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(74) Agents: SECHLEY, Konrad et al.; Gowling Lafleur Hen-
derson LLP, 160 Elgin Street, Suite 2600, Ottawa, Ontario
K1P 1C3 (CA).

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(71) Applicant (for all designated States except US): **6231934**
CANADA INC. [CA/CA]; 208 Joseph-Carrier, Vaudreuil,
Quebec J7V 5V5 (CA).

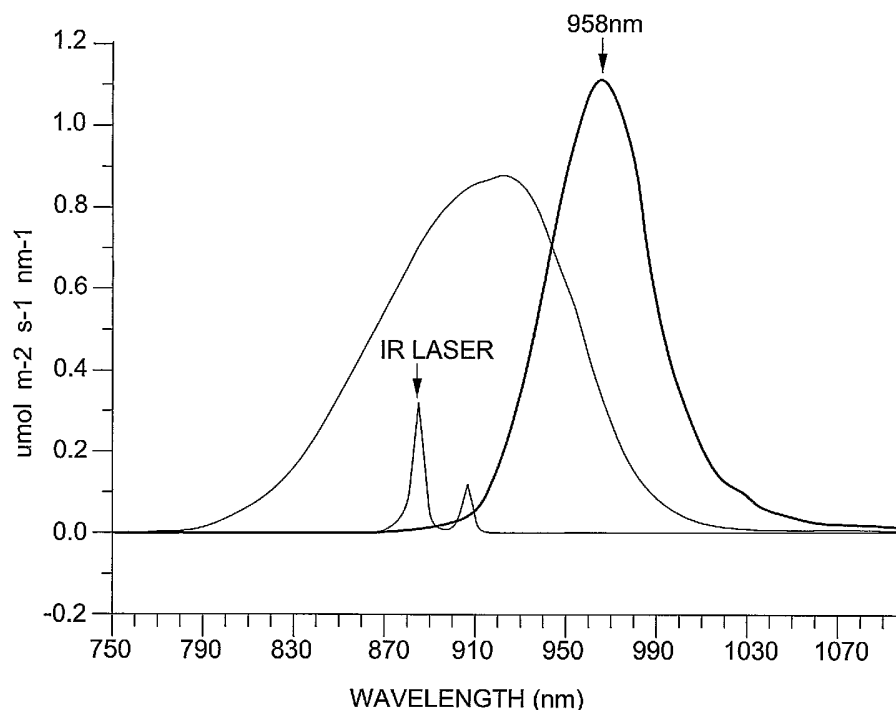
(72) Inventor; and

(75) Inventor/Applicant (for US only): **VASILENKO,**
Vladimir [CA/CA]; 10 Spring Street, Maxville, Ontario
K0C 1T0 (CA).

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(54) Title: METHOD AND APPARATUS FOR STORING PRODUCE



(57) Abstract: The invention can be summarized as follows. A produce container comprising one or more infrared lights, one or more red lights or a combination thereof. The produce container may further be refrigerated or comprise a refrigeration system. Also disclosed are methods of preserving produce using the produce container.



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METHOD AND APPARATUS FOR STORING PRODUCE

The present invention relates to a method and apparatus for preserving stored produce. More particularly, the present invention relates to a method for preserving produce during storage by exposing the produce to infrared light, red light or a combination thereof and to a produce container comprising a red light, infrared light or a combination thereof.

BACKGROUND OF THE INVENTION

There has been much interest in prolonging the quality of produce such as fruits, vegetables, meats, dairy products and the like during storage. Most of these processes have focused on reducing microorganism growth, for example by using a variety of techniques such as radiation processing, heat sterilization or pasteurization, chemical treatment, or cold storage.

Some types of produce are subjected to radiation such as gamma radiation or ultraviolet radiation to sanitize or sterilize food products. While these processes can destroy the growth of microorganisms in produce, drawbacks of using these types of radiation include breakdown or decomposition of the food products causing off tastes, and off odors. There is also a common public perception that produce treated by radiation may be unsafe for consumption. In addition, gamma radiation and to a lesser extent ultraviolet radiation can be hazardous to biological organisms including humans, and thus general public or household use of such types of radiation is either not possible or unadvisable.

