

DESCRIPTION**TITLE OF INVENTION**

VEGETABLE STERILIZATION APPARATUS AND METHOD FOR
PRODUCTION OF STERILIZED VEGETABLES

5 TECHNICAL FIELD**[0001]**

The present invention relates to a vegetable
sterilization apparatus and a method for producing sterilized
vegetables.

10 BACKGROUND ART**[0002]**

There is a growing demand for cut vegetables in a package
which can be eaten plain or cooked after the package is opened.
The cut vegetables are produced by cutting vegetables harvested
15 in farms. Here, in most cases, stains such as dirt and live
bacteria adhere to the harvested vegetables. For this reason,
after the vegetables harvested in fields are cut, the cut
vegetable products are often prepared by washing the cut
vegetables with a neutral detergent or the like, followed by
20 sterilization using a sodium hypochlorite aqueous solution or
the like.

[0003]

As a method of sterilizing live bacteria that adhere to
the vegetables, the method using the sodium hypochlorite
25 aqueous solution has been known from the viewpoint of its ease
of handling and low cost. The vegetables are sterilized by
being immersed in the sodium hypochlorite aqueous solution for
a predetermined period of time. However, when a chlorine-based
disinfectant such as sodium hypochlorite is used, the smell of
30 chlorine may remain on the vegetables or by-products may be
generated and remain thereon. For this reason, there is a
demand for development of a sterilization method alternative
to the sodium hypochlorite aqueous solution. In this regard,

a sterilization method using ozone water which is a non-chlorine-based disinfectant has been under study. Ozone has a property that it is quickly decomposed into oxygen by a reaction with other substances or by a self-decomposition reaction and is therefore less likely to remain on the sterilized vegetables.

[0004]

In relation to this technique, Patent Literature 1 describes a sterilization treatment using ozone water even with low disinfecting power, the method including washing leaf vegetables in a specific method before the sterilization treatment. Then, this literature also discloses that the sterilization treatment significantly reduces the number of bacteria remaining on julienned leaf vegetables thus produced, and suppresses the growth of bacteria with time.

CITATION LIST**Patent Literature****[0005]**

Patent Literature 1: Japanese Patent No. 4381349

SUMMARY OF INVENTION**Technical Problem****[0006]**

The sterilization of the vegetables using the ozone water is carried out, for example, by immersing the vegetables in an ozone water sterilization tank that holds the ozone water. In addition, a wash tank for washing the vegetables may be provided, if necessary, at least at a preceding stage or a subsequent stage of the ozone water sterilization tank. Such a wash tank is a pre-wash tank or a post-wash tank, for example.

[0007]

Ozone gas in the ozone water is easily desorbed from the ozone water. In this regard, a possible option is to install a venting hood above the ozone water sterilization tank, to

establish a negative pressure in an environment above the ozone water sterilization tank, and to constantly discharge the desorbed ozone gas. In this way, the ozone gas is prevented from being discharged to the outside of this system.

5 **[0008]**

However, while the above-mentioned configuration can prevent the ozone gas from being leaked to the outside, this configuration also prompts the ozone gas to be desorbed from the ozone water since the venting fan encourages the discharge thereof. As a consequence, an amount of the ozone gas used increases in order to recover a reduction in concentration of the ozone gas, which leads to a high operating cost.

[0009]

The present invention has been made in view of the aforementioned problems. A problem to be solved by the present invention is to provide a vegetable sterilization apparatus and a method for producing sterilized vegetables, which are capable of suppressing desorption of ozone gas and more reliably preventing a leakage of the ozone gas to the outside at the same time.

Solution to Problem

[0010]

As a result of earnest studies by the inventors of the present invention in order to solve the aforementioned problem, the inventors have found out that the problem can be solved by establishing airtightness of a portion above at least an ozone water sterilization tank among the ozone water sterilization tank and other tanks provided as appropriate and annexed thereto.

30 **Advantageous Effects of Invention**

[0011]

According to the present invention, it is possible to provide a vegetable sterilization apparatus and a method for

producing sterilized vegetables, which are capable of suppressing desorption of ozone gas and more reliably preventing a leakage of the ozone gas to the outside at the same time.

5 BRIEF DESCRIPTION OF DRAWINGS

[0012]

FIG. 1 is a configuration diagram of a vegetable sterilization apparatus of a first embodiment.

FIG. 2 shows a sterilization flow to be performed by the
10 vegetable sterilization apparatus of the first embodiment.

FIG. 3 is a configuration diagram of a vegetable sterilization apparatus of a second embodiment.

FIG. 4 shows a sterilization flow to be performed by the vegetable sterilization apparatus of the second embodiment.

