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(54) **METHOD AND SYSTEM FOR RECAPTURING AND REUSING UNREACTED ANTIMICROBIAL SOLUTIONS IN SPRAY APPLICATIONS**

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(57) **ABSTRACT**

A system providing for on-site reclamation and re-use of reclaimed antimicrobial solution includes a dispenser, at least one receptacle, piping, and at least one pump. The dispenser sprays antimicrobial solution toward moving raw food products. Unspent antimicrobial solution that did not contact the moving raw food products and rebound antimicrobial solution that did contact the raw food products combine to form a reclaimed antimicrobial solution. The reclaimed antimicrobial solution is collected in the receptacle and is pumped through the piping to a location for reuse.

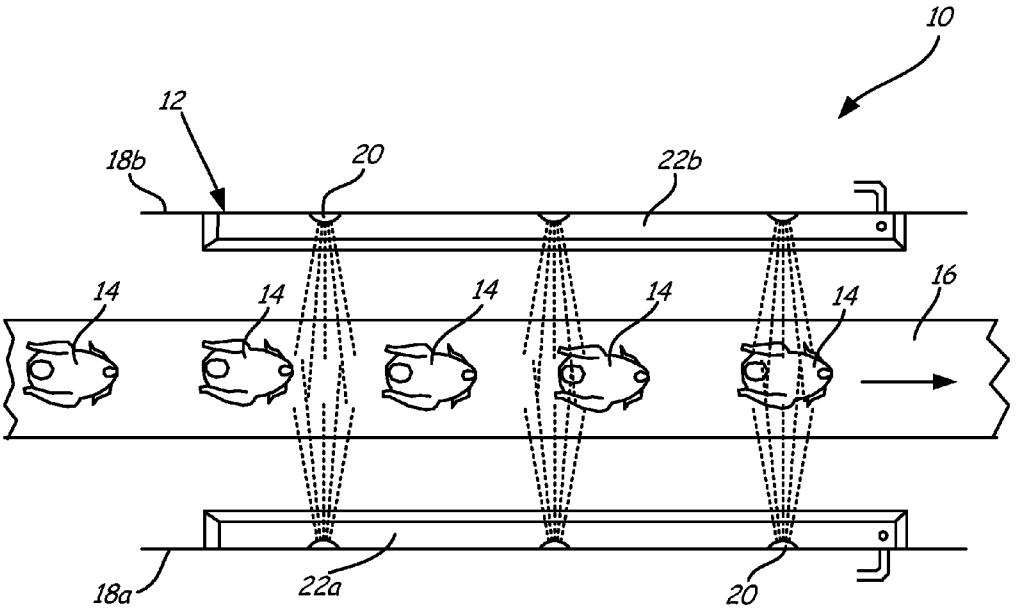


FIG. 1

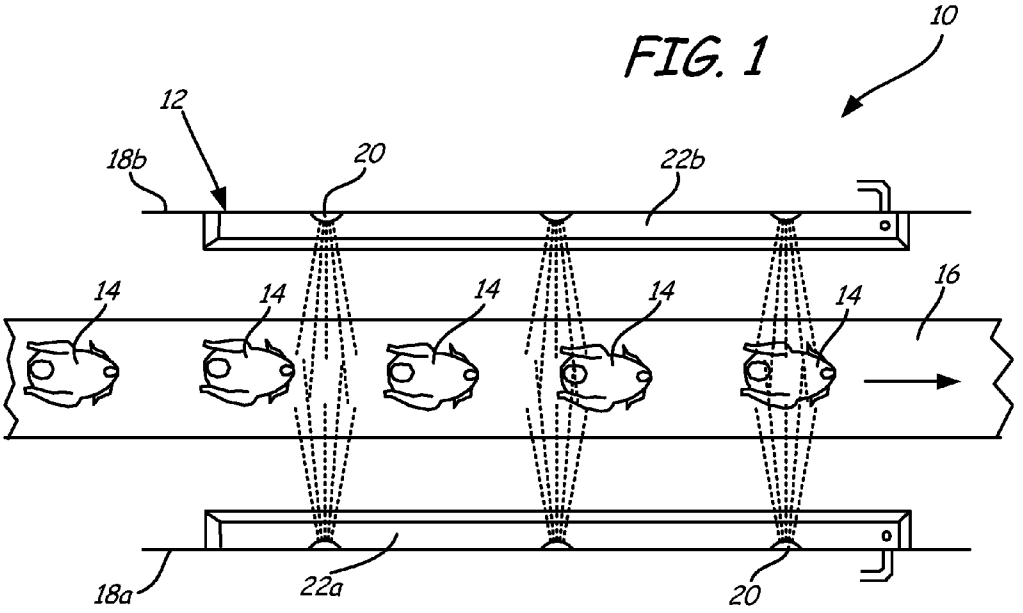
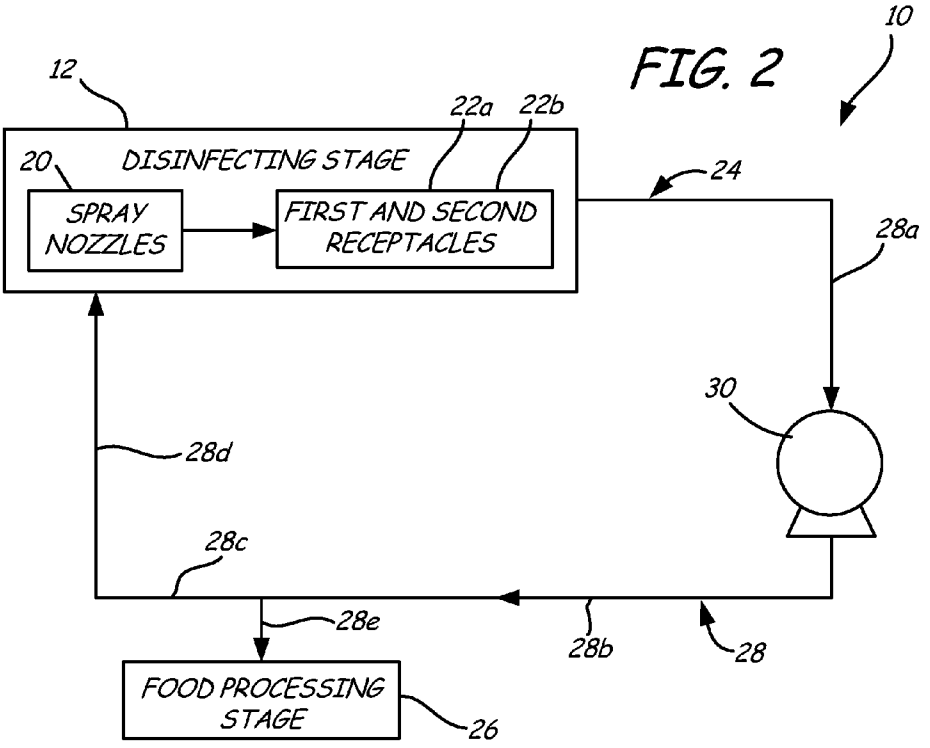

10
12
18b
20
22b
14
14
14
14
14
16
18a
22a
20

FIG. 2


10
12
22a
22b
20
DISINFECTING STAGE
SPRAY NOZZLES
FIRST AND SECOND RECEPTACLES
24
28a
30
28d
28c
28e
28b
28
FOOD PROCESSING STAGE
26

