Title: FISH, POULTRY, MEAT PROCESSING METHOD AND APPARATUS

Abstract: Processing apparatus and method for fish, poultry and meat products include multiple successive immersions in sanitizing solutions at different successive temperatures within controlled environments to promote low contamination during transfer of product between processing stations in preparation for encapsulation within a controlled environment confined within a barrier of composite sheet material that controls the transfer of selected gases therethrough.
FISH, POULTRY, MEAT PROCESSING

METHOD AND APPARATUS

Related Cases:

The subject matter of this application is related to the subject matter of U.S. Patent No. 5,711,980 issued on January 27, 1998 to M. Terry, and to the subject matter of U.S. Patent No. 6,050,391 issued on April 18, 2000 to M. Terry, which subjects matter are incorporated herein by this reference.

Field of the Invention:

This invention relates to equipment and processes for processing and packaging fresh fish or poultry or meat to retard deterioration and promote extended shelf life.

Background of the Invention:

Fish, poultry and meat products are commonly processed from catch or slaughter to market distribution in cold or frozen condition to retard the rate of decay of the product attributable to microorganisms present in the product. Extended shelf lives for such products commonly result from maintaining the products in frozen conditions during final processing, packaging, distribution and display. However, for such products that are not conducive to processing, packaging, distribution or display in frozen condition, icing down or otherwise refrigerating such products to cool, non-frozen condition is an alternative procedure that attains some extension of shelf life though not as extensively as in frozen condition. However, frozen product once thawed and non-frozen product commonly deteriorate rapidly out of an iced or refrigerated environment, attributable to microorganisms present on the surface of the product as well as within the product that remain present from initial processing and that are capable of rapid proliferation at elevated temperatures. In contrast to fresh produce that may be harvested in the field or orchard or vineyard and that is inherently immune from deterioration at the moment of
harvest, fleshy products of fish, poultry and meat are notoriously more prone to rapid deterioration from the moment of catch or slaughter.

**Summary of the Invention:**

In accordance with the present invention, fish, poultry and meat products are initially processed through a series of diverse environments that tend to cycle the respiration rates of the product and significantly diminish the internal and surface concentrations of pathogens which affect decay of the product at elevated temperatures. The resultant product exhibits extended shelf life, even after freezing and thawing, and appealing marketability for enhanced product sales with reduced losses over longer processing, distribution and retailing intervals.

**Description of the Drawings:**

Figure 1 is a pictorial diagram of successive environments for processing product in accordance with the present invention; and

Figure 2 is a flow chart illustrating the process of the present invention; and

Figure 3 is a perspective view of a composite sheet material that is suitable for wrapping the processed product to selectively control the aspiration rate thereof.

**Detailed Description of the Invention:**

Referring now to Figures 1 and 2, there are shown pictorial diagrams of a product processing line and process containing several environments through which product 13 is processed according to the present invention, as illustrated in the flow chart of Figure 2. Specifically, three successive environments 9,10,11 are assembled to receive fish, poultry or meat products 13 previously cleaned, scaled, filleted, or otherwise prepared or dressed from the initial natural state following catch or slaughter of the host animal. The first environment 9 includes a tank 15 containing a sanitizing solution of water and
an anti-microbial agent such as peroxycetic acid as a colorless, odorless, tasteless composition (commercially available as TSUNAMI 100) which is cooled to approximately 32°-35°F and is circulated in the tank 15 at a concentration of about 85 parts per million parts water. The surrounding ambient conditions within environment 9 include air temperature at about 33°35°F with relative humidity of about 98%. Product 13 is initially immersed 16 in the aqueous solution within tank 15 for about 1-3 minutes to effectively thermally shock the product, which is believed to elevate the cell respiration rate and prepare the product for the next processing environment. The dwell time of approximately 3 minutes ensures substantial reductions in surface bacterial concentrations at logarithmic rates per unit time of immersion, as is commonly known in the food processing industry. Products 13 of larger unit volumes greater than a cut size of about 10 pounds may require additional immersion time to accomplish comparable shock elevation of cell respiration rates and reductions in surface bacterial concentrations.