FIG. 5 is a configuration diagram of a vegetable
15 sterilization apparatus of a third embodiment.

FIG. 6 shows a sterilization flow to be performed by the vegetable sterilization apparatus of the third embodiment.

FIG. 7 is a configuration diagram of a vegetable
20 sterilization apparatus of a fourth embodiment.

FIG. 8 shows a sterilization flow to be performed by the vegetable sterilization apparatus of the fourth embodiment.

FIG. 9 is a configuration diagram of a vegetable sterilization apparatus of a fifth embodiment.

FIG. 10 shows a sterilization flow to be performed by the
25 vegetable sterilization apparatus of the fifth embodiment.

DESCRIPTION OF EMBODIMENTS

[0013]

Hereinafter, embodiments of the present invention will
30 be described with reference to the accompanying drawings.

[0014]

[1. First Embodiment]

FIG. 1 is a configuration diagram of a vegetable

sterilization apparatus 100 of a first embodiment. The vegetable sterilization apparatus 100 is configured to sterilize vegetables V by using ozone water. Conveyors 50 and 60 are connected to the vegetable sterilization apparatus 100.

5 The vegetables V supplied to the vegetable sterilization apparatus 100 by the conveyor 50 are sterilized in the vegetable sterilization apparatus 100, and are then supplied to a not-illustrated packaging apparatus and the like by the conveyor 60.

10 **[0015]**

The vegetable sterilization apparatus 100 includes a pre-wash tank 2, an ozone water sterilization tank 3, a post-wash tank 4, and a venting hood 10 disposed above these tanks. The venting hood 10 is partitioned into three
15 compartments (spaces) 20, 30, and 40 by vertically movable partition plates 11, 12, 13, and 14. Among these compartments, the compartment 20 is formed above the pre-wash tank 2, the compartment 30 is formed above the ozone water sterilization tank 3, and the compartment 40 is formed above the post-wash
20 tank 4. In this embodiment, it is considered that the compartment 20 is part of the pre-wash tank 2, the compartment 30 is part of the ozone water sterilization tank 3, and the compartment 40 is part of the post-wash tank 4.

[0016]

25 Meanwhile, the partition plates 11, 12, 13, and 14 are usually closed and are to be opened when the vegetables V are transported between any of the compartments 20, 30, and 40. Accordingly, the respective compartments 20, 30, and 40 are made airtight when the partition plates 11, 12, 13, and 14 are closed.

30 **[0017]**

The vegetable sterilization apparatus 100 is provided with an arithmetic and control unit 70 which controls the respective constituent units of the vegetable sterilization

apparatus 100. The arithmetic and control unit 70 is connected, by means of not-illustrated electric signal lines, to a drive unit (not illustrated) for moving the partition plates 11, 12, 13, and 14 up and down, and to air feed-venting fans 22 and 42.

5 Accordingly, in the vegetable sterilization apparatus 100, the drive unit (not illustrated) for moving the partition plates 11, 12, 13, and 14 up and down and the air feed-venting fans 22 and 42 are controlled by the arithmetic and control unit 70. The drive of the air feed-venting fans 22 and 42 are temporarily
10 stopped when any of the partition plates 11, 12, 13, and 14 is opened. Moreover, although it is not illustrated, the arithmetic and control unit 70 is also configured to control transport baskets 2a, 3a, and 4a, the conveyors 50 and 60, and the like (i.e., to control a sterilization flow).

15 **[0018]**

Here, the arithmetic and control unit 70 includes a CPU (central processing unit), a RAM (random access memory), a ROM (read only memory), an HDD (hard disk drive), an I/F (interface), and the like though none of which are illustrated, and is
20 embodied by causing the CPU to execute a given control program stored in the ROM.

[0019]

The pre-wash tank 2 is configured to wash the vegetables V supplied thereto with cold water, thereby removing stains such
25 as dirt adhering to the vegetables V transported by the conveyor 50. The cold water is held in the pre-wash tank 2 and the transport basket 2a is disposed in such a way as to be immersed in the cold water. Accordingly, the vegetables V supplied by the conveyor 50 are put in (thrown in) the transport basket 2a
30 in the pre-wash tank 2 in the first place. Then, the vegetables V in the state of being put in the transport basket 2a are washed with the cold water by means of vibration and the like of the transport basket 2a.

[0020]

The partition plates 11 and 12 are closed while the vegetables V are washed in the pre-wash tank 2. In other words, the pre-wash tank 2 is in an airtight environment during the washing of the vegetables V in the pre-wash tank 2. Then, the partition plate 11 is moved up and opened when the vegetables V are transported to the transport basket 2a in the pre-wash tank 2 by the conveyor 50.

