. The plant part of any one of claims 23-25, wherein a portion of the cellulose nanomaterial of the substantially dried coating comprises cellulose microfibrils, cellulose microcrystals, or a combination thereof.

27. The plant part of claim 26, wherein the portion of the cellulose nanomaterial comprises the cellulose microfibrils.

28. A method, comprising coating or substantially coating a plant or a plant part with the coating composition of any one of claims 1-16.

29. The method of claim 28, wherein a portion of the cellulose nanomaterial of the substantially dried coating comprises cellulose microfibrils, cellulose microcrystals, or a combination thereof.

30. The method of claim 29, wherein the portion of the cellulose nanomaterial comprises the cellulose microfibrils.

31. A coating composition, comprising:

a cellulose nanomaterial in an amount ranging from 0.1% w/w wet basis to 1% w/w wet basis; and

an emulsion system, comprising a fatty acid and a surfactant, wherein the fatty acid is present in an amount ranging from 0.1% w/w wet basis to 5% w/w wet basis and the surfactant is present in an amount ranging from 0.1% w/w wet basis to 2% w/w wet basis.

32. The coating composition of claim 31, wherein the fatty acid is oleic acid and the surfactant is a sucrose ester of a fatty acid.

33. The coating composition of claim 31 or claim 32, wherein a portion of the cellulose nanomaterial of the substantially dried coating comprises cellulose microfibrils, cellulose microcrystals, or a combination thereof.

34. The coating composition of claim 33, wherein the portion of the cellulose nanomaterial comprises the cellulose microfibrils.