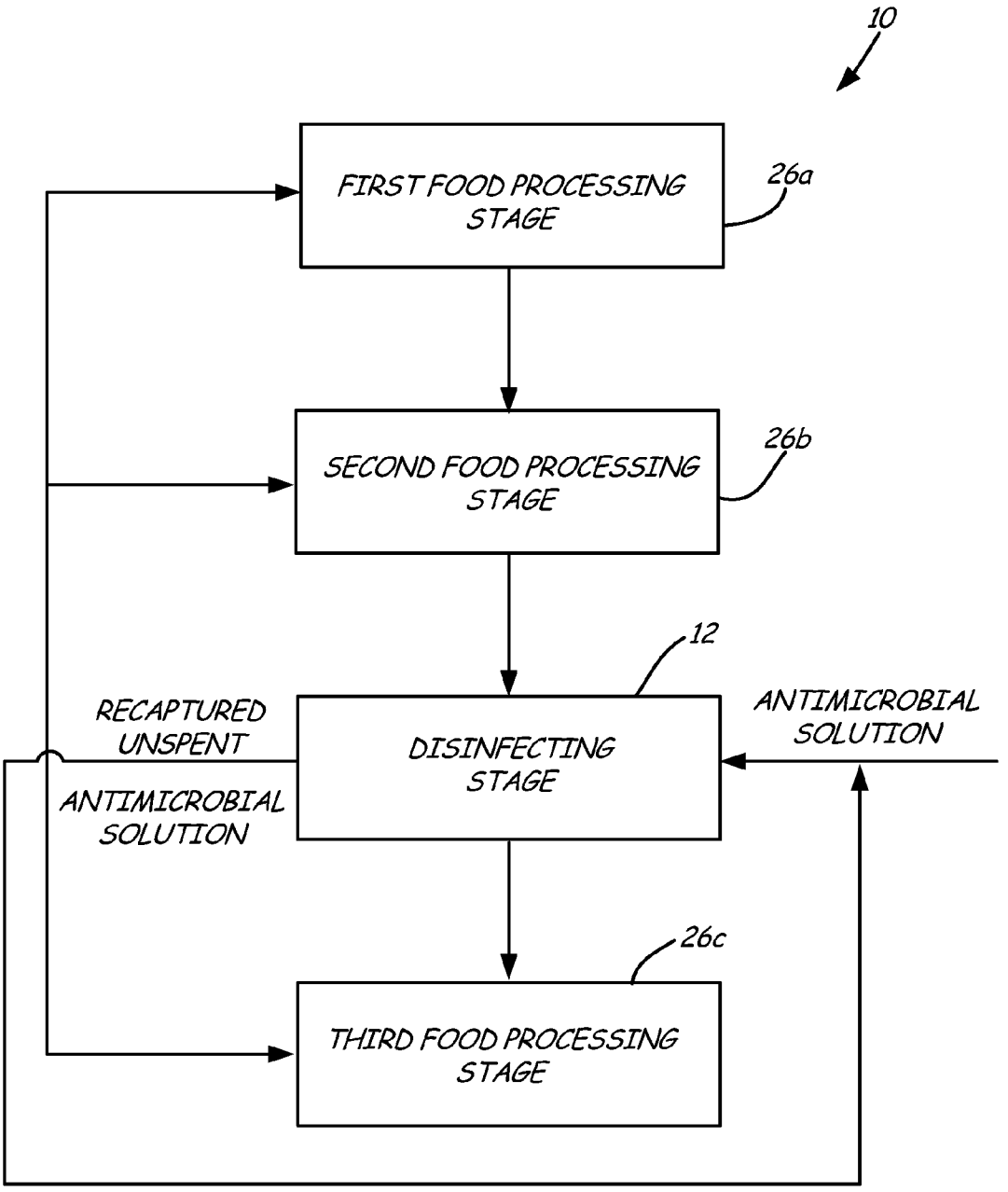

10
FIRST FOOD PROCESSING STAGE
26a
SECOND FOOD PROCESSING STAGE
26b
12
RECAPTURED UNSPENT ANTIMICROBIAL SOLUTION
DISINFECTING STAGE
ANTIMICROBIAL SOLUTION
26c
THIRD FOOD PROCESSING STAGE

FIG. 3

METHOD AND SYSTEM FOR RECAPTURING AND REUSING UNREACTED ANTIMICROBIAL SOLUTIONS IN SPRAY APPLICATIONS

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of U.S. application Ser. No. 12/702,057 filed Feb. 8, 2010, published as US2010/0136189-A1, which is a divisional application of U.S. application Ser. No. 11/335,239 filed Jan. 19, 2006, and issued as U.S. Pat. No. 7,870,822 on Jan. 18, 2011. The entire disclosures of which are hereby expressly incorporated herein by reference including, without limitation, the specification, claims, and abstracts, as well as any figures, tables, or drawings thereof.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to the field of food processing. In particular, the present invention relates to a system and a method for on-site reclamation and reapplication of raw food product antimicrobial solution.