[0021]

The transportation from the pre-wash tank 2 to the ozone water sterilization tank 3 is accomplished by turning the transport basket 2a clockwise in FIG. 1 around an end portion of the transport basket 2a. Specifically, by turning this way, the vegetables V put in the transport basket 2a are transported to the transport basket 3a in the ozone water sterilization tank 3 at the subsequent stage. Then, the partition plate 11 is closed again after the transportation is completed. Meanwhile, as with the first partition plate 11, the partition plate 12 is opened when the vegetables V are transported from the transport basket 2a in the pre-wash tank 2 to the transport basket 3a in the ozone water sterilization tank 3, and is closed again after the transportation.

[0022]

Above the pre-wash tank 2, there is provided an air feed-venting port 21 for performing air feed to the compartment 20 formed thereabove and venting from the compartment 20. The air feed-venting fan 22 is connected to the air feed-venting port 21, and an air pressure (a positive pressure or a negative pressure) in the space 20 that is made airtight is controlled by driving the air feed-venting fan 22. In the first embodiment, the venting from the compartment 20 is performed by rotating a drive motor (not illustrated) in the air feed-venting fan 22 forward so as to establish the negative pressure inside the

compartment 20. On the other hand, the air feed to the compartment 20 is performed by rotating the drive motor backward so as to establish the positive pressure inside the compartment 20.

5 **[0023]**

Moreover, an ozone decomposition unit 23 for decomposing ozone gas contained in the air discharged from the compartment 20 is connected to the air feed-venting fan 22. Although the details will be described later, ozone gas desorbed from ozone
10 water in the ozone water sterilization tank 3, which is likely to exist in the compartment 30 adjacent to the compartment 20, may flow into the compartment 20. This is why the ozone decomposition unit 23 is provided so as to decompose the ozone gas in the air discharged from the air feed-venting fan 22, and
15 to discharge the resultant gas to the outside.

[0024]

The ozone water sterilization tank 3 is configured to sterilize the vegetables V, which have been washed in the pre-wash tank 2, by using the ozone water. Cold ozone water
20 is held in the ozone water sterilization tank 3. The cold ozone water is prepared by a not-illustrated ozone water generation unit. Meanwhile, although the details will be described later, the space above the held ozone water is made airtight. Moreover, the transport basket 3a for containing the vegetables V is
25 disposed in the ozone water sterilization tank 3 as with the pre-wash tank 2. Furthermore, as with the above-mentioned pre-wash tank 2, the vegetables V are transported to the post-wash tank 4 by moving the partition plate 13 up and turning the transport basket 3a.

30 **[0025]**

As with the compartment 20 formed above the pre-wash tank 2, an airtight environment is also established in the compartment 30 formed above the ozone water sterilization tank

3. However, unlike the compartment 20, the compartment 30 is not provided with an air feed-venting port or the like for establishing the positive pressure or the negative pressure inside the compartment 30.

5 **[0026]**

 The post-wash tank 4 is configured to wash off the ozone water adhering to the vegetables V, which have been sterilized in the ozone water sterilization tank 3, by using clean cold water. As with the pre-wash tank 2, cold water is held in the
10 post-wash tank 4. Moreover, the transport basket 4a for containing the vegetables V is disposed in the post-wash tank 4 as with the pre-wash tank 2 and the ozone water sterilization tank 3. Furthermore, the vegetables V are transported to the conveyor 60 by moving the partition plate 14 up and down and
15 turning the transport basket 4a.

[0027]

 As with the compartments 20 and 30, an airtight environment is also established in the compartment 40 formed above the post-wash tank 4. Moreover, as with the compartment
20 20, an air feed-venting port 41 for establishing the positive pressure or the negative pressure in the compartment 40 formed above the post-wash tank 4 is provided above the post-wash tank 4. The air feed-venting fan 42 is connected to the air feed-venting port 41. The positive pressure or the negative
25 pressure is established inside the space 40, which is made airtight, by driving the air feed-venting fan 42. Furthermore, as with the compartment 20, the air feed-venting fan 42 and an ozone decomposition unit 43 are connected to the air feed-venting port 41.

30 **[0028]**

 FIG. 2 shows a sterilization flow (a method for producing sterilized vegetables) to be performed by the vegetable sterilization apparatus 100 of the first embodiment. In the

vegetable sterilization apparatus 100, the vegetables V are sterilized while controlling the pressure in each of the compartment 20 and the compartment 40 either at the positive pressure or the negative pressure. The respective units in the vegetable sterilization apparatus 100 are controlled by the arithmetic and control unit 70 shown in FIG. 1. Note that for the convenience of explanation, the flow shown in FIG. 2 illustrates not only the flow to sterilize the vegetables V but also a flow to transport the vegetables V and a flow to control the respective units in the vegetable sterilization apparatus 100.

