trehalose, increase the complexity of the product and can lead to problems for patients with intolerances to the additives.

[0005] For the above reasons, it is desirable to provide improved hemostatic compositions, methods of making these compositions, and related methods of using the compositions for preventing excessive bleeding and promoting healing following surgery or other trauma using powdered formulations that may be provided in powdered form and dissolved and reconstituted quickly and effectively. These compositions do not require additional additives in order to perform well.

SUMMARY

[0006] To improve medical treatment, especially to prevent excessive bleeding and promote healing, new hemostatic compositions and methods of making and using the same are described herein. The present disclosure seeks to implement new hemostatic compositions that eliminate undesirable features of current compositions, such as a long time to reconstitute, and the addition of ingredients that may not be tolerable to all patients.

[0007] The present disclosure sets forth methods for inhibiting bleeding by providing a spray-dried powdered thrombin material that is reconstituted and applied topically to a wound site in one example. The thrombin material is aseptically spray-dried and does not require the addition of trehalose or a similar carbohydrate, e.g. a stabilizing sugar. The new and improved fast-reconstituting thrombin is spray-dried and contains an unexpectedly reduced amount of albumin.

[0007a] In one aspect of the present disclosure, there is provided a hemostatic composition comprising spray-dried thrombin and less than 5% by weight albumin.

[0007b] In another aspect of the present disclosure, there is provided a thrombin feedstock solution for spray-drying comprising less than 5% by weight albumin prior to spray-drying.

[0007c] In a further aspect of the present disclosure, there is provided a spray-dried thrombin material obtained by spray-drying the thrombin feedstock solution disclosed herein.

[0007d] In another aspect of the present disclosure, there is provided a spray-dried thrombin material obtained by spray-drying the thrombin feedstock solution disclosed herein.

[0007e] In a further aspect of the present disclosure, there is provided a use of a spray-dried thrombin material in the manufacture of a medicament for inhibiting bleeding, wherein:

the spray-dried thrombin material is reconstituted in less than sixty seconds;

the reconstituted spray-dried thrombin material is to be applied to a wound site; and

a biologically compatible polymer is to be optionally administered to the wound site.

[0008] In light of the disclosure herein, and without limiting the scope of the invention in any way, in a first example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, a hemostatic composition includes spray-dried thrombin and less than 5% by weight albumin, for example, less than 3% by weight albumin less than 2.5 % by weight albumin, 1.5% to 2% by weight albumin, 2% to 2.5% by weight albumin, 2.5% to 3.5% by weight albumin, 2.5% to 3% by weight albumin, and/or 2.2% to 2.5% by weight albumin.

[0009] In a second example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, the hemostatic composition may be substantially free of carbohydrates.

[0010] In a third example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, the hemostatic composition may be substantially free of trehalose.

[0011] In a fourth example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, the hemostatic composition may be substantially free of mannitol.

[0012] In a fifth example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, a thrombin feedstock solution for spray-drying includes less than 5% by weight albumin prior to spray-drying, for example, less than 3% by weight albumin less than 2.5 % by weight albumin, 1.5% to 2% by weight albumin, 2% to 2.5% by weight albumin, 2.5% to 3.5% by weight albumin, 2.5% to 3% by weight albumin, and/or 2.2% to 2.5% by weight albumin.

[0013] In a sixth example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, a spray-dried thrombin material may be obtained by spray-drying a thrombin feedstock solution as disclosed herein.

[0014] In a seventh example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, the thrombin may be aseptically spray-dried.

[0015] In an eighth example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, a spray-dried thrombin material includes 75% to 90% by weight total protein based on the total solids content of the material, for example 75% to 80% by weight total protein, 80% to 85% by weight total protein, and/or 85% to 90% by weight total protein.

[0016] In a ninth example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, a method for inhibiting bleeding includes reconstituting a spray-dried thrombin material as disclosed herein in less than sixty seconds, applying the reconstituted spray-dried thrombin material to a wound site; and, optionally co-administering a biologically compatible polymer to the wound site.

[0017] In a tenth example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, the biologically compatible polymer may be a gelatin.

[0018] In an eleventh example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, the gelatin may be cross-linked.

[0019] In a twelfth example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, the spray-dried thrombin material may be reconstituted in less than 1% NaCl by weight.

[0020] In a thirteenth example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, the spray-dried thrombin material may be reconstituted in less than thirty seconds, for example, in less than twenty seconds, in less then ten seconds, and/or in ten to twenty seconds.

[0021] In a fourteenth example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, the spray-dried thrombin material may not comprise trehalose.

[0022] In a fifteenth example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, a method of manufacturing a hemostatic composition includes aseptically spray-drying the thrombin feedstock solution as disclosed herein to obtain a spray-dried thrombin material.

[0023] In a sixteenth example of the present disclosure, which may be combined with any other example listed herein unless specified otherwise, the spray-dried thrombin material may maintain stability and potency in the absence of trehalose and/or mannitol.

[0024] Additional features and advantages of the disclosed compositions and methods are described in, and will be apparent from, the following Detailed Description and the Figures. The features and advantages described herein are not all-inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the figures and description. Also, any particular example does not have to have all of the advantages listed herein. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and not to limit the scope of the inventive subject matter.

BRIEF DESCRIPTION OF THE FIGURES

[0025] Understanding that the figures depict only typical embodiments of the invention and are not to be considered to be limiting the scope of the present disclosure,

CLAIMS

The invention is claimed as follows:

1. A hemostatic composition comprising spray-dried thrombin and less than 5% by weight albumin.

2. The hemostatic composition of claim 1, comprising less than 3% by weight albumin.

3. The hemostatic composition of claim 1, comprising less than 2.5 % by weight albumin.

4. The hemostatic composition of claim 1, wherein the composition is substantially free of carbohydrates.

5. The hemostatic composition of claim 1, wherein the composition is substantially free of trehalose.

6. The hemostatic composition of claim 1 wherein the composition is substantially free of mannitol.

7. A thrombin feedstock solution for spray-drying comprising less than 5% by weight albumin prior to spray-drying.

8. A spray-dried thrombin material obtained by spray-drying the thrombin feedstock solution of claim 7.

9. The composition of claim 8, wherein the thrombin is aseptically spray-dried.

10. A spray-dried thrombin material comprising 75 to 90% by weight total protein based on the total solids content of the material.

11. Use of a spray-dried thrombin material in the manufacture of a medicament for inhibiting bleeding, wherein:

the spray-dried thrombin material is reconstituted in less than sixty seconds;

the reconstituted spray-dried thrombin material is to be applied to a wound site; and

a biologically compatible polymer is to be optionally administered to the wound site.

12. The use of claim 11, wherein the biologically compatible polymer is a gelatin.

13. The use of claim 12, wherein the gelatin is cross-linked.

14. The use of claim 11, wherein the spray-dried thrombin material is reconstituted in less than 1% NaCl by weight.

15. The use of claim 11, wherein the spray-dried thrombin material is reconstituted in less than thirty seconds.

16. The use of claim 11, wherein the spray-dried thrombin material is reconstituted in ten to twenty seconds.

17. The use of claim 11, wherein the spray-dried thrombin material is obtained by spray-drying the thrombin feedstock composition of claim 1.

18. The use of claim 11, wherein the spray-dried thrombin material comprises 75 to 90% by weight total protein based on the total solids content of the composition.

19. The use of claim 11, wherein the spray-dried thrombin material does not comprise trehalose.