[0003] One of the stages in raw food product processing is disinfecting the raw food product in order to reduce or control microbial populations on the surface of the raw food products. During the disinfecting stage, the surface of the raw food product is sprayed with a disinfecting solution, typically an antimicrobial solution, to kill or remove organics and inorganics, both dissolved and particulate, from the surface of the raw food product. The raw food product (e.g., poultry, beef sides or products, fruits, vegetables) is moved through the processing system along an automated device, such as a conveyor rail, and is sprayed by stationary or moving spray nozzles positioned on either side of the conveyor rail. Antimicrobial solution is applied onto the raw food products through the spray nozzles to reduce microbial populations on the raw food product. Thus, as the raw food product travels along the conveyor rail, it is sprayed with antimicrobial solution from various directions. While the spray nozzles usually provide a continuous spray, the raw food products are typically spaced apart from one another as they move along the conveyor rail. Thus, as the raw food products travel along the conveyor rail, a portion of the spray volume will contact the surfaces of the raw food products and a portion of the spray volume will pass through the spaces between the raw food products.

[0004] Although recycling the entire runoff of the antimicrobial solution is technically feasible, current systems are complex, time-consuming, and not cost-effective. The recaptured antimicrobial solution must be filtered and treated to remove soluble organics as well as particulates removed from the surface of the raw food products to meet regulatory parameters set by the United States Department of Agriculture (USDA) prior to reuse. A widely used antimicrobial solution is acidified sodium chlorite (ASC). Fresh ASC antimicrobial solution must meet FDA approvals (21 C.F.R. 173.325) as well as industry standards. Immediately after mixing the sodium chlorite with an acid solution, a certain amount of chlorous acid is formed. After contacting the surfaces of the raw food products, the concentration of chlorous acid and sodium chlorite decreases, making the solution less effective. This typically occurs in two ways. First, a portion of the chlorous acid in the antimicrobial solution reacts with organics and inorganics on the surface of the raw food product, decreasing the sodium chlorite concentration of the spent solution. Second, some raw food products exude sera or other materials that buffer and/or consume some of the acidity of the antimicrobial solution such that the pH of the spent solution is higher than the initial pH of the solution.

BRIEF SUMMARY OF THE INVENTION

[0005] A system providing for on-site reclamation and reuse of reclaimed antimicrobial solution includes a dispenser, at least one receptacle, piping, and at least one pump. The dispenser sprays antimicrobial solution toward moving raw food products. Unspent antimicrobial solution that did not contact the moving raw food products and rebound antimicrobial solution that did contact the raw food products combine to form a reclaimed antimicrobial solution. The reclaimed antimicrobial solution is collected in the receptacle and is pumped through the piping to a location for reuse.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is an overhead view of a disinfecting stage of an antimicrobial solution reapplication system.

[0007] FIG. **2** is a diagram of the antimicrobial solution reapplication system of the present invention.

[0008] FIG. **3** is a block diagram of the antimicrobial solution reapplication system of the present invention.

DETAILED DESCRIPTION

[0009] FIG. **1** is an overhead view of a disinfecting stage of an antimicrobial solution reapplication system **10** in accordance with the present invention. Reapplication system **10** is an antimicrobial solution reclamation and reapplication system that permits the reuse of reclaimed antimicrobial solution during raw food processing by reclaiming unspent antimicrobial solution as well as some spent antimicrobial solution. Reapplication system **10** is beneficial for reducing antimicrobial solution consumption through more efficient utilization of antimicrobial solution, which in turn also decreases the impact on the environment. Although the specification discusses the reclamation and reapplication of antimicrobial solution, those skilled in the art will recognize that the system and method can be used for the reclamation and reapplication of any sprayed-on additive.