The product thus ‘shocked’ to a state of elevated cell respiration is then transferred 17 to the second environment 10 for immersion in a tank 19 containing an aqueous solution similar to the solution contained in tank 15 and that is circulating at a temperature of about 70°-105°F. The surrounding ambient conditions within environment 10 include air temperature at about 60°-95°F with relative humidity of about 98%. It is believed that exposure of the product 13 to this sudden increase in temperature while at an elevated cell respiration rate expands the cell matrix and cell structure (vacuole) of the product analogous to opening up the pores of the product, and this facilitates increased penetration of the anti-microbial liquid agent into the cell matrix and cell structure (vacuole). This facilitates more thorough penetration of the product by the anti-microbial liquid agent in tank 19 which is thus rendered more effective in destroying pathogens within the cell matrix of the product.
13. The product 13 remains immersed in tank 19 for about 3-7 minutes (dependent in part upon cut size and batch size) to affect substantial reductions in both the internal pathogens and any remaining surface bacteria, at rates of diminishing concentrations that vary logarithmically with time, in a manner that is commonly known in the food processing industry.

The product 13 thus elevated in temperature and exhibiting enhanced absorption of the anti-microbial liquid agent in tank 19 is then transferred 21 to the third environment 11 for immersion in tank 23 containing an aqueous solution similar to the solution contained in tank 15 and that is circulating at a temperature of about 32°-35°F. The surrounding ambient conditions within environment 11 include air temperature of about 33°-35°F with relative humidity of about 98%. This sudden decrease in temperature lowers the cell respiration rate of the product 13 to near dormancy state and promotes expulsion of absorbed liquids. The product 13 remains immersed in the tank 23 for approximately 5-10 minutes (dependent in part upon cut size and batch size) to ensure maximum expulsion of absorbed liquid and to effect substantial reductions in remaining bacterial concentrations at logarithmic rates per unit time, in a manner that is commonly known in the food processing industry.

The product is then removed from the environment 11 and is transported 25 either to quick-freezing environment 24, or directly 28 to packaging facilities 26 within a cooled environment operating at a temperature of about 33° to 35°F. The product 13 thus transported (either via quick-freezing facility 24, or directly) to the packaging facilities 26 thus remains in dormant (or frozen) state with substantially reduced levels of pathogens that can adversely affect the deterioration of the product 13 thus processed according to the present invention.

Referring still to Figure 1, the temperature and humidity and air purity conditions within the environments 9, 10, 11, 26 are carefully controlled in
response to the air conditioning equipment that is shown assembled above each environment. Specifically, cooling coils 31 are disposed with respect to modular blower or fan units 33 that may be assembled in modular arrays with respect to each environment 9, 10, 11 and packaging facility 26 to transfer cooled air from about the coils 31 through fine HEPA filters 35 to the respective environments. Specifically, the HEPA filters 35 are selected to restrict passage therethrough of particles and contaminants not greater than about .3µ dimension, which therefore effectively filters out most, if not all, bacterial and pathogenic airborne contaminants. Such filters may also be assembled in modular arrays of about 2 foot by 4 foot panels for convenient cleaning and other servicing. Additionally, permeable curtains 37 such as overlapping vertical-hanging flexible strips of polyvinyl chloride (PVC) plastic material are disposed between environment 9, 10, 11 to facilitate maintaining temperature differentials in the adjacent environments 9, 10 and 10, 11.

The product 13 is transported between environments by conveyor mechanisms 39 which retrieve product 13 from the immersion tank 15, 19, 23 in one environment for transport to the next environment. And, within each immersion tank 15, 19, 23, the product 13 is kept moving through the immersion liquid composition by submerged conveyor mechanisms 41. In this way, dwell times of product 13 within each tank 15, 19, 23 may be controlled by the rate of movement of the submerged conveyor mechanism from an entry location for incoming product 13 to an exit location for outgoing product 13. And, the volumetric capacity of the tanks 15, 19, 23 may be sized proportionally to the dwell time of product 13 in each tank. Alternatively, the rate of product 13 entering environment 9 may be limited by the capacity of tank 23 that requires the longest product dwell time. In this way, continuous processing of product 13 may be accomplished without backup of product 13 into the slowest processing environment.
Where desirable, product 13 emerging 25 from the last processing environment 11 may be quick frozen in conventional manner within the freeze processing environment 24 for transfer to the final packaging phase in environment 26. Alternatively, product 13 emerging from the last processing environment 11 may be transferred 25 directly to the final packaging phase where frozen product is not desirable. The packaging environment 26 is also maintained at about 33°F and relative humidity of about 98% via the cooling coils 31 and blower or fan modules 33 and HEPA filters 35, in the manner as previously described. In this environment, frozen product 13 transferred from the quick freeze environment 24 has only brief exposure time to non-freezing environment and has no opportunity to thaw while being wrapped and sealed or otherwise encapsulated 30 for retail distribution 32 under sustained freezing temperatures during transport and storage. Alternatively, product 13 transferred from environment 11 remains in non-frozen but dormant state during the brief interval while being wrapped and sealed or otherwise encapsulated 30 for retail distribution 32 under sustained near-freezing temperature during transport and storage.

