DEVICE AND METHOD FOR TREATING A PERISHABLE OBJECT

FIELD OF INVENTION

The present invention relates broadly to a device and method for treating a perishable object.

BACKGROUND

Conventional methods and devices to keep food and beverages fresh and natural, particularly in the raw, semi-processed and processed states, typically involve thermal treatments, mainly by refrigeration. However, such devices are usually operated by electricity, which may not be available in some circumstances.

In the decomposition of all living cells, such as in fish and meat products, there are several chemical and biochemical processes taking place. These processes include: (1) enzymatic spoilage that is caused by the tissue enzymes of the fish or meat itself; (2) oxidative deterioration that results in foul, rancid odors and color changes; (3) spoilage due to bacterial growth from its secondary products, primarily from the enzymes that cause the decomposition of proteins. These chemical-related deterioration processes are conventionally controlled by the reduction of ambient temperature by means of refrigeration processes. However, such refrigeration devices require electrical supply, which may not be available in some circumstances.

Further, even if refrigeration devices are available, it may be desirable to help prolong and/or enhance the freshness of food and beverages stored in a refrigerator for a longer period of time.

SUMMARY

In accordance with a first aspect of the present invention there is provided a method of treating a perishable object, the method comprising exposing the perishable object to a south magnetic field created by magnetic interference of a plurality of magnets.

The perishable object may comprise a food item, a beverage item, or both, and the exposure maintains the freshness of the food item, the beverage item, or both.

The exposure may control a surface temperature of the perishable object.

The exposure may control the rate of bacterial growth on the perishable object.

The duration of said exposing step may be chosen such that the rate of bacterial growth is reduced compared to a rate without said exposure.

The duration of said exposing step may be chosen such that the rate of bacterial growth is increased compared to a rate without said exposure.

The plurality of magnets may be arranged in a substantially staggered arrangement.

The method may further comprise shielding a north-pole side of the magnets.

The magnets may be permanent magnets or electromagnets.

In accordance with a second aspect of the present invention there is provided device for treating a perishable object, the device comprising at least one panel defining at least a portion of a space for containing the perishable object; a plurality of magnets housed within the panel and arranged such that a south magnetic field created by magnetic interference of the plurality of magnets extends into the space for containing the perishable object.

The perishable object may comprise a food item, a beverage item, or both and exposure maintains a freshness of the food item, the beverage item or both.

The exposure may control a surface temperature of the perishable object.

The exposure may control a rate of bacterial growth on the perishable object.

The plurality of magnets may be arranged in a substantially staggered arrangement.

The device may further comprise a magnetic shielding unit.

The magnetic shielding unit may comprise a magnetic shield plate disposed at a north-pole side of the magnets housed in each panel.

The device may further comprise protective padding disposed around the magnets.

The magnets are sealed within the panels.

The magnets may be permanent magnets or electromagnets.

The device may be a six sided container.

The device may be a tray.

The device may be a plate.

The device may be a five sided container.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Figure 1 is a schematic perspective view of a device according to an embodiment of the invention;

Figure 2 is a schematic view of the arrangement of magnets housed in a side panel of the device shown in Figure 1;

Figure 3 is a table showing the comparison of magnetic flux from an example in-line arrangement of four magnets and an example staggered arrangement of the four magnets;

Figure 4 is a schematic cross sectional view of the side panel in Figure 2 along A-A;

Figure 5 is a schematic view of the device according to another embodiment of the present invention;

Figure 6 is a schematic view of the device according to another embodiment of the present invention;

Figure 7 is a schematic view of the device according to another embodiment of the present invention;

Figure 8 is a graph of bacterial growth against exposure time of food samples;

Figure 9 is a table showing experimental results of average internal ambient temperature differences with and without a device according to an embodiment of the present invention;

Figure 10(a) is a thermal image of a cooler box containing ice cubes and placed in a device according to an embodiment of the present invention;

Figure 10(b) is a thermal image of a cooler box containing ice cubes without a device according to an embodiment of the present invention;

Figures 10(c) and 10(d) are thermal images of the contents of the cooler boxes in Figures 10(a) and 10(b), respectively; and

Figure 11 shows the experimental results for subjecting perishable food under different environmental conditions with and without using a device according to an embodiment of the present invention.

