agents such as nucleic acid aptamers, and signaling polynucleotides (SPNs) derived from aptamers, specific to allergen proteins, are provided as well.

[0014a] In one aspect of the present disclosure, there is provided an allergen detection system comprising:

(a) at least one sampler for collecting a test sample suspected of containing one or more allergens of interest;

(b) at least one detection vessel comprising detection agents that recognize one or more allergens of interest and generate polarized fluorescence signals, for receiving and processing the test sample, and contacting detection agents with said one or more allergens presented in the test sample; and

(c) a detection device for detecting the allergen content in the test sample by measuring and visualizing fluorescence polarization signals from the binding interaction between the detection agents and the one or more allergens presented in the test sample.

[0014b] In a further aspect of the present disclosure, there is provided a method of detecting the presence and/or absence of an allergen of interest in a sample comprising,

(a) obtaining a test sample suspected of containing an allergen of interest using a sampler;

(b) processing and digesting the obtained sample in an extraction buffer in a disposable vessel;

(c) mixing the processed sample with detection agents that bind to the allergen of interest and changes fluorescence polarization upon binding to the allergen,

(d) treating the mixture from step (c) with a fluorescent excitation means and detecting a fluorescence signal emitted from the detection agents using an optic system; and

(e) digitizing the detected signals and visualizing the interaction between the detection agents and the allergen of interest.

CLAIMS

What is claimed is:

1. An allergen detection system comprising:

(a) at least one sampler for collecting a test sample suspected of containing one or more allergens of interest;

(b) at least one detection vessel comprising detection agents that recognize one or more allergens of interest and generate polarized fluorescence signals, for receiving and processing the test sample, and contacting detection agents with said one or more allergens presented in the test sample; and

(c) a detection device for detecting the allergen content in the test sample by measuring and visualizing fluorescence polarization signals from the binding interaction between the detection agents and the one or more allergens presented in the test sample.

2. The detection system of claim 1, wherein the sampler is a food pickup corer that comprises a distal portion provided with a top cap at the distal end, a proximal portion provided with a sample collecting tube, a grip for handling the corer which is connected to the sample collecting tube, and a plunger inside the sample collecting tube which has a distal end connected to the top cap and a plunger tip at the proximal end,
wherein the proximal plunger tip can protrude out from the sample collecting tube for picking up the test sample.

3. The detection system of claim 2, wherein the food pickup corer is further provided with a means for weighing the test sample being picked up, or comprises a snap at the proximal end.

4. The detection system of claim 1 or 2, wherein the detection vessel is a disposable test cup or cup-like container.

5. The detection system of claim 4, wherein the disposable test cup or cup-like container comprises a cup lid assembly and a cup body having a wider distal end connected to the cup lid assembly and a proximal base, and wherein the cup lid assembly comprises three ports on the top cap of the cup lid assembly: a port (a) for holding a food pickup corer, a port (b) through which a homogenizer is assembled, and a port (c) for connection to a flow controlling means for driving and controlling the flow rate of the processed sample solution during the allergen detection testing; and an optional means for aligning and stabilizing the cup lid assembly and the cup body when both are assembled together to form a test cup or cup-like container.

6. The detection system of claim 5, wherein the cup lid assembly further comprises two or more reaction chambers on the top cap of the cup lid assembly for detection of said one or more allergens in the test sample; and a fluid channel for conveying the processed sample solution from the cup body to said two or more reaction chambers,
wherein said two or more reaction chambers consist of one or more allergen analytical chambers where detection agents specific to the one or more allergens are present.

7. The detection system of claim 6, wherein the cup lid assembly further comprises,
(a) a flow tube through which the processed sample solution is flowed from the cup body to said two or more reaction chambers; and
(b) a flow tube cap and filter assembly in the cup lid assembly for further filtering large particles in the processed sample solution and preventing humidification of the molecules in said two or more reaction chambers.

8. The detection system of claim 5, wherein the cup body further comprises two or more reaction chambers and a filter membrane, wherein said two or more reaction chambers are positioned at the bottom of the cup body and the filter membrane is located above the one or more reaction chambers at the bottom of the cup body which is used to filter the processed test sample before it flows to the one or more reaction chambers at the bottom of the cup body.

9. The detection system of claim 5, wherein the cup body is divided into two separate but connected parts, the first part of which is configured for receiving and processing the test sample, and the second part of which includes two or more reaction chambers,
wherein the two parts are connected by a fluid tube and a valve through which the processed sample solution is flowed from the first part of the cup body to the two or more reaction chambers within the second part of the cup body.

10. The detection system of claim 9, wherein the two or more reaction chambers within the second part of the cup body are configured in a side-to-side orientation, or a stack orientation, or a front-to-back orientation, or in a diagonal orientation.

11. The allergen detection system of claim 5, wherein the cup body is configured for receiving the test sample collected by the sampler and for processing the test sample using the homogenizer assembled through the port (b) on the top of the cup lid assembly,

wherein the homogenizer rotor and stator are inserted into the cup body through the port (b) on the top of the cup lid assembly, wherein the distal caps of the homogenizer rotor and stator are connected to the port (b) and the proximal portions of the homogenizer rotor and stator extend to the cup body.