Heat sterilization or pasteurization has been used for a long time to reduce microorganism growth in many types of produce. Usually the produce is heat pasteurized to extend the shelf-life of the product prior to being sold to the consumer. Heat pasteurization of produce requires substantial energy in order to raise the temperature of the produce to a level suitable to kill microorganisms that can be partly responsible for the degradation of quality in foods. Unfortunately a consumer storing

- 2 -

pasteurized produce such as milk or other type of produce cannot re-pasteurize the produce after it is opened to prolong its shelf life. Also, many types of produce such as fruits and vegetables cannot be treated by heat sterilization or pasteurization without severely affecting the quality of the produce.

A major drawback of the existing processes used to extend shelf life of produce is that they have traditionally focused on inhibiting microorganism growth in the produce rather than simultaneously addressing natural, spontaneous decomposition of the food products themselves after the food products are removed from the natural environment in which they are grown or live. For example, after a food product such as a leafy vegetable is removed from the natural environment in which it lives, the vegetable begins to undergo attrition as cellular processes collapse. The process of cellular collapse is very complex process and depends on many variables. However, it is well known that as the integrity of the cellular systems collapse, the quality of the produce diminishes.

US Pat. No. 6,010,727 discloses a process for sanitizing fresh foods and beverage products using multiple stages of exposure to wavelengths of ultraviolet, near infrared and infrared light. A food or beverage product is exposed to ultraviolet light to kill microorganisms on the product. However, the UV light damages the organoleptic properties of the product. The damaged organoleptic properties are subsequently restored by exposure of the product to near infrared light. In addition the reference teaches that infrared light may be used to inactivate enzymes responsible for decomposition of the product. A drawback of this reference is that produce must be treated with a plurality of light sources in a complex method. In particular, the produce must be treated with ultraviolet light. In many cases, it is undesirable to treat fresh produce such as fruits and vegetables with ultraviolet light as such treatment can affect the quality of the produce.

One of the best known methods to extend the quality of produce is by refrigeration. It is well known that refrigeration reduces metabolic activity of microorganisms and generally slows normal biological and biochemical processes. While it is well known

- 3 -

in the art to store fresh produce in refrigerators, most conventional refrigerators are only capable of extending the quality of produce by a short time. Thus, there is a need in the art to further extend the quality of produce during storage at room temperature, and at reduced temperatures, for example in a household refrigerator or other refrigeration system.

It is an object of the invention to overcome disadvantages of the prior art.

The above object is met by the combinations of features of the main claims, the sub-claims disclose further advantageous embodiments of the invention.

- 4 -

SUMMARY OF THE INVENTION

The present invention relates to a method and apparatus for preserving stored produce. More particularly, the present invention relates to a method for preserving produce during storage by exposing the produce to infrared light, red light or a combination thereof and to a produce container comprising a red light, infrared light or a combination thereof.

According to the present invention there is provided a produce container comprising one or more red lights, one or more near infrared lights or a combination thereof. Further, the produce container may be refrigerated or comprise a refrigeration system to maintain produce in the container at a temperature between about 0°C and 15°C, more preferably about 3°C and about 6°C.

The produce container of the present invention may be employed for produce such as, but not limited to fruits, vegetables, meats, milk, eggs, dairy products, dairy product beverages, fruit juices, beer, breads and a combination thereof. The produce container may also be employed to store flowers, and plants. In a preferred embodiment the produce container is employed for fruits and vegetables such as, but not limited to lettuce, onions, parsley, broccoli, cauliflower, spinach, green beans, yellow beans, carrots, bean sprouts, pears, brussel sprouts, tomatoes, cucumbers, mangos, bananas and a combination thereof. Other types of produce including produce that is stored at room temperature, or below room temperature, may be also stored in the produce container of the present invention.

Also according to the present invention, there is provided a produce container as defined above wherein the container comprises a near infrared light source that emits wavelengths over a range of about 790 nm to about 1100 nm, with a peak emission at about 950nm. The near infrared light may be generated from a source comprising gallium-arsenide or aluminum-gallium-arsenide. However, any suitable infrared emitting source may be employed.

The present invention further contemplates a produce container as defined above

- 5 -

wherein the red light source emits wavelengths over a range of about 600nm to about 700nm with a peak emission between about 630nm and 660nm. The red light may be generated from any suitable source, for example but not limited to a source comprising gallium-aluminum-arsenide.