DETAILED DESCRIPTION

Generally, the described embodiments relate to a method and device to reduce the rate of chemical and biochemical activities that cause the denaturing and decomposition of perishable objects such as food and beverages. The example device and method also function to retain the moisture content in food by maintaining cell hydration, which can be particularly useful for food such as cooked rice and bread.

Figure 1 is a schematic perspective view of a device 10, in accordance with an embodiment of the present invention. The device 10 comprises a substantially rectangular shaped container 10 having a cavity 12 defined by six panels, namely: four side panels 14, a base panel 16 and a top panel 18. The top panel 18 acts as a cover or lid of the container 10. Each of the panels 14, 16, 18 houses a plurality of magnets 20 within the panel. The four side panels 14, the base panel 16 and the top panel 18 are configured to envelop an object (not shown), for example, perishable food. The object is placed in the cavity 12 of the container 10 such that the object is surrounded by the panels 14, 16, 18 in all three linear axes, namely the x, y, and z-axes.

Each of the plurality of magnets 20 are housed within the panels 14, 16, 18 with their respective south-pole side (shown in Figure 4) facing towards the object placed in

the cavity 12 of the container 10, such that a magnetic south field is directed upon the object. Further, since the object is surrounded by the panels 14, 16, 18, this ensures that the targeted object is only exposed to the magnetic south field in all three axes.

There are two polarities and directions in a magnetic field. One direction is from the North magnetic pole and the other direction is from the South magnetic pole. Based on scientific convention, the compass "north" needle points in the direction of the magnetic flux, that is, in an outward direction from a magnet's North pole end and inward at the magnet's South pole end.

The magnets 20 are permanent magnets in the example embodiment. It should be appreciated that the material, size and shape of the permanent magnets 20 may vary, depending on design and application. Further, the number of magnets 20 used may vary depending on e.g. the shape and size of the container 10, for example. The magnets 20 may also be in the form of electromagnets instead of permanent magnets.

Figure 2 is a schematic view showing the arrangement of the plurality of magnets 20 housed in one of the four side panels 14 of the container 10 in Figure 1. In this example embodiment, the magnets 20 are arranged such that nearest neighboring circles 17 of magnets 20 are substantially in a staggered arrangement with substantially uniform spacing between the magnets 20 within the side panel 14 to produce magnetic interference 15, which in turn enhances magnetic field strength. Magnetic interference significantly increases the total propagated magnetic field (in this case the south magnetic field). Since magnetic interference increases the strength of the magnetic field, the size of the magnets and/or the number of magnets required to achieve a desired magnetic field strength is reduced. This in turn reduces the total weight and the cost of the device. The magnets 20 in the base panel 16 and top panel 18 are arranged in a similar staggered arrangement as described above.

Figure 3 is a table showing the comparison of magnetic flux from an example in-line arrangement 34 of four magnets 30 and an example substantially staggered arrangement 36 of the four magnets 30. Schematic plan views of the positions of the magnets 30 in the in-line arrangement 34 and the substantially staggered arrangement 36 are shown in the first and second rows of the table, respectively. The positions of the

magnets 30 are represented by dots "•" and the center of the arrangement of the magnets 30 are represented by a cross "**X**". The magnetic flux is measured from the center of each arrangement 34, 36, about 60mm away from a magnetic plane 38. The magnetic flux at the center of the staggered arrangement 36 (magnetic flux of 1700 ± 8G) is greater compared to the magnetic flux at the center of the in-line arrangement 34 (magnetic flux of 1300 ± 10G). This shows an enhancement of the magnetic field strength and propagation of the magnetic field of the staggered arrangement 36 over the in-line arrangement 34.

Figure 4 is a cross sectional view of the side panel 14 in Figure 2 along A-A. The side panel 14 comprises a casing 24. The magnets 20 are housed within the casing 24. Protective padding 26 is disposed on a south-pole side 20a and a north-pole side 20b of the magnets 20. The protective padding 26 acts as a spacer, heat insulator and shock absorber for the magnets 20. The north-pole side 20b of the magnets 20 is shielded by a magnetic shielding device 28 in the form of, for example, a shield plate. The shield plate 28 is disposed between the protective padding 26 on the north-pole side 20b of the magnets 20 and the casing 24. The protective padding 26 may be made of materials such as neoprene based foam tape, which is structurally stable and offers good moisture and fungus resistance properties. The thickness of the protective padding 26 depends on the magnetic field strength of the magnets 20 used. The protective padding 26 also serves to provide the necessary spacing between the magnets 20 and an outer surface of the casing 24 such that the magnetic field strength on the outer surface of the casing 24 is not too large to attract any ferromagnetic objects.

