AMENDED CLAIMS
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Claims

1. A method of predicting overall bacterial density of a plurality of series at a predetermined time comprising:

receiving a number of tubes in each of a plurality of series that exhibit bacterial growth at a first incubation time;

calculating a bacterial density of each of said plurality of series from said number of tubes exhibiting bacterial growth in each of said plurality of series at said first incubation time;

determining one of said plurality of series having a highest bacterial density as a reference series;

calculating an estimated adjusted number of tubes that exhibit growth at a second incubation time using said reference series; and

calculating an overall bacterial density of said plurality of series using said estimated adjusted number of tubes for each of said plurality of series; and

determining an estimated overall bacterial density at said second incubation time wherein said second incubation time is greater than said first incubation time.

2. The method of claim 1 further comprising:

determining a number of tubes that exhibit growth in a total number of tubes in each of a plurality of series.

3. The method of claim 2 further comprising:

taking a plurality of samples from a liquid;

placing each of said plurality of samples in each of said number of tubes in each of said plurality of series;

incubating said plurality of series; and

observing for growth of organism in said number of tubes.

4. The method of claim 1 wherein said second incubation time is the time required for the bacteria population to reach maximum growth.

5. The method of claim 4 wherein said first incubation time is less than the said second incubation time.

6. The method of claim 1 wherein said determining said estimated overall bacterial density is based upon a type of identified organism.

7. The method of claim 1 wherein said determining said estimated overall bacterial density is based upon a culture medium.

8. The method of claim 1 wherein said determining said estimated overall bacterial density is based upon organism growth indicator.

9. The method of claim 1 wherein said calculating bacterial density for each of said plurality of series is performed using the following equation: $-\frac{1}{v}\ln\left(1-\frac{f}{n}\right)$, wherein v is a volume of a sample inoculums in a tube of said one of said plurality of series, f is said number of tubes in said one of said plurality of series that exhibit growth, and n is said number of tubes for said one of said plurality of series.

10. The method of claim 1 further comprising:
determining one of said plurality of series that has a smaller sample inoculums volume than said sample inoculums volume of said reference series.

11. The method of claim 10 wherein said calculating said estimated adjusted number of tubes for said one of said plurality of series that exhibit growth at an end of said second incubation time using said reference series is performed in response to said one of said plurality of series having a smaller sample inoculums volume than said reference series using the following equation:

$f_i^{Predict} = \arg\min f_i\left\{-\frac{1}{v_i}\ln\left(1-\frac{f_i}{n_i}\right) > \delta^{ref}\right\}$, wherein $f_i^{Predict}$ is said estimated adjusted of tubes that exhibits growth at said end of said second incubation time, v_i is a volume of a sample inoculums in said tube, f_i is said number of tubes that exhibit

growth, n_i is said number of tubes for said series, and δ^{ref} is said reference bacterial density.

12. The method of claim 1 further comprises:

determining one of said plurality of series that has a larger sample inoculums volume than said sample inoculums volume of said reference series.

13. The method of claim 12 wherein said calculating said estimated adjusted number of tubes for said one of said plurality of series that exhibit growth at an end of incubation time using said reference series is performed in response to said one of said plurality of series having a larger sample inoculums volume than said reference series using the following equation: $f_i^{Predict} = \arg\max f_i \left\{ -\frac{1}{v_i} \ln\left(1 - \frac{f_i}{n_i}\right) < \delta^{ref} \right\}$, wherein $f_i^{Predict}$ is said estimated adjusted number of tubes that exhibits growth at said end of said second incubation time, v_i is a volume of a sample inoculums in said tube, f_i is said number of tubes that exhibit growth, n_i is said number of tubes for said series, and δ^{ref} is said reference bacterial density.

14. The method of claim 1 wherein said calculating said overall bacterial density of said plurality of series using said estimated adjusted number of tubes for each of said plurality of series is performed using the following equation:

$$\sum_{i=1}^{m}(n_i - f_i)v_i = \prod_{i=1}^{m} \frac{f_i v_i \exp^{-v_i\delta}}{1 - \exp^{-v_i\delta}}$$

, wherein m is a number of said series, n_i is said number of tubes for an i^{th} one of said plurality of series, f_i is said number of tubes that exhibit growth for said i^{th} one of said plurality of series, v_i is a volume of a sample inoculums in said tube for said i^{th} one of said plurality of series, and δ is said overall bacterial density to be calculated.

15. The method of claim 1 further comprising:

calculating a total variance using the following equation:

$$v^2 = \sum \frac{\left(\log\left(Density_{Predicted}\right) - \log\left(Density_{Expected}\right)\right)^2}{\log\left(Density_{Expected}\right)}$$

wherein v^2 is a normalized log variance.

