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METHOD OF FUMIGATION OF ORGANIC PRODUCTS

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This invention relates to the fumigation of organic products, and more particularly to the treatment of such products in such a manner as to greatly reduce the bacterial content thereof and the infestation by other similar organisms such as mold or spore organisms.

Organic products most commonly treated in this manner are foods and one particularly susceptible type of food is the spices. It has heretofore been suggested that such products might be sterilized (the word sterilized is here used to indicate a substantial reduction of bacterial content which may or may not be complete) by subsection for a considerable period to high temperatures under a vacuum, followed by treatment with ethylene oxide at relatively high concentrations. Inasmuch, however, as foods and particularly the spices depend for their desirability upon their flavor, the application of heat plus high vacuum, results in many cases in high depreciation in quality.

It has heretofore been believed impossible to procure sterilization or even any appreciable reduction in bacterial content by means of ethylene oxide alone at atmospheric temperatures. At the same time, the use of undiluted ethylene oxide presents explosive hazards unless carefully controlled.

By means of this invention the bacterial infestations are reduced to a surprisingly great degree and this is particularly true of gas-forming bacteria. The same is true of yeast and mold infestations.

As an example of the invention, spice was subjected to a vacuum of about 28" and then at least six pounds of ethylene oxide per 100 cubic feet of space in the container were introduced and maintained for a period of approximately six hours. The presence of the six pounds per 100 cubic feet of ethylene oxide will produce a vacuum of about 15". The time interval, however, varies according to the product and concentration of ethylene oxide used. If more ethylene oxide is added, the time interval may be approximately correspondingly reduced. For example, with twelve pounds per 100 cubic feet, the time may be as little as three hours. After the proper time interval, the ethylene oxide is removed from the chamber. It has been found that the method of removal is of considerable importance. It is preferred to evacuate the container to about 29". After the evacuation, the vacuum is broken with air to about 15", the tank is again re-evacuated to about 29", the vacuum is again broken with air to about 15", the tank is again re-evac-

uated to 29" and the vacuum is broken again with air, after which it may be opened and entered.

The series of steps just outlined reduces the ethylene oxide concentration in the tank below 3% and it has been discovered that if it is so reduced, there is no danger of explosion. It is highly undesirable even to open the container until the ethylene oxide content has been reduced as low as 3%. Moreover, the disposal of ethylene oxide through the vacuum pump is important from the standpoint of safety. The entire system should be carefully grounded and it is preferred to employ a steam jet and a barometric condenser for the evacuation operation. Ethylene oxide is highly soluble in water and the use of the steam and barometric condenser result in very safe removal thereof.

As a specific example of the process, the following materials were subjected to a 27" vacuum and in treatment A were then heated to 100° F., after which ethylene oxide was introduced to break the vacuum to 10.3" and the temperature maintained for six hours.

In treatment B the procedure was the same except that the products were left at atmospheric temperature of 77° F.

The bacterial figures given are after incubation for two days at 37½° centigrade in a plain nutrient agar 1½% medium at a pH of 6.8.

Readings given are at a dilution of 1 to 1,000.

Material	Original total bacterial count	Count after test "A"	Count after test "B"
Black pepper.....	*6,400,000	2,000	4,000
Whole savory seed.....	450,000	0	0
Whole thyme.....	620,000	0	0
Ground black pepper.....	*19,200,000	2,000	9,000
Ground cinnamon.....	10,000	1,000	0
Ground ginger.....	*13,120,000	27,000	29,000
Sausage seasoning.....	120,000	0	3,000
Chili powder.....	3,350,000	71,000	*838,000
Ground red pepper.....	6,750,000	150,000	144,000

*Estimated.

In practically all instances the differences between tests A and B are within the ordinary limits of experimental error.

The foregoing treatment is upon dry products and it is highly undesirable from the standpoint particularly of spices that any substantial amounts of moisture be present. The high initial vacuum insures that accidentally large amounts of moisture in warm products will be removed, and at the same time such products

would be cooled at least to 100° F. or thereabouts by evaporation.

The presence of undue amounts of moisture may lead to combination of the ethylene oxide therewith to form undesirable products in the food.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom.

I claim:

1. The method of treating organic products infested with microorganisms for marked reduction in the microorganism content thereof, which comprises subjecting the dry food product to a vacuum of approximately 28" of mercury, and then treating the product with ethylene oxide at substantially atmospheric temperatures, the concentration of ethylene oxide being at least six pounds per 100 cubic feet of space, and the period of treatment being of the order of six hours for a concentration of ethylene oxide of six pounds per 100 cubic feet.

2. The method of sterilizing dry food materials which comprises subjecting the material to a high vacuum, introducing ethylene oxide therein to produce a concentration of at least six pounds of ethylene oxide for 100 cubic feet of space, maintaining the ethylene oxide in contact with the product for at least a period of 36 hours divided by the number of pounds of ethylene oxide per 100 cubic feet of space.

3. The method as set forth in claim 2 in which the product is a dry spice.

4. The method of sterilizing products with ethylene oxide in substantially pure form which comprises substantially eliminating air from a container containing the product, introducing

ethylene oxide thereto in substantially pure form to produce a gas explosive on mixture with air, and then alternately re-evacuating the container and admitting air thereto while maintaining a vacuum therein until the ethylene oxide content in the gas is below 3% and then opening the container to atmosphere.

5. The method as set forth in claim 4 in which the ethylene oxide is evacuated to a barometric condenser in the water of which the ethylene oxide dissolves.

6. The method of treating a product for marked reduction in the microorganism content thereof, which comprises subjecting the product in dry state to a vacuum of approximately 28" of mercury, introducing substantially pure ethylene oxide to the vacuum at substantially atmospheric temperature, the concentration of ethylene oxide being at least 6 lbs. per 100 cubic feet of space and the period of treatment being of the order of 6 hours for a concentration of ethylene oxide of six pounds per 100 cubic feet.

7. The method of treating bacteria infested organic products for marked reduction in the bacterial content thereof, which comprises subjecting a dry food product to a vacuum of approximately 28" of mercury, and then treating the product with ethylene oxide at substantially atmospheric temperatures, the concentration of ethylene oxide being at least six pounds per 100 cubic feet of space, and the period of treatment being of the order of six hours for a concentration of ethylene oxide of six pounds per 100 cubic feet and then again subjecting the food product to a vacuum at least approximately as high as the initial vacuum.

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