The shield plate 28, the protective padding 26 and the magnets 20 are sealed within the casing 24. This is to ensure that the magnets 20, the protective padding 26 and the shield plate 28 are insulated. The top and base panels, 16, 18 of the container 10 are configured in a similar manner as described above.

The shield plate 28 may be made of any ferromagnetic material such as low cost tin sheets, which comprise iron (Fe) mixed with tin (Sn). The composition and thickness of the shield plate 28 may vary, but the magnetic saturation value of the material used for the shield plate 28 should be higher than the external magnetizing field strength, which depends on the type and size of the permanent magnets 20 used.

The material used for the casing 24 may be any non-magnetic material, especially for the portion of the casing, for example, polyethylene and polypropylene, which are chemically and structurally stable, and also food safe. The materials are durable against wear, high temperatures and washing by detergents. The thickness of the material used for the casing 24 may be sufficient to prevent deformation from rough handling and protect the magnets 20 from damage.

In the above embodiment, the device 10 is in the form of a closed rectangular container, with six panels. However, the device may be designed in various other forms.

For example, in Figure 5, the device 50 is in the form of a plate. A plurality of magnets 52 are disposed in a staggered arrangement in a base panel 54 of the plate 50. The plate 50 may be used in buffets and catering applications to display ready-to-eat food and at the same time maintain the freshness of the food.

In another embodiment, the device 60 may be in the form of an open container comprising five panels 62, as shown in Figure 6. Similarly, each of the panels 62 houses a plurality of magnets 64 disposed in a staggered arrangement. A cooler box 66 may be placed in the container 60 for use outdoors, such as for picnics and fishing, to keep food chilled.

In another embodiment, the device 70 may be in the form of a tray, as shown in Figure 7. Each of the panels 72 forming the sides and the base of the tray 70 houses a plurality of magnets 74 as described earlier. The tray 70 may be used to contain ready-to-eat food, such as bread and cooked food.

Figure 8 is a graph, based on experimental results, showing bacterial growth against exposure period of food samples to the north magnetic field, the south magnetic field and without any magnetic field. Comparing the curves of the south magnetic field growth curve and the north magnetic field growth curve, during early stages of exposure, for example within 1- 3 days for seafood in (about $0^0C \sim 4^0C$) chiller environment, the rate of bacterial growth is higher for food samples exposed to the north magnetic field compared to samples exposed to the south magnetic field. Also, this difference in the

rate of bacterial growth is found to be greater when magnetic interference is applied. By using magnetic interference from the south magnetic filed, it was found that there is a significant reduction in biochemical and chemical reactions during the early stages of exposure, which causes a delay in the food denaturing process. As a result of the reduced biochemical and chemical reactions, the overall quality of foods exposed to the interfered south magnetic field can be maintained longer than foods that are not exposed to any magnetic field or foods exposed to the north magnetic field.

The duration of early stages of exposure depends on the condition and type of food and beverages, and storage conditions such as ambient temperature. For example, the early stages for a processed fish stored in chiller conditions (about $0^0C \sim 4^0C$) may be 1 to 3 days, whereas at room temperature conditions (about $20^0C \sim 25^0C$) may be 2 to 4 hours.

In addition, it was found that in example embodiments the mechanism of maintaining the freshness in food and beverages is due to the reduction of energy state in electrons in all atoms and molecules. By using the magnetic south field, the ordering of electron spins towards a spin down direction causes the energy state of the electrons to be reduced. This reduction of energy state in turn reduces the vibration energy of the electrons, and hence creates an energy barrier that prevents electron transfer required for any biochemical or chemical reactions to occur. Thus, the rate of chemical and biochemical deterioration activities that cause the decomposition of food and beverages can be slowed down or reduced, thereby maintaining the freshness of the food and beverages.

Experiments were conducted to monitor the temperature differences of various objects such as melting ice cubes and deteriorating beverages and foods. Differences in the temperature of an object that is exposed to the South magnetic field and the temperature of the object without exposure to a magnetic field were observed. The difference in temperature indicates the relative energy state of the object, for example, a phase change for melting ice (from solid to liquid state) and changes in chemical and biochemical reactions for deteriorating food.