16. A system for estimating an overall bacterial density of plurality of series at a predetermined time comprising:

circuitry in a quality of food controller configured to receive a number of tubes in each of a plurality of series that exhibit bacterial growth at a first incubation time,

circuitry in said quality of food controller configured to calculate a bacterial density of each of said plurality of series from said number of tubes exhibiting bacterial growth at said first incubation time,

circuitry in said quality of food controller configured to determine one of said plurality of series having a highest bacterial density as a reference series,

circuitry in said quality of food controller configured to calculate an estimated adjusted number of tubes that exhibit growth at a second incubation time using said reference series,

circuitry in said quality of food controller configured to calculate an overall bacterial density of said plurality of series using said estimated adjusted number of tubes for each of said plurality of series, and

circuitry in said quality of food controller configured to determine an estimated overall bacterial density at said second incubation time wherein said second incubation time is greater than said first incubation time.

17. The system of claim 16 wherein said second incubation time is the time required for the bacteria population to reach maximum growth.

18. The system of claim 17 wherein said first incubation time is less than the said second incubation time.

19. The system of claim 16 wherein circuitry in said quality of food controller configured to determine said estimated overall bacterial density is based upon a type of identified organism.

20. The system of claim 16 wherein said circuitry in said quality of food controller configured to determine said estimated overall bacterial density is based upon a culture medium.

21. The system of claim 16 wherein said circuitry in said quality of food controller configured to determine said estimated overall bacterial density is based upon organism growth indicator.

22. The system of claim 16 wherein said circuitry in said quality of food controller configured to calculate bacterial density for each of said plurality of series is performed using the following equation: $-\frac{1}{v}\ln\left(1-\frac{f}{n}\right)$, wherein v is a volume of a sample inoculums in a tube of said one of said plurality of series, f is said number of tubes in said one of said plurality of series that exhibit growth, and n is said number of tubes for said one of said plurality of series.

23. The system of claim 16 further comprising:

circuitry in said quality of food controller configured to determine one of said plurality of series that has a smaller sample inoculums volume than said sample inoculums volume of said reference series.

24. The system of claim 23 wherein said circuitry in said quality of food controller configured to calculate said estimated adjusted number of tubes for said one of said plurality of series that exhibit growth at an end of said second incubation time using said reference series is performed in response to said one of said plurality of series having a smaller sample inoculums volume than said reference series using the following equation: $f_i^{Predict} = \arg\min f_i\left\{-\frac{1}{v_i}\ln\left(1-\frac{f_i}{n_i}\right) > \delta^{ref}\right\}$, wherein $f_i^{Predict}$ is said estimated adjusted of tubes that exhibits growth at said end of said

second incubation time, v_i is a volume of a sample inoculums in said tube, f_i is said number of tubes that exhibit growth, n_i is said number of tubes for said series, and δ^{ref} is said reference bacterial density.

25. The system of claim 16 further comprises:

circuitry in said quality of food controller configured to determine one of said plurality of series that has a larger sample inoculums volume than said sample inoculums volume of said reference series.

26. The system of claim 25 wherein said circuitry in said quality of food controller configured to calculate said estimated adjusted number of tubes for said one of said plurality of series that exhibit growth at an end of said second incubation time using said reference series is performed in response to said one of said plurality of series having a larger sample inoculums volume than said reference series using the following equation: $f_i^{Predict} = \arg\max f_i \left\{ -\frac{1}{v_i} \ln\left(1 - \frac{f_i}{n_i}\right) < \delta^{ref} \right\}$, wherein $f_i^{Predict}$ is said estimated adjusted number of tubes that exhibits growth at said end of said second incubation time, v_i is a volume of a sample inoculums in said tube, f_i is said number of tubes that exhibit growth, n_i is said number of tubes for said series, and δ^{ref} is said reference bacterial density.

27. The system of claim 16 wherein said circuitry in said quality of food controller configured to calculate said overall bacterial density of said plurality of series using said estimated adjusted number of tubes for each of said plurality of series is performed using the following equation: $\sum_{i=1}^{m}(n_i - f_i)v_i = \prod_{i=1}^{m} \frac{f_i v_i \exp^{-v_i\delta}}{1 - \exp^{-v_i\delta}}$, wherein m is a number of said series, n_i is said number of tubes for an i^{th} one of said plurality of series, f_i is said number of tubes that exhibit growth for said i^{th} one of said plurality of series, v_i is a volume of a sample inoculums in said tube for said i^{th} one of said plurality of series, and δ is said overall bacterial density to be calculated.

28. The system of claim 16 further comprising:

circuitry in said quality of food controller configured to calculate a total variance using the following equation:

$$v^2 = \sum \frac{\left(\log\left(Density_{Predicted}\right) - \log\left(Density_{Expected}\right)\right)^2}{\log\left(Density_{Expected}\right)}$$

wherein v^2 is a normalized log variance.