[0029]

First, the arithmetic and control unit 70 opens the partition plate 11 (step S101). Then, the vegetables V are thrown into the pre-wash tank 2 by the conveyor 50 (step S102). Hence, the pre-wash of the vegetables V by using the cold water is started in the pre-wash tank 2. Subsequently, the arithmetic and control unit 70 closes the partition plate 11 (step S103). Accordingly, the compartment 20 formed above the pre-wash tank 2 is made airtight.

[0030]

Then, the air feed-venting fan 22 provided in the compartment 20 is rotated backward in this state (step S104, an air feed step). Thus, the air feed-venting fan 22 feeds the air to the compartment 20 and the positive pressure is established in the compartment 20. At this time, the vegetables V are pre-washed in the pre-wash tank 2 in tandem with the air feed to the compartment 20.

[0031]

When the pre-wash is completed, the arithmetic and control unit 70 opens the partition plate 12 (step S105). Here, as described above in step S104, the positive pressure is established in the compartment 20, whereby the air pressure in

the compartment 20 is set to a higher air pressure than the air pressure in the compartment 30 where the air pressure is not particularly controlled. For this reason, when the partition plate 12 partitioning these compartments is opened, the air flow is directed from the compartment 20 to the compartment 30. Accordingly, the ozone gas in the compartment 30 is less likely to flow into the compartment 20.

[0032]

Then, the arithmetic and control unit 70 transports the vegetables V from the pre-wash tank 2 to the ozone water sterilization tank 3 (step S106, a transport step). Thereafter, the arithmetic and control unit 70 closes the partition plate 12 (step S107, a sterilization step). Accordingly, both of the compartments 20 and 30 are made airtight, and the vegetables V are sterilized by using the ozone water.

[0033]

Then, the air feed-venting fan 22 provided in the compartment 20 is rotated forward (step S108). Thus, the air feed-venting fan 22 discharges the air from the compartment 20 and the negative pressure is established in the compartment 20. Moreover, the air feed-venting fan 42 provided in the compartment 40 formed above the post-wash tank 4 is rotated backward (step S109, an air feed step). Thus, the air feed-venting fan 42 feeds the air to the compartment 40 and the positive pressure is established in the compartment 40. The positive pressure is established to the extent that the air pressure in the compartment 40 becomes higher than the air pressure in the compartment 30.

[0034]

When the ozone water sterilization is completed, the arithmetic and control unit 70 opens the partition plate 13 (step S110). As with step S105 mentioned above, the air flow is directed from the compartment 40 to the compartment 30 in

this step S110 as well. Accordingly, the ozone gas in the compartment 30 is less likely to flow into the compartment 40.

[0035]

Then, the arithmetic and control unit 70 transports the
5 vegetables V from the ozone water sterilization tank 3 to the
post-wash tank 4 (step S111, a transport step). Thus, the
post-wash of the vegetables V is stated in the post-wash tank
4 by using the cold water. Thereafter, the arithmetic and
control unit 70 closes the partition plate 13 (step S112).
10 Accordingly, both of the compartments 30 and 40 are made
airtight.

[0036]

Then, the air feed-venting fan 42 provided in the
compartment 40 is rotated forward in this state (step S113).
15 Thus, the air feed-venting fan 42 discharges the air from the
compartment 40 and the negative pressure is established in the
compartment 40.

[0037]

When the post-wash is completed, the arithmetic and
20 control unit 70 opens the partition plate 14 (step S114). Then,
the arithmetic and control unit 70 transports the vegetables
V from the post-wash tank 4 to the outside (step S115). Thus,
the sterilization treatment of the vegetables V is completed.

[0038]

25 As described above, when the partition plate 12 or 13 is
opened, the air pressure in the compartment 20 or 40 is higher
than the air pressure in the compartment 30. Accordingly, when
the partition plate 12 or 13 is opened, the air flow is directed
from the compartment 20 or 40 to the compartment 30. For this
30 reason, the ozone gas in the compartment 30 is less likely to
flow into the compartment 20 or 40, so that the ozone gas is
more likely to stay in the compartment 30. Thus, a partial
pressure of the ozone gas in the compartment 30 is likely to

be maintained almost at a constant level, and the partial pressure of the ozone gas is likely to be maintained almost at the constant level as well. As a consequence, the desorption of the ozone gas from the ozone water is suppressed.