Referring now to Figure 3, there is shown a composite flexible sheet material 44 that is applied to product 13 following processing thereof as previously described in accordance with the present invention. The composite sheet material 44 is formed as bonded layers of polyethylene film 45 over polypropylene film 47. This composite sheet material 44 is preferred as a sealing wrap about product 13 in frozen or dormant state for transportation and storage at the respective requisite temperatures during retail distribution because of the desirable gas permeability of such composite sheet material. Specifically, it has been discovered that such composite sheet material 44 transfers oxygen and carbon dioxide, among other gases, in a manner that retains an internal modified atmosphere of typically more than about 13%
oxygen and less than about 5.5% carbon dioxide. The transmission rate of gases through the composite sheet material 44 may be altered by varying the thicknesses of the films 45, 47 that comprise the sheet material 44. Specifically, it has been determined that, for a thickness of the polypropylene film 45 of about 1.0-3.0 mils, and a thickness of the polyethylene film 47 of about .5-3.0 mils, the composite sheet material is capable of transferring about .01-50 microliters of oxygen per hour at freezing or near-freezing temperatures (dependent upon headspace analysis determinations of the respiration rates of the individual products 13 and their associates cuts). Such permeability with respect to oxygen is believed to benefit the product 13 wrapped and sealed in such composite sheet material because of the resultant reductions in excess oxygen available to accelerate the known KREBS cycle (i.e., the breakdown of carbon compounds generated during the decaying process limits or retards the decaying process). As the KREBS cycle, or decay cycle, is a resultant of carbolic actions taking place on and within the product 13 to generate carbon compounds, the modified environment in which the product 13 is sealed is significantly altered, in that, the amount of bacteria/pathogens/particulates in the modified atmosphere is significantly less, and the ability to break down the complex carbon compounds via excess oxygen in the sealed environment is significantly reduced.

The resultant is a much slower growth of bacteria and a retarding of the KREBS cycle, and the apparatus and process of the present invention thus greatly reduce pathogenic contaminants that contribute to the deterioration of animal products prepared for retail distribution, and thereby significantly increase retail shelf life and sanitary packaging of such products.
What is claimed is:

1. A method for processing fish, poultry or meat products, comprising:
   immersing the product in a sanitizing solution at approximately 32°-35°F for a first time interval;
   after the first time interval, immersing the product in a sanitizing solution at approximately 70°-105°F for a second time interval;
   after the second time interval, immersing the product in a sanitizing solution at approximately 33°-35°F for a third time interval; and
   after the third time interval, preparing the product for distribution.

2. The method according to claim 1 in which the first, second and third time intervals are in the range of about 1 to 10 minutes.

3. The method according to claim 1 in which the third time interval is longer than the second time interval which is longer than the first time interval.

4. The method according to claim 1 in which ambient air conditions around an immersion of the product include relative humidity of about 98%.

5. The method according to claim 1 in which the sanitizing solution includes an anti-microbial agent in a concentration of about 85 parts to one million parts water.

6. The method according to claim 1 in which preparing the product for distribution includes enclosing the product within a confining package...
within a packaging environment including air temperature of about 33°F and relative humidity of about 98%.

7. The method according to claim 1 including filtering the air within an environment surrounding processing of the product through HEPA filtration.

8. The method according to claim 7 in which HEPA filtration filters out particulate matter greater than approximately .3 micron dimensions.

9. The method according to claim 1 in which preparing the product for distribution includes freezing the product after the third time interval.

10. Apparatus for processing fish or poultry or meat products, comprising:
    a plurality of process stations, each including an immersion chamber and ingress and egress for product, one of the process stations including a vessel containing sanitizing liquid at about 70°-105°F for receiving product therein and another of the process stations including a vessel containing sanitizing liquid at about 32°-35°F for receiving product therein from the one process station; and
    a transport system for transferring product from egress of the other process station.

11. Apparatus according to claim 10 comprising:
    a first of the plurality of process stations including a vessel containing sanitizing liquid at about 33°F for receiving product therein prior to transfer therefrom of the product to the one process station.
12. Apparatus according to claim 10 in which the transport system operates within a confined environment and includes a packaging station disposed to package the product, said confined environment including an air circulating module disposed to filter particulate contaminants from air circulated thereby within the confined environment.