Also contemplated by the produce container as defined above, the one or more red lights, one or more infrared lights, or both may be located on one or more panels. The panels may be located:

- a) attached to or part of one or more of the interior sides of the container;
 - b) attached to or part of the bottom interior surface of the container;
 - c) attached to or part of the top interior surface of the container;
 - d) hanging from within the container
 - e) attached to or part of the underside of a shelf within the container;
 - f) attached to the or part of the upper surface of a shelf of within the container,
- or;
- e) any combination of a) through f).

The produce container as defined above may also comprise a plurality of compartments, with each compartment comprising one or more panels. Also, each of the plurality of compartments may comprise an independent system for regulating temperature, humidity or both inside the compartment.

Also contemplated by the produce container of the present invention, preferably the near infrared light source, red light source or both, is capable of illuminating produce with light in the range of about 10 to about 1000 $\mu\text{mol m}^{-2} \text{s}^{-1}$, preferably about 200 to about 500 $\mu\text{mol m}^{-2} \text{s}^{-1}$.

The present invention also contemplates a method for prolonging the quality of produce comprising the steps of

- a) selecting produce;
- b) storing the produce in a produce container comprising one or more red light source, one or more near infrared light source, or a combination thereof; and;

- 6 -

c) subjecting the produce within the container to infrared light, red light or a combination thereof.

The infrared light and red light may be independently regulated in duration of illumination, duration of non-illumination, and intensity. Preferably infrared light is employed to illuminate produce for a total duration of between about 0.1 hours and 24 hours preferably about 2 hours and about 3 hours. Preferably the red light is employed to illuminate produce for a total duration of between about 0.1 hours and about 24 hours, more preferably about 24 hours.

The present invention also contemplates a method of prolonging the quality of produce as defined above, wherein the produce is stored in a sealable translucent bag or the like that is substantially transparent to red light, near infrared light or a combination thereof during storage in the produce container.

This summary of the invention does not necessarily describe all necessary features of the invention but that the invention may also reside in a sub-combination of the described features.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings wherein:

Figure 1A shows a spectral profile of a gallium arsenide LED that exhibits a peak emission at about 958nm. Also shown in Figure 1A is a spectral profile of an aluminum-gallium-arsenide LED with average peak wavelengths of about 916 nm. Figure 1B shows spectral profiles for two other infrared LEDs (aluminum-gallium arsenide LED-880 and LED 935).

Figure 2A shows the spectral profile of a gallium-aluminum-arsenide LED having a peak emission at about 660nm. Figure 2B shows the spectral profile comparing data of light $\mu\text{mol m}^{-2} \text{s}^{-1}$ versus wavelength for a 660nm LED.

Figure 3 shows a LED panel comprising a plurality of infrared lights and red lights.

Figure 4 shows a graphical comparison of brussel sprout quality versus storage time in a control produce container (●), a produce container comprising a red light (■) and a produce container comprising a near infrared light (▲).

Figure 5 shows a graphical comparison of mango quality versus storage time in a control produce container (●), a produce container comprising a red light (■) and a produce container comprising a near infrared light (▲).

Figure 6 shows a graphical comparison of iceberg lettuce quality versus storage time in a control produce container (●), a produce container comprising a red light (■) and a produce container comprising a near infrared light (▲).

Figure 7 shows a graphical comparison of tomato quality versus storage time in a control produce container (●), a produce container comprising a red light (■) and a produce container comprising a near infrared light (▲).

Figure 8 shows a graphical comparison of broccoli quality versus storage time in a control produce container (●), a produce container comprising a red light (■) and a produce container comprising a near infrared light (▲).

Figure 9 shows a graphical comparison of cucumber quality versus storage time in a control produce container (●), a produce container comprising a red light (■) and a produce container comprising a near infrared light (▲).

Figure 10A shows a graphical comparison of quality versus storage time for green beans in a control produce container (●) and a produce container comprising a near infrared light (▲). Figure 10B shows a graphical comparison of green bean quality versus storage time in a control produce container (●), a produce container comprising a red light (■) and a produce container comprising a near infrared light (▲).

Figure 11 shows a graphical comparison of spinach quality versus storage time in a control produce container (●) and a produce container comprising a near infrared light (▲).

Figure 12 shows a graphical comparison of cauliflower quality versus storage time in a control produce container (●) and a produce container comprising a near infrared light (▲).

Figure 13 shows a graphical comparison of carrot quality versus