5 **[0039]**

[2. Second Embodiment]

Next, a configuration and a controlling method of a vegetable sterilization apparatus 200 according to a second embodiment will be described with reference to FIG. 3 and FIG.

10 4. In the following explanation, different features from the configuration and the controlling method of the vegetable sterilization apparatus 100 will be mainly described. Meanwhile, constituents of the vegetable sterilization apparatus 200 which are the same as those of the above-described
15 vegetable sterilization apparatus 100 will be denoted by the same reference signs and detailed description thereof will be omitted.

[0040]

FIG. 3 is a configuration diagram of the vegetable
20 sterilization apparatus 200 of the second embodiment. An air feed port 31 and an air feed fan 32 are connected to the vegetable sterilization apparatus 200 in order to feed the air to the compartment 30 formed above the ozone water sterilization tank 3 of the vegetable sterilization apparatus 100 mentioned above.
25 The arithmetic and control unit 70 controls the air feed fan 32. The drive of the air feed fan 32 is temporarily stopped when any of the partition plates 11, 12, 13, and 14 is opened.

[0041]

FIG. 4 shows a sterilization flow to be performed by the
30 vegetable sterilization apparatus 200 of the second embodiment. In the sterilization flow shown in FIG. 4, the steps which are the same as those in the above-described sterilization flow shown in FIG. 2 will be denoted by the same step numbers and

detailed description thereof will be omitted.

[0042]

First, the vegetables V are pre-washed and the positive pressure is established in the compartment 20 (steps S101 to 5 S104) as in the case of the above-described vegetable sterilization apparatus 100. Subsequently, the arithmetic and control unit 70 feeds the air to the compartment 30 by driving the air feed fan 32 (step S201). Thus, the positive pressure is established in the compartment 30. In this way, the air 10 pressure inside the compartment 30 is elevated and the desorption of the ozone gas from the ozone water is suppressed.

[0043]

However, the air pressure in the compartment 30 to be elevated in step S201 is set lower than the air pressure in the 15 compartment 20. Specifically, even when the air is fed to the compartment 30 in step S201, the air pressure in each of the compartments 20 and 40 is still higher than the air pressure in the compartment 30. Accordingly, the air flow when the partition plate 12 is opened is directed from the compartment 20 to the compartment 30 as with step S104 mentioned above. 20 Since the positive pressure is established in the compartment 30 as described above, the ozone gas is less likely to be desorbed. Nonetheless, the ozone gas may be desorbed a little. In this regard, by setting the same air flow as that in step S104 25 mentioned above, the ozone gas inside the compartment 30 is less likely to flow into the compartment 20, whereby the desorption of the ozone gas from the ozone water to the compartment 30 is suppressed more efficiently.

[0044]

30 Thereafter, the vegetables V are sterilized as in the steps S105 to S115 in the above-described vegetable sterilization apparatus 100. Here, when the positive pressure is established in the compartment 40 in step S109, the positive

pressure is established in the compartment 40 such that the air pressure in the compartment 40 becomes higher than the air pressure in the compartment 30. Thus, the ozone gas inside the compartment 30 is less likely to flow into the compartment 40, whereby the desorption of the ozone gas from the ozone water to the compartment 30 is suppressed more efficiently.

[0045]**[3. Third Embodiment]**

Next, a configuration and a controlling method of a vegetable sterilization apparatus 300 according to a third embodiment will be described with reference to FIG. 5 and FIG. 6. In the following explanation, different features from the configurations and the controlling methods of the vegetable sterilization apparatuses 100 and 200 will be mainly described. Meanwhile, constituents of the vegetable sterilization apparatus 300 which are the same as those of the above-described vegetable sterilization apparatuses 100 and 200 will be denoted by the same reference signs and detailed description thereof will be omitted.

[0046]

FIG. 5 is a configuration diagram of the vegetable sterilization apparatus 300 of the third embodiment. In the vegetable sterilization apparatus 300, the ozone gas is used instead of the air as the gas to be fed to the compartment 30 in the vegetable sterilization apparatus 200 mentioned above. Accordingly, unlike the vegetable sterilization apparatus 200 mentioned above, the vegetable sterilization apparatus 300 is provided with an ozone gas generation unit 35 which generates ozone from the air that contains oxygen. In addition, the vegetable sterilization apparatus 300 is provided with an ozone gas feed fan 36 in order to feed the ozone gas generated by the ozone gas generation unit 35 to the compartment 30. The arithmetic and control unit 70 controls the ozone gas feed fan

36.

[0047]

FIG. 6 shows a sterilization flow to be performed by the vegetable sterilization apparatus 300 of the third embodiment.