12. The allergen detection system of claim 11, wherein the cup body contains a volume of an extraction buffer which is used for dissociating the test sample and extracting allergen proteins.

13. The allergen detection system of claim 4, wherein the detection device comprises,
(a) an external housing configured for providing support for the components of the detection device consisting of a housing cover and a housing base;
(b) a first part that can be opened for insertion of the disposable test cup or cup-like container that comprises a cup lid assembly and a cup body, and the food pickup corer;
(c) components integrated for operating an allergen detection testing; and
(d) a power supply;
wherein the components integrated for operating the detection testing (c) comprise,
(i) a homogenizer configured for homogenizing the test sample and extracting allergen proteins from the test sample in an extraction buffer in the cup body of the disposable test cup or cup-like container;
(ii) means for driving and controlling the homogenizer;
(iii) means for driving and controlling the flow of the processed sample solution during the process of the allergen detection testing;
(iv) an optical assembly for detecting a change in fluorescence polarization;
(v) means for converting and digitizing the fluorescence polarization signals; and
(vi) a display window for receiving the detected signals and indicating the presence and/or absence of the allergen in the test sample.

14. The detection system of claim 13, wherein the external housing (a) comprises an alignment on the top front of the housing for aligning the disposable test cup or cup-like container during the process of the allergen detection testing.

15. The detection system of claim 13, wherein the first part (b) is a drawer assembly which comprises an open well for inserting the disposable test cup or cup-like container and a drawer frame, the drawer frame comprising one chimb on each side of the drawer frame, respectively.

16. The detection system of claim 13, wherein the homogenizer (i) comprises a homogenizer stator, a homogenizer rotor inside the stator which are inserted to the cup body through the port (b) on the top cap of the cup lid assembly of the disposable test cup or cup-like container, a coupling that couples the homogenizer stator and the rotor to a gearhead, and a gearhead for connecting the homogenizer to a gear train, through which the homogenizer is connected to the means (ii) for driving and controlling the homogenizer.

17. The detection system of claim 16, wherein the homogenizer stator has a distal portion provided with a cap which is connected to the port (b) on the top of the cup lid assembly of the disposable test cup or cup-like container, and a proximal end provided with one or more slots on the axis of the stator which extend to the cup body of the disposable test cup or cup-like container.

18. The detection system of claim 13, wherein the homogenizer (i) comprises a homogenizer rotor which is welded to the port (b) on the top cap of the cup lid assembly, through a membrane seal.

19. The detection system of claim 16, wherein the means (ii) for driving and controlling the homogenization is a motor.

20. The detection system of claim 13, wherein a vacuum micro pump is used for driving and controlling the flow of the extracted allergen protein solution, which is connected to the underside of a platen which connects to the disposable test cup through the port (c) on the top cap of the cup lid assembly of the disposable test cup or the cup-like container.

21. The detection system of claim 20, wherein the platen includes a vacuum duct that is connected to the port (c) on the top cap of the cup lid assembly of the disposable test cup or cup-like container; an air channel, a port configured for connection to the gear train, a port for connection to the port (c) on the top cap of the cup lid assembly of the disposable test cup wherein the port of the platen for connection to the port (c) on the top cap of the cup lid assembly is sealed with a vacuum gasket.

22. The detection system of claim 13, wherein the optical assembly (iv) is connected to the reaction chambers within the test cup or cup-like container for providing plane polarization excitation light, detecting light remitted from the detection agents, and

measuring a detectable signal upon the binding of said one or more allergens in the test sample to the detection agents,

wherein the optical assembly comprises an excitation optical path including a light source, an excitation filter and an excitation polarizing filter; and an emission optical path including an emission filter, a pair of emission polarizing filters and a pair of photo detectors.

23. The detection system of claim 22, wherein the detection agents are aptamer based signaling polynucleotides probed with a fluorophore and the detectable signals are changes in fluorescence polarization.

24. The detection system of claim 23, wherein the pair of emission polarizing filters and the pair of photo detectors are arranged at a 90 degree to each other.

25. The detection system of claim 23, wherein the pair of emission polarizing filters and the pair of photo detectors are arranged in parallel to each other.

26. The detection system of claim 13, wherein the power supply (d) is a rechargeable or replaceable battery.

27. The detection system of claim 13, wherein the display is a printed circuit board (PCB).

28. A method of detecting the presence and/or absence of an allergen of interest in a sample comprising,

(a) obtaining a test sample suspected of containing an allergen of interest using a sampler;

(b) processing and digesting the obtained sample in an extraction buffer in a disposable vessel;

(c) mixing the processed sample with detection agents that bind to the allergen of interest and changes fluorescence polarization upon binding to the allergen,

(d) treating the mixture from step (c) with a fluorescent excitation means and detecting a fluorescence signal emitted from the detection agents using an optic system; and

(e) digitizing the detected signals and visualizing the interaction between the detection agents and the allergen of interest.