[0010] FIG. **1** specifically shows a first disinfecting stage **12** of reapplication system **10**. Disinfecting stage **12** removes organics, inorganics, and other particulates from raw food product **14** and generally includes conveyor rail **16**, opposing first wall **18***a* and second wall **18***b*, spray nozzles **20**, first receptacle **22***a* and second receptacle **22***b*, and circulation system **24** (shown and described in FIG. **2**). Conveyor rail **16** is positioned between opposing first and second walls **18***a* and **18***b* and moves raw food product **14** through disinfecting stage **12**.

[0011] Spray nozzles **20** are positioned along opposing first and second walls **18***a* and **18***b* of disinfecting stage **12** and contain antimicrobial solution for disinfecting raw food product **14**. As raw food product **14** moves along conveyor rail **16**, spray nozzles **20** continuously spray antimicrobial solution towards raw food product **14**. Antimicrobial solution is sprayed from spray nozzles **20** at a force sufficient to propel the droplets of antimicrobial solution to raw food product **14** as well as the opposing wall. Although FIG. **1** depicts spray nozzles **20** in staggered positions along opposing first and

second walls **18***a* and **18***b*, spray nozzles **20** can be positioned along first and second walls **18***a* and **18***b* in a variety of arrangements as long as the droplets of antimicrobial solution leaving spray nozzles **20** are not prevented from reaching either raw food product **14**. Additionally, although FIG. **1** depicts spray nozzles **20** positioned along first and second walls **18***a* and **18***b*, spray nozzles can also be positioned on the ceiling or floor, as long as the antimicrobial solution is directed to contact raw food product **14**.

[0012] First and second receptacles **22***a* and **22***b* are positioned directly below spray nozzles **20** along first and second walls **18***a* and **18***b*, respectively. As antimicrobial solution is sprayed toward raw food product **14**, a portion of the antimicrobial solution will contact raw food product **14** (spent antimicrobial solution) and adhere to the surface of raw food product **14**. Because raw food products **14** are spaced along conveyor rail **16** at a distance from one another, a portion of the antimicrobial solution will not contact raw food products **14** (unspent antimicrobial solution). The unspent antimicrobial solution thus continues past conveyor rail **16** and raw food product **14**. The unspent antimicrobial solution from spray nozzles **20** positioned along first wall **18***a* continues toward opposing second wall **18***b*, while the unspent antimicrobial solution from spray nozzles **20** positioned along second wall **18***b* continues toward opposing first wall **18***a*. Once the unspent antimicrobial solution contacts respective opposing first or second wall **18***a* and **18***b*, the unspent antimicrobial solution runs down first or second wall **18***a* and **18***b* and into first and second receptacles **22***a* and **22***b*, respectively. Although FIG. **1** depicts first and second receptacles **22***a* and **22***b* positioned directly below spray nozzles **20**, first and second receptacles **22***a* and **22***b* can be positioned at different locations as long as first and second receptacles **22***a* and **22***b* are positioned to receive the unspent antimicrobial solution after it is sprayed at raw food products **14**.

[0013] When the antimicrobial solution contacts raw food product **14**, the chemicals in the antimicrobial solution react with dissolved organics, inorganics, and/or particles on the surface of raw food product **14** and are typically not be reused without first being reconditioned. In contrast, the unspent antimicrobial solution collected in first and second receptacles **22***a* and **22***b* are not significantly degraded because it never contacted raw food product **14** and did not undergo any chemical reactions, such as oxidation or reduction. In addition, the unspent antimicrobial solution will not be buffered outside any pH specifications that may be set by the FDA and/or USDA. Some spent antimicrobial solution containing organic contaminants and particulates (rebound antimicrobial solution) will also be collected into first and second receptacles **22***a* and **22***b* along with the unspent antimicrobial solution through deflection or rebound off raw food product **14**, or through other means. Although a portion of the rebound antimicrobial solution is mixed with the unspent antimicrobial solution (reclaimed antimicrobial solution) in first and second receptacles **22***a* and **22***b*, the level of organic contaminants and particulates in the reclaimed antimicrobial solution is still less than the level of organic contaminants and particulates that would be present in a solution combining all of the spent antimicrobial solution and all of the unspent antimicrobial solution. After the reclaimed antimicrobial solution has been collected, the reclaimed antimicrobial solution is typically sent through a reconditioning step, such as filtration, prior to reuse in order to satisfy USDA standards and regulations. Optionally, if the level of organic contaminants and particulates in the reclaimed antimicrobial solution satisfies USDA standards and regulations, the reclaimed antimicrobial solution can be immediately reused without reconditioning.