5 In the sterilization flow shown in FIG. 6, the steps which are the same as those in the above-described sterilization flow shown in FIG. 2 will be denoted by the same step numbers and detailed description thereof will be omitted.

[0048]

10 First, the arithmetic and control unit 70 feeds the ozone gas to the compartment 30 formed above the ozone water sterilization tank 3, by controlling the ozone gas feed fan 36 (step S301). By feeding the ozone gas instead of the air, the partial pressure of the ozone gas in the compartment 30 is
15 elevated. Thus, the desorption of the ozone gas from the ozone water is suppressed more effectively.

[0049]

Meanwhile, in this embodiment, the amount of the ozone gas to be fed to the compartment 30 is set to such an amount
20 with which the air pressure inside the compartment 30 becomes lower than the air pressure in the compartment 20 where the positive pressure is established in step S104, and lower than the air pressure in the compartment 40 where the positive pressure is established in step S109. In this way, the
25 desorption of the ozone gas is sufficiently suppressed as described above.

[0050]

Thereafter, the vegetables V are sterilized as with the sterilization flow (steps S101 to S115) in the above-described
30 vegetable sterilization apparatus 100.

[0051]

In the third embodiment, the ozone gas is fed to the compartment 30. Accordingly, the vegetables V transported

from the pre-wash tank 2 and the vegetables V washed in the transport basket 3a and transported to the post-wash tank 4 come into contact with the high-concentration ozone gas in the compartment 30. For this reason, this embodiment can exert a sterilization effect attributed to the contact with the high-concentration ozone gas in addition to the sterilization with the ozone water in the ozone water sterilization tank 3.

[0052]

[4. Fourth Embodiment]

Next, a configuration and a controlling method of a vegetable sterilization apparatus 400 according to a fourth embodiment will be described with reference to FIG. 7 and FIG. 8. In the following explanation, different features from the configurations and the controlling methods of the vegetable sterilization apparatuses 100 to 300 will be mainly described. Meanwhile, constituents of the vegetable sterilization apparatus 400 which are the same as those of the above-described vegetable sterilization apparatuses 100 to 300 will be denoted by the same reference signs and detailed description thereof will be omitted.

[0053]

FIG. 7 is a configuration diagram of the vegetable sterilization apparatus 400 of the fourth embodiment. In the vegetable sterilization apparatus 400, the air (which may contain the ozone gas as appropriate) is transferred among the compartment 20, the compartment 30, and the compartment 40. For this reason, besides the air feed-venting fans 22 and 42 in the above-described vegetable sterilization apparatus 100 and the air feed fan 32, the vegetable sterilization apparatus 400 is provided with dampers 51 and 52 for taking in the outside air. Moreover, these constituents are connected so as to be capable of performing the air feed and venting in a different manner from that by the above-described vegetable sterilization

apparatus 100 and the like. The arithmetic and control unit 70 controls these constituents.

[0054]

FIG. 8 shows a sterilization flow to be performed by the vegetable sterilization apparatus 400 of the fourth embodiment. In the sterilization flow shown in FIG. 8, the steps which are the same as those in the above-described sterilization flow shown in FIG. 2 will be denoted by the same step numbers and detailed description thereof will be omitted.

[0055]

First, the arithmetic and control unit 70 opens the damper 51 and drives the air feed fan 32 (step S401). Thus, the outside air is fed to the compartment 30 and the positive pressure is established in the compartment 30. Subsequently, steps S101 to S107 are executed as in the case of the above-described vegetable sterilization apparatus 100.

[0056]

After the partition plate 12 is closed and the compartments 20 and 30 are made airtight in step S107, the arithmetic and control unit 70 closes the damper 51 and rotates the air feed-venting fan 22 forward (step S402). Thus, the air is discharged from the compartment 20. In addition, since the air feed fan 32 is driven at this time, the air discharged from the compartment 20 is fed to the compartment 30. Here, the ozone gas inside the compartment 30 may flow into the compartment 20 as mentioned previously. For this reason, the ozone gas inside the compartment 20 may be fed to the compartment 30 by the air feed-venting fan 22 and the air feed fan 32. Thus, the positive pressure is established in the compartment 30 and the partial pressure of the ozone gas in the compartment 30 is elevated, whereby the desorption of the ozone gas from the ozone water is suppressed more effectively.

[0057]

Next, the arithmetic and control unit 70 opens the damper 52 after stopping the air feed-venting fan 22 and the air feed fan 32, and rotates the air feed-venting fan 42 backward (step S403). Thus, the outside air is fed to the compartment 40 and the positive pressure is established in the compartment 40. The positive pressure is established to the extent that the air pressure in the compartment 40 becomes higher than the air pressure in the compartment 30. Thereafter, steps S110 to S112 are executed as in the case of the above-described vegetable sterilization apparatus 100.

