furosine, etc.) caused by excessive heating (superheating) or the like. Particularly, the object is to provide a sterilization method which is controlled with two factors of a temperature and a time as in the UHT treatment and the LTLT treatment which are the standard sterilization methods.

Solution to Problem

[0012] The inventors conducted researches on a sterilization method capable of attaining a favorable effect on bacteria which form spores under mild conditions to find that the bacterial spores are effectively sterilized under milder conditions (sterilization temperature and heating and retention time) than standard sterilization methods, i.e. with a milder thermal history than the standard sterilization methods, by performing a stepwise heat (sterilization) treatment by changing heating conditions, in which heat resistance (heat stability) of the bacterial spores is reduced, and then a heat treatment at a temperature lower than that set for the heat resistance reduction is performed.

In an aspect, there is provided a sterilization method, comprising: providing an object to be sterilized in a continuous process line comprising a first chamber 4 to perform a first heat treatment step, a second chamber 5 to perform a cooling step, and a third chamber 9 to perform a second heat treatment step, the second chamber connected to the third chamber through a conduit; performing the first

heat treatment step at a first temperature of 100 to 180°C for a retention time of 1 to 60 seconds; performing the cooling step to reach a second temperature; and then performing the second heat treatment step at a third temperature of 40 to 100°C for a retention time of 5 seconds to 60 minutes, wherein the second temperature is lower than the third temperature, and the third temperature is lower than the first temperature.

[0013] Specifically, the present disclosure ~~invention~~ set forth in ~~claim~~ statement 1 ~~according to the present invention~~ is a sterilization method characterized by comprising performing a first heat treatment step on an object to be sterilized and then performing a second heat treatment step which is performed at a temperature lower than that of the first heat treatment step.

[0014] The present disclosure ~~invention~~ set forth in ~~claim~~ statement 2 is the sterilization method according to ~~claim~~ statement 1, characterized by comprising a preheating step before the first heat treatment step.

[0015] The ~~invention~~ present disclosure set forth in ~~claim~~ statement 3 is the sterilization method according to ~~claim~~ statement 1 or 2, characterized by comprising a cooling step after the first heat treatment.

[0016] The ~~invention~~ present disclosure set forth in ~~claim~~ statement 4 is the sterilization method according to any one of ~~claims~~ statements 1 to 3, characterized in that the cooling step after the first heat treatment step is performed at a temperature lower than the heat treatment temperature of the second heat treatment step.

[0017] The ~~invention~~ present disclosure set forth in ~~claim~~ statement 5 is the sterilization method according to any one of ~~claims~~ statements 1 to 4, characterized in that the first heat treatment step is performed under heating conditions which are not capable of completely inactivating spore-forming bacteria and bacterial spores in the sterilization object solely by the first heat treatment step.

[0018] The ~~invention~~ present disclosure set forth in ~~claim~~ statement 6 is the sterilization method according to any one of ~~claims~~ statements 1 to 4, characterized in that the first heat treatment step is performed under heating conditions which are capable of completely inactivating spore-forming bacteria and bacterial spores in the sterilization object solely by the

first heat treatment step.

[0019] The ~~invention~~ present disclosure set forth in ~~claim~~ statement 7 is the sterilization method according to any one of ~~claims~~ statements 1 to 6, wherein the first heat treatment step is the step in which a temperature of the sterilization object is retained at 100°C to 180°C, and a retention time at the temperature is 1 second or more and 60 seconds or less.

[0020] The ~~invention~~ present disclosure set forth in ~~claim~~ statement 8 is the sterilization method according to any one of ~~claims~~ statements 1 to 7, wherein the first heat treatment step is the step in which a temperature of the sterilization object is retained at 100°C to 180°C, and a retention time at the temperature is 1 second or more and 60 seconds or less, and the second heat treatment step is the step in which the temperature of the sterilization object is retained at 40°C to 100°C, and a retention time at the temperature is 5 seconds or more and 60 minutes or less.

Advantageous Effects of Invention

[0021] Since the present invention combines the first heat treatment step and the second heat treatment step in which the heat treatment is performed at the temperature lower than that of the first heat treatment step, a thermal history accompanying the heat treatments is reduced as compared to a case of attaining a sterilization effect equivalent to the present invention. Therefore, the bacterial spores are inactivated while suppressing deterioration of various useful nutritious ingredients

Claims

1. A sterilization method, comprising:

providing an object to be sterilized in a continuous process line comprising a first chamber 4 to perform a first heat treatment step, a second chamber 5 to perform a cooling step, and a third chamber 9 to perform a second heat treatment step, the second chamber connected to the third chamber through a conduit;

performing the first heat treatment step at a first temperature of 100 to 180°C for a retention time of 1 to 60 seconds;

performing the cooling step to reach a second temperature; and then

performing the second heat treatment step at a third temperature of 40 to 100°C for a retention time of 5 seconds to 60 minutes,

wherein the second temperature is lower than the third temperature, and the third temperature is lower than the first temperature.

2. The sterilization method according to claim 1, further comprising a preheating step before the first heat treatment step.

3. The sterilization method according to claim 1,

wherein the conduit continues from the second chamber 5, through the third chamber 9 to a fourth chamber 10 to retain the temperature at the third temperature.

4. The sterilization method according to claim 1, wherein the first heat treatment step is performed at a temperature of 100°C to 120°C.

5. The sterilization method according to claim 1, wherein the first heat treatment step is performed at a temperature of 100°C to 120°C for a retention time of 1 to 10 seconds.

Claims

1. A sterilization method characterized by comprising performing a first heat treatment step on an object to be sterilized and then performing a second heat treatment step which is performed at a temperature lower than that of the first heat treatment step.

2. The sterilization method according to claim 1, characterized by comprising a preheating step before the first heat treatment step.

3. The sterilization method according to claim 1 or 2, characterized by comprising a cooling step after the first heat treatment.

4. The sterilization method according to any one of claims 1 to 3, characterized in that the cooling step after the first heat treatment step is performed at a temperature lower than the heat treatment temperature of the second heat treatment step.

5. The sterilization method according to any one of claims 1 to 4, characterized in that the first heat treatment step is performed under heating conditions which are not capable of completely inactivating spore-forming bacteria and bacterial spores in the sterilization object solely by the first heat treatment step.

6. The sterilization method according to any one of claims 1 to 4, characterized in that the first heat treatment step is performed under heating conditions which are capable of completely inactivating spore-forming bacteria and bacterial spores in the sterilization object solely by the first heat treatment step.

7. The sterilization method according to any one of claims 1 to 6, wherein the first heat treatment step is the step in which a temperature of the sterilization object is retained at 100°C to 180°C, and a retention time at the temperature is 1 second or more and 60 seconds or less.

8. The sterilization method according to any one of claims 1 to 7, wherein the first heat treatment step is the step in which a temperature of the sterilization object is retained at 100°C to 180°C, and a retention time at the temperature is 1 second or more and 60 seconds or less, and the second heat treatment step is the step in which the temperature of the sterilization object is retained at 40°C to 100°C, and a retention time at the temperature is 5 seconds or more and 60 minutes or less.