[0014] Examples of suitable antimicrobial solutions include, but are not limited to: octanoic acid, acetic acid, acidified sodium chlorite, carnobacterium maltaromaticum stain CB1; cetylpyridinium chloride; citric acid; chlorine dioxide; 1,3 di-bromo-5, 5-dimethylhydantoin; citric acid, phosphoric acid, and hydrochloric acid mixtures; lactic acid; lactoferrin; lauramide arginine ethyl ester; nisin, ozone; hydrogen peroxide; peroxyacetic acid; peroxyoctanoic acid; potassium diacetate; lactic acid and acidic calcium sulfate mixtures; lactic acid, acidic calcium sulfate, and propionic acid mixtures; lactic acid, calcium sulfate, and sodium phosphate mixtures; sodium metasilicate; trisodium phosphate; or combinations thereof. An example of a suitable commercially available antimicrobial solution includes, but is not limited to, trade designated SANOVA® acidified sodium chlorite, available from Ecolab, Incorporated, Saint Paul, Minn.

[0015] FIG. **2** is a diagram of reapplication system **10** showing disinfecting stage **12**, which includes spray nozzles **20** and first and second receptacles **22***a* and **22***b*, circulation system **24**, and raw food processing stage **26**. Circulation system **24** generally includes piping **28** and pump **30**. Circulation system **24** circulates the reclaimed antimicrobial solution through reapplication system **10**. Piping **28** of circulation system **24** generally includes collection line **28***a*, intermediate line **28***b*, T-line **28***c*, recycle line **28***d*, and secondary line **28***e*. Collection line **28***a* connects disinfecting stage **12** and pump **30**. First intermediate line **28***b* connects pump **30** to T-line **28***c*, which is connected to recycle line **28***d* and secondary line **28***e*. When the reclaimed antimicrobial solution comes to T-line **28***c*, the reclaimed antimicrobial solution can be passed to recycle line **28***d*, secondary line **28***e*, or both recycle line **28***d* and secondary line **28***e*. Recycle line **28***d* connects T-line **26***c* and disinfecting stage **12**. Secondary line **28***e* connects T-line **28***c* and raw food processing stage **26**. Pump **30** pumps the unspent solution collected in first and second receptacles **22***a* and **22***b* through piping **28**.

[0016] After the mixture of unspent and rebound antimicrobial solution has been reclaimed by first and second receptacles **22***a* and **22***b* (shown in FIG. **1**), circulation system **24** of reapplication system **10** transports the reclaimed antimicrobial solution back to disinfecting stage **12** or raw food processing stage **26** for reuse. Optionally, reapplication system **10** can also include a reconditioning stage upstream of food processing stage **26** or disinfecting stage **12**.

[0017] FIG. **3** is a block diagram of reapplication system **10** showing first food processing stage **26***a*, second food processing stage **26***b*, disinfecting stage **12**, and third food processing stage **26***c*. During raw food processing, the raw food product is passed through numerous food-processing stages in preparation for human consumption. First and second food processing stages **26***a* and **26***b* occur prior to disinfecting stage **12** and can be any number of food processing steps where antimicrobial solution is needed. For example, first or second food processing stages **26***a* and **26***b* can include stripping the raw food product of any undesirable exterior protection, such as, but not limited to: removing hides from red meat carcasses, removing feathers from poultry products, or removing stems from fruit or vegetable products. First and second food processing stages **26***a* and **26***b* can also include eviscerating the raw food product, including, but not limited to, removing the guts of red meat carcasses or poultry products.