[0058]

Subsequently, the arithmetic and control unit 70 closes the damper 52, and drives the air feed fan 32 and rotates the air feed-venting fan 42 forward (step S404). Thus, the air is discharged from the compartment 40, and the discharged air is fed to the compartment 30. Here, as with the above-described compartment 20, the ozone gas may also flow from the compartment 30 into the compartment 40. For this reason, by feeding the discharged air from the compartment 40 to the compartment 30, the partial pressure of the ozone gas in the compartment 30 is elevated, whereby the desorption of the ozone gas from the ozone water is suppressed.

[0059]

Thereafter, steps S114 and S115 are executed as in the case of the above-described vegetable sterilization apparatus 100, and the sterilization of the vegetables V is thus completed.

[0060]

[5. Fifth Embodiment]

Next, a configuration and a controlling method of a vegetable sterilization apparatus 500 according to a fifth embodiment will be described with reference to FIG. 9 and FIG. 10. In the following explanation, different features from the

configurations and the controlling methods of the vegetable sterilization apparatuses 100 to 400 will be mainly described. Meanwhile, constituents of the vegetable sterilization apparatus 500 which are the same as those of the above-described vegetable sterilization apparatuses 100 to 400 will be denoted by the same reference signs and detailed description thereof will be omitted.

[0061]

FIG. 9 is a configuration diagram of the vegetable sterilization apparatus 500 of the fifth embodiment. The apparatus configuration of the vegetable sterilization apparatus 500 is basically the same as that of the vegetable sterilization apparatus 400 described with reference to FIG. 7 and the like. However, the vegetable sterilization apparatus 500 is provided with the ozone gas generation unit 35 described above in conjunction with the vegetable sterilization apparatus 300. Accordingly, the vegetable sterilization apparatus 500 corresponds to the configuration of the above-described vegetable sterilization apparatus 400, which is provided with the ozone gas generation unit 35 of the above-described vegetable sterilization apparatus 300.

[0062]

FIG. 10 shows a sterilization flow to be performed by the vegetable sterilization apparatus 500 of the fifth embodiment. In the sterilization flow shown in FIG. 10, the steps which are the same as those in the above-described sterilization flow will be denoted by the same step numbers and detailed description thereof will be omitted.

[0063]

First, as with the aforementioned step S301, the arithmetic and control unit 70 feeds the ozone gas to the compartment 30 (step S301). Subsequently, steps S101 to S103 are executed as in the case of the above-described vegetable

sterilization apparatus 100.

[0064]

Then, the arithmetic and control unit 70 opens the damper 51 and rotates the air feed-venting fan 22 backward (step S501, an air feed step). Thus, the outside air is fed to the compartment 20 through the damper 51 and the positive pressure is established in the compartment 20. The positive pressure is established to the extent that the air pressure in the compartment 20 becomes higher than the air pressure in the compartment 30. In this way, when the partition plate 12 is opened in the step S105 mentioned later, the ozone gas that may exist in the compartment 30 is kept from flowing into the compartment 20. Accordingly, the desorption of the ozone gas from the ozone water is effectively suppressed.

15 **[0065]**

Thereafter, the above-described steps S105 to S107, S402, S403, S110 to S112, S404, S114, and S115 are executed in this order. Hence, the sterilization of the vegetables V is completed.

20 **[0066]**

[6. Modified Examples]

The vegetable sterilization apparatus and the method for producing vegetables of the present invention have been described by citing five embodiments. However, the vegetable sterilization apparatus and the method for producing vegetables of the present invention are not limited only to the above-described embodiments. In this context, any one or more of the above-described embodiments may be carried out in combination, and any of the embodiments may also be carried out while applying appropriate modifications thereto.

30 **[0067]**

For example, in each of the above-described embodiments, the pre-wash tank 2, the ozone water sterilization tank 3, and

the post-wash tank 4 are integrally provided, and the compartments 20, 30, and 40 are formed by partitioning the space inside the single venting hood 10 with the partition plates 12 and 13. However, the vegetable sterilization apparatus of the present invention is not limited to the above-mentioned configuration. For example, the pre-wash tank 2, the ozone water sterilization tank 3, and the post-wash tank 4 may be built separately and connected to one other with pipes that can transport the vegetables V. This configuration is also capable of more reliably preventing the ozone gas from leaking out and achieving the effect of the present invention.