Figure 9 is a table showing experimental results of average internal ambient

temperature differences with and without a device according to an embodiment of the present invention. The cooler boxes that are placed in the device are exposed to a south magnetic field, while the cooler boxes without the device are not subjected to any magnetic field. In this experiment, the device used is a five-panel container substantially similar to the device 60 shown in Figure 6. In Experiment 1, 1 kg of ice cubes is placed in the cooler boxes. In Experiment 2, 1 kg of ice cubes and 1 kg of fishes (comprising 10 whole fishes of approximately 100g each) are placed in the cooler boxes. The experimental results shown in Figure 9 illustrate one of the observable temperature effects when objects are continuously undergoing physical and chemical changes. For example, the ice cubes kept in the 25 litre cooler box that gradually melts over a time period of 24 hours, and similar ice cubes with an additional load of whole fishes that are gradually melting and deteriorating with time respectively. In both Experiment 1 and Experiment 2, the difference in the average internal ambient temperatures between the cooler boxes placed in the device and the cooler boxes without the device are negative (i.e. the internal ambient temperature of the cooler boxes placed in the device is lower). The standard deviation for both Experiment 1 and Experiment 2 is about 0.15.

The results observed in the table of Figure 9 demonstrate that the south magnetic field is able to reduce the total energy state in ice, as such the melting process is slowed. With the additional load into the cooler box (for this case, the whole fishes), the effect of melting ice and deteriorating fish gave rise to higher internal ambient temperature differences (i.e. -1.24^0C compared to -0.66^0C). The lower temperatures observed in the cooler boxes that were exposed to the south magnetic field demonstrate the effect on the reduction of the rate of heat transfer and absorption in melting ice, and also the ability to lower the chemical and biochemical reactions that generate additional heat during the fish decomposition process.

Figures 10(a) and 10(b) are thermal images of a cooler box 100 containing ice cubes that are placed in a device according to an embodiment of the present invention (i.e. exposed to magnetic south field), and a cooler box 102 containing ice cubes without the device (i.e. not exposed to any magnetic field), respectively. The device used is a five-panel open container substantially similar to that described earlier in Figure 6. A thermal image analysis provides further evidence to the above explanation on the reduction of energy state. Regions of darker shades in the thermal images represent

areas of lower temperatures. The cooler box 100 that is exposed to a south magnetic field has more distinct darker regions compared to the cooler box 102 that was not exposed to any magnetic field.

Figures 10(c) and 10(d) are thermal images of the contents of the cooler boxes 100, 102 described above, respectively. The thermal images were obtained after 10 hours of storage in a room environment (28^0C ~ 31^0C). The remaining ice cubes (represented by the darker shaded regions) in the cooler boxes 100, 102 show that more ice cubes remained in solid form when the ice cubes are exposed to the South magnetic field (Figure 10(c)) compared to the ice cubes that were not exposed to any magnetic field (Figure 10(d)).

The phenomenon of a relatively colder surface temperature on objects that are undergoing changes, such as a phase change (in the case of melting ice) or chemical and biochemical reactions (in the case of food deterioration) were consistently observed when the objects are exposed to the South magnetic field. Examples of such objects are beverages such as soy bean drink, perishable foods such as raw fish and inorganic materials such as iron bolts undergoing corrosion process. This effect results in the retention of water molecules within cells, thereby maintaining intracellular hydration and hence reduces the evaporation rate of moisture from the object, for example in bread and cooked rice.

However, due to the cellular hydration effect when food samples are exposed to the South magnetic field, it is observed that in the advance stages of exposure, for example, 3 to 5 days for processed fish in a chiller environment, the rate of bacterial growth is greater compared to samples exposed to the north magnetic field and samples not exposed to any magnetic field (see Figure 8). As cell hydration is maintained, the bacterial cells present in the food samples may synthesize more surface proteins, which consequently promote bacterial cell growth at the advanced stages. As a result, the device in accordance with embodiments of the present invention may be further used for promoting specific bacterial cell cultures and its enzymes secretions for pharmaceutical and biotechnological applications.

Figure 11 shows a table of the experimental results for subjecting perishable food

under different environmental conditions with and without a device according to another embodiment of the present invention.