13. Apparatus for processing fish or poultry or meat products, comprising:

a plurality of work stations including at least two immersion chambers operating at different temperatures, each work station including ingress and egress for product transfers;

a transport system communicating with an ingress or egress for at least one work station for transferring product thereby, said transport system operating within an environment including ambient air; and

a structure associated with the environment for circulating ambient air therethrough to remove particulate material from the ambient air.

14. Apparatus according to claim 13 in which the transport system includes conveyor apparatus communicating with egress from a work station to transfer product to a packaging station, said packaging station operating within an environment for encapsulating the product within the environment of the packaging station.

15. Apparatus according to claim 14 in which the packaging station includes a structure for cooling and filtering ambient air in the environment within which the product is encapsulated.
16. Apparatus according to claim 15 including an air filter for excluding particulate contaminants greater than above .3\( \mu \) inches from ambient air in the environment within which the product is encapsulated.

17. Apparatus according to claim 15 including a structure disposed relative to the environment within which the product is encapsulated for cooling ambient air therein to about 33\(^{\circ}\)-35\(^{\circ}\)F.

18. Product encapsulating material comprising:
   a first flexible layer of polypropylene, and integrated therewith,
   a second flexible layer of polyethylene to form a composite flexible sheet material exhibiting selected gas permeability characteristics for wrapping about processed product as an encapsulating barrier to control gas transfers through the composite flexible sheet material relative to processed product encapsulated thereby.

19. Product encapsulating material as in claim 18 in which the first layer has a thickness in the range of about 1.0 to 3.0 millimeters.

20. Product encapsulating material as in claim 18 in which the second layer has a thickness in the range of about 0.5 to 3.0 millimeters.
Immerse Prepared Product in Chilled Anti-Microbial Solution for Selected Interval

Transfer Product to Anti-Microbial Solution at Elevated Temperature for Selected Interval

Transfer Product to Chilled Anti-Microbial Solution for Selected Interval

Freeze Product for Distribution?

Yes

Quick Freeze Product

No

Encapsulate Product in Gas Permeable Wrapping within Chilled Environment

Distribute Packaged Product

Figure 2
# INTERNATIONAL SEARCH REPORT

## A. CLASSIFICATION OF SUBJECT MATTER

<table>
<thead>
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<th>IPC(7)</th>
<th>US CL</th>
<th>According to International Patent Classification (IPC) or to both national classification and IPC</th>
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<td>A23B 4/08,4/12.4/14.4/26; B65B 55/12.55/22; F25D 13/04,13/06,25/00, B32B 27/08</td>
<td>426/332,399,524,129; 99/517,534; 62/63,65,378; 428/516</td>
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## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)


Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim(s)</th>
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<tr>
<td>X</td>
<td>US 4,862,557 A (CLAYTON et al.) 05 September 1989 (05.09.1989), column 2, lines 42-64.</td>
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<td>US 5,939,115 A (KOUNEV et al.) 17 August 1999 (17.08.1999), entire document.</td>
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- **X** Special category of cited documents:
  - **A** document defining the general state of the art which is not considered to be of particular relevance
  - **B** earlier application or patent published on or after the international filing date
  - **L** document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  - **O** document referring to an oral disclosure, use, exhibition or other means
  - **P** document published prior to the international filing date but later than the priority date claimed

- **Y** later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

- **X** document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

- **Y** documents of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

- **A** document member of the same patent family

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Date of the actual completion of the international search: 30 January 2002 (30.01.2002)

Date of mailing of the international search report: 13 MAR 2002

Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231

Facsimile No. (703)305-3230

Authorized officer: Jeta Proctor

Paralegal: Robert Madsen

Telephone No. (703) 308-0061

Form PCT/ISA/210 (second sheet) (July 1998)
## C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 4,626,456 A (FARRELL et al.) 02 December 1986 (02.12.1986), abstract, example 1.</td>
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<td>US 4,367,630 A (BERNARD et al.) 11 January 1983 (11.01.1983), column 4, line 12 to</td>
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<td>13, 17</td>
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<td>Y</td>
<td>US 6,103,286 A (GUTZMANN et al.) 15 August 2000 (15.08.2000), abstract and column 13, line 11 - column 14, line 8.</td>
<td>1.5</td>
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### Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to
such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule
6.4(a).

### Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Continuation Sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all
searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invoice
payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search
report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report
is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

☐ The additional search fees were accompanied by the applicant’s protest.

☒ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet(1)) (July 1998)
BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING
This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claim(s) 1-17, drawn to a method of and apparatuses for immersing products.

Group II, claim(s) 18-20, drawn to a product encapsulating material comprising two layers.

The inventions listed as Groups II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: They do not require an immersion step or an apparatus for immersion.