[0068]

Note that when the pre-wash tank 2, the ozone water sterilization tank 3, and the post-wash tank 4 are built separately, the compartment 20 can be considered as the space inside the pre-wash tank 2, the compartment 30 can be considered as the space inside the ozone water sterilization tank 3, and the compartment 40 can be considered as the space inside the post-wash tank 4, respectively.

[0069]

Meanwhile, as explained in the respective embodiments described above, it is preferable to establish the positive pressure and the negative pressure in the compartments 20, 30, and 40, for example. Moreover, among these compartments, it is preferable to set the air pressure in the compartment 30 lower than the air pressures in the compartments 20 and 40. However, although the above-mentioned aspects are preferable, the air pressures in the respective tanks in the vegetable sterilization apparatus of the present invention may be set arbitrarily as long as a portion above the ozone water sterilization tank 3 is made airtight.

[0070]

In the meantime, while a qualitative operation is carried

out in each of the above-described embodiments, a quantitative operation depending on the air pressures in the respective tanks may be carried out by providing air pressure sensors to the respective tanks and the like, for example.

5 **[0071]**

Furthermore, the configurations of the tanks of the vegetable sterilization apparatus are not limited to the illustrated examples. So far as the ozone water sterilization tank to perform sterilization by using the ozone water is provided, the configurations of other tanks are arbitrary. In the meantime, as for the aspect of forming the compartments 20, 30, and 40 by partitioning the inside of the single venting hood 10, the present invention is not limited to the aspect of using the partition plates 11, 12, 13, and 14. For example, double doors are applicable thereto.

[0072]

Still further, the above-described sterilization flows may be carried out with any of the steps replaced or deleted as appropriate.

20 **Reference Signs List**

[0073]

- 2 pre-wash tank (vegetable treatment tank)
- 3 ozone water sterilization tank (sterilization tank)
- 4 post-wash tank (vegetable treatment tank)
- 25 10 venting hood (sterilization tank, vegetable treatment tank)
- 11 partition plate (vegetable treatment tank)
- 12 partition plate (sterilization tank, vegetable treatment tank)
- 30 13 partition plate (sterilization tank, vegetable treatment tank)
- 14 partition plate (vegetable treatment tank)
- 22 air feed-venting fan (first air feed unit)

	32	air feed fan (second air feed unit)
	35	ozone gas generation unit
	36	ozone gas feed fan (ozone gas feed unit)
	42	air feed-venting fan (first air feed unit)
5	50	arithmetic and control unit (first arithmetic and control unit, second arithmetic and control unit)
	51	damper
	52	damper
	100	vegetable sterilization apparatus
10	200	vegetable sterilization apparatus
	300	vegetable sterilization apparatus
	400	vegetable sterilization apparatus
	500	vegetable sterilization apparatus

CLAIMS

1. A vegetable sterilization apparatus comprising:

a sterilization tank configured to sterilize
5 vegetables by immersing the vegetables in ozone water,
wherein

a space above the ozone water held in the
sterilization tank is made airtight.

10 2. The vegetable sterilization apparatus according to
claim 1, comprising:

a vegetable treatment tank provided to at least one of
a preceding stage and a subsequent stage of the
sterilization tank;

15 a first air feed unit configured to feed air to the
vegetable treatment tank; and

a first arithmetic and control unit configured to set
an air pressure inside the vegetable treatment tank higher
than an air pressure inside the sterilization tank by using
20 the first air feed unit.

3. The vegetable sterilization apparatus according to
claim 2, comprising:

a second air feed unit configured to feed the air to
25 the sterilization tank; and

a second arithmetic and control unit configured to
establish a positive pressure in the sterilization tank by
using the second air feed unit.

30 4. The vegetable sterilization apparatus according to
claim 2 or 3, wherein the vegetable treatment tank is
connected to the sterilization tank in such a way as to
allow the air inside the vegetable treatment tank to be fed

to the sterilization tank.

5. The vegetable sterilization apparatus according to any one of claims 1 to 3, comprising:

5 an ozone gas generation unit configured to generate ozone gas; and

an ozone gas feed unit configured to feed the ozone gas generated by the ozone gas generation unit to the sterilization tank.

10

6. A method for producing sterilized vegetables comprising:

a sterilization step of sterilizing vegetables by immersing the vegetables in ozone water in a sterilization tank in which the ozone water is held and a space above the held ozone water is made airtight;

15 an air feed step of setting an air pressure inside a vegetable treatment tank higher than an air pressure inside the sterilization tank, the vegetable treatment tank being provided to at least one of a preceding stage and a subsequent stage of the sterilization tank; and

20 a transport step of transporting the vegetables between the vegetable treatment tank with the air pressure set higher in the air feed step and the sterilization tank.

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