From the experimental results in Figure 11, it was observed that the device of the embodiments of the present invention is able to maintain or prolong the freshness of food and beverages, particularly for highly perishable foods such as fish and seafood during the early stages. The total plate count, which indicates the total bacterial present in food was significantly less when the device is used. Similarly, for the total Colliform count, which indicates other disease-causing bacterial that results primarily from human handling, was also significantly less when the device is used. The total volatile nitrogen (TVN) analysis provides an indication of the freshness of the food samples. The change in TVN of the food samples was less when the device is used. The rate of volatile nitrogen emission, for example ammonia gas, from raw sliced salmon deterioration was reduced as a result of exposure to the South magnetic field. In addition, the device in accordance with embodiments of the present invention is also able to retain the moisture content in foods. This is particularly useful for storing foods such as cooked rice and bread.

In contrast to the conventional methods of maintaining freshness of foodstuffs, such as refrigeration, the device in accordance with the embodiments of the present invention does not require any electricity to function. This makes it mobile and very convenient for use outdoors and in places without electricity.

Further, the device in accordance with the embodiments of the present invention may be used in conjunction with a refrigeration device to maintain freshness of food beverages, for example, the device may be in the form of a container that is placed into a refrigerator.

Conversely, instead of using the device for keeping food and beverages fresh at the early stages, the device of the present invention may also be suitable for promoting bacterial growth and protein synthesis by using the advance stages. It can be observed from the graph in Figure 8 and from the experimental results in Figure 11 (for example, sliced salmon fish stored in a chiller after 5 days of storage) that in the advanced stages of exposure period, the rate of bacterial growth is greater for specimens that are

exposed to the magnetic south field.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

CLAIMS:

1. A method of treating a perishable object, the method comprising exposing the perishable object to a south magnetic field created by magnetic interference of a plurality of magnets.

2. The method as claimed in claim 1, wherein the perishable object comprises a food item, a beverage item, or both, and the exposure maintains the freshness of the food item, the beverage item, or both.

3. The method as claimed in claim 1, wherein the exposure controls a surface temperature of the perishable object.

4. The method as claimed in claim 1, wherein the exposure controls the rate of bacterial growth on the perishable object.

5. The method as claimed in claim 4, wherein the duration of said exposing step is chosen such that the rate of bacterial growth is reduced compared to a rate without said exposure.

6. The method as claimed in claim 4, wherein the duration of said exposing step is chosen such that the rate of bacterial growth is increased compared to a rate without said exposure.

7. The method as claimed in any one of claims 1 to 4, wherein the plurality of magnets are arranged in a substantially staggered arrangement.

8. The method as claimed in any one of claims 1 to 7, further comprising shielding a north-pole side of the magnets.

9. The method as claimed in any one of claims 1 to 8, wherein the magnets are permanent magnets or electromagnets.

10. A device for treating a perishable object, the device comprising:

at least one panel defining at least a portion of a space for containing the perishable object;

a plurality of magnets housed within the panel and

arranged such that a south magnetic field created by magnetic interference of the plurality of magnets extends into the space for containing the perishable object.

11. The device as claimed in claim 10, wherein the perishable object comprises a food item, a beverage item, or both and exposure maintains a freshness of the food item, the beverage item or both.

12. The device as claimed in claim 10, wherein the exposure controls a surface temperature of the perishable object.

13. The device as claimed in claim 10, wherein the exposure controls a rate of bacterial growth on the perishable object.

14. The device as claimed in any one of claims 10 to 13, wherein the plurality of magnets are arranged in a substantially staggered arrangement.

15. The device as claimed in any one of claims 10 to 14, further comprising a magnetic shielding unit.

16. The device as claimed in claim 15, wherein the magnetic shielding unit comprises a magnetic shield plate disposed at a north-pole side of the magnets housed in each panel.

17. The device as claimed in any one of claims 10 to 16, further comprising protective padding disposed around the magnets.

18. The device as claimed in any one of claims 10 to 17, wherein the magnets are sealed within the panels.

19. The device as claimed in any one of claims 10 to 18, wherein the magnets are permanent magnets or electromagnets.

20. The device as claimed in any one of the preceding claims, wherein the device is a six sided container.

21. The device as claimed in any one of the preceding claims, wherein the device is a tray.

22. The device as claimed in any one of the preceding claims, wherein the device is a plate.

23. The device as claimed in any one of the preceding claims, wherein the device is a five sided container.