[0018] Third food processing stage **26***c* occurs after disinfecting stage **12** and can include any number of food processing steps where antimicrobial solution is needed. For example, third food processing stage **26***c* can include applying antimicrobial solution to a raw food product after it has been stripped of any undesirable products and is ready for human consumption, including, but limited to, a cold carcass application of antimicrobial solution.

[0019] After antimicrobial solution has been sprayed in disinfecting stage **12**, the reclaimed antimicrobial solution is collected for transport and reuse in various raw food processing stages of reapplication system **10**. Circulation system **24** (shown in FIG. **2**) transports the reclaimed antimicrobial solution to any raw food processing stage in reapplication system **10** requiring antimicrobial solution, including first, second, and third food processing stages **26***a,* **26***b,* and **26***c*. The reclaimed antimicrobial solution can also be transported back to disinfecting stage **12** for reuse. While FIG. **3** depicts recapturing the reclaimed antimicrobial solution for reuse only during disinfecting stage **12** of reapplication system **10**, the reclaimed antimicrobial solution can be recaptured and reused during any stage of reapplication system **10**. Additionally the reclaimed antimicrobial solution can be sent through a filtering stage prior to reuse.

[0020] The reclaimed antimicrobial solution recapture and reapplication system of the present invention collects the reclaimed antimicrobial solution from a raw food processing stage and transports the reclaimed antimicrobial solution to the reapplication system for reuse. During numerous stages of raw food processing, antimicrobial solution is sprayed toward a raw food product for disinfection. A portion of the antimicrobial solution contacts the raw food product and reacts with organics, inorganics, and other particulates on the surface of the raw food product to disinfect the raw food product. Another portion of the antimicrobial solution does not contact the raw food product and remains in substantially fresh condition. The unspent antimicrobial solution, along with any rebound antimicrobial solution is collected and transported through a circulation system of the reapplication system to a raw food processing stage for reuse.

[0021] Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

1-5. (canceled)

6. A method for on-site reclamation of antimicrobial solution in a raw food product processing system, the method comprising:

(a) spraying an antimicrobial solution toward raw food products during a disinfecting stage with a plurality of spray nozzles;

(b) collecting both unspent antimicrobial solution that did not contact the raw food products and a portion of rebound antimicrobial solution that did contact the raw food products to form a reclaimed antimicrobial solution in a first receptacle positioned directly below a first portion of the plurality of spray nozzles and a second receptacle positioned directly below a second portion of the plurality of spray nozzles;

(c) pumping the reclaimed antimicrobial solution from the first receptacle and the second receptacle through piping;

(d) optionally filtering the reclaimed antimicrobial solution through a filtration system connectable to the piping prior to reuse; and

(e) transporting the reclaimed antimicrobial solution to a reuse location;

wherein the rebound antimicrobial solution comprises spent antimicrobial solution at the disinfecting stage; and wherein the reclaimed antimicrobial solution has a level of organic contaminants and particulates that is lower than a level of organic contaminants and particulates that would be present if the reclaimed antimicrobial solution contained all of the spent antimicrobial solution from the disinfecting stage.

7. The method of claim **6**, wherein the step of spraying the antimicrobial solution occurs continuously.

8. The method of claim **6**, wherein the spraying the antimicrobial solution comprises spraying acidified sodium chlorite.

9. The method of claim **6**, wherein the spraying the antimicrobial solution comprises spraying peroxyacetic acid or peroxyoctanoic acid.

10. The method of claim **6**, wherein the spraying the antimicrobial solution comprises spraying acetic acid, octanoic acid, citric acid, lactic acid, phosphoric acid, or proprionic acid.

11. The method of claim **6**, wherein the spraying the antimicrobial solution comprises spraying hydrogen peroxide.

12. The method of claim **6**, further comprising reconditioning the reclaimed antimicrobial solution before transporting the reclaimed antimicrobial solution to the reuse location.

13. The method of claim **6**, wherein the reclaimed antimicrobial solution is reused without reconditioning.

14. The method of claim **6**, wherein the raw food product is selected from the group consisting of poultry, beef, fruits, vegetables, or combinations thereof.

* * * * *