et al., 2016) and also, a theoretical limit of detection of 20 CFU/mL in undiluted orange juice (Shaibani et al., 2018).

SUMMARY

The embodiments of present disclosure generally relate to apparatus, systems, and methods for use thereof to detect at least one target viable bacterial cell in a 100-mL fluid sample. The apparatus and methods are configured to provide a positive result or a negative result within 1 h of commencing the method using the apparatus.

In an example of an embodiment according to the present disclosure, a cartridge for use with a system for rapid analysis of a fluid sample for detection of at least one viable microbial organism therein, wherein the cartridge comprises: a casing with an outward-facing tab configured for demountable engagement with the receptacle, a first well extending downward from an upper surface of the casing, said first well configured for receiving a fluid sample therein, a second well imbedded in the casing underneath a first portion of the first well, said second well having a screen printed electrode housing therein a counter electrod having a terminal end exposed at the outward-facing tab and a reference electrode having a terminal end exposed at the outward-facing tab; a third well imbedded in the casing underneath a second portion of the first well, said third well having a light-addressable potentiometric sensor with an upper surface having a layer of functionalized pH-sensitive hydrogel nanofibers thereon, said light-addressable potentiometric sensor having a working electrode having a terminal end exposed at the outward-facing tab; wherein a bottom surface of the casing has a bore extending upward to about a bottom surface of the third well, said bore configured for communication with a port of a reader component of the system for rapid analysis of the fluid sample; and wherein the screen printed electrode is configured to communicate a reference signal to the detector and the light-addressable potentiometric sensor is configured to communicate a sample signal to the detector.

In an example of an embodiment according to the present disclosure, a system for rapid analysis of a fluid sample for detection of at least one viable microbial organism therein comprises: a reader component comprising a housing containing therein an illumination supply in communication with a port extending to a selected target site on the outer casing, circuitry for controlling the illumination supply, a potentiostat; circuitry interconnecting the potentiostat with one or more receptacles; a detector configured for detecting one or more differences in photocurrent between a reference source and a sample source; wherein said reader component is configured for electronic communication with a microprocessor for modulation of the circuitry for controlling the illumination supply and for modulation of the potentiostat; and at least one cartridge comprising a casing with an outward-facing tab configured for demountable engagement with the receptacle, a first well extending downward from an upper surface of the casing, said first well configured for receiving a fluid sample therein, a second well imbedded in the casing underneath a first portion of the first well, said second well having a screen printed electrode housing therein a counter electrode having a terminal end exposed at the outward-facing tab and a reference electrode having a terminal end exposed at the outward-facing tab; a third well imbedded in the casing underneath a second portion of the first well, said third well having a light-addressable potentiometric sensor with an upper surface having a layer of functionalized pH-sensitive hydrogel nanofibers thereon, said light-addressable potentiometric sensor having a working electrode having a terminal end exposed at the outward-facing tab; wherein a bottom surface of the casing has a bore

CLAIMS

1. A cartridge for use with a system for rapid analysis of a fluid sample for detection of at least one viable microbial organism therein, wherein the cartridge comprises:

a casing with an outward-facing tab configured for demountable engagement with a receptacle,

a first well extending downward from an upper surface of the casing, said first well configured for receiving a fluid sample therein,

a second well imbedded in the casing underneath a first portion of the first well, said second well having a screen printed electrode housing therein a counter electrode having a terminal end exposed at the outward-facing tab and a reference electrode having a terminal end exposed at the outward-facing tab;

a third well imbedded in the casing underneath a second portion of the first well, said third well having a light-addressable potentiometric sensor with an upper surface having a layer of functionalized pH-sensitive hydrogel nanofibers thereon, said light-addressable potentiometric sensor having a working electrode having a terminal end exposed at the outward-facing tab;

wherein a bottom surface of the casing has a bore extending upward to about a bottom surface of the third well, said bore configured for communication with a port of a reader component of the system for rapid analysis of the fluid sample;

and wherein the screen printed electrode is configured to communicate a reference signal to the detector and the light-addressable potentiometric sensor is configured to communicate a sample signal to the detector.

2. A cartridge according to claim 1, wherein the wherein the cartridge is a single-use disposable cartridge.

3. A system for rapid analysis of a fluid sample for detection of at least one viable microbial organism therein, the system comprising:

a reader component comprising a housing containing therein:

an illumination supply in communication with a port extending to a selected target site on the outer surface of the casing of the cartridge as defined by any one of claims 1 or 2 when the cartridge is provided to the reader component,

circuitry for controlling the illumination supply,

a potentiostat;

circuitry interconnecting the potentiostat with one or more receptacles;

a detector configured for detecting one or more differences in photocurrent outputs between a reference source and a sample source;

wherein said reader component is configured for electronic communication with a microprocessor for modulation of the circuitry for controlling the illumination supply and for modulation of the potentiostat; and

at least one cartridge as defined by any one of claims 1 or 2.

4. A system according to claim 3, wherein the housing is provided with a USB port or connection interconnected with the circuitry for controlling the illumination supply and with the potentiostat.

5. A system according to claim 3, wherein the reader component is configured for wireless communication with the microprocessor, said microprocessor configurable for communication with and modulation of one or more of the circuitry for controlling the illumination supply, the potentiostat, and the detector.

6. A system according to claim 3, wherein the cartridge is a single-use disposable cartridge.

7. A system according to claim 3, wherein the one or more receptacles comprise 8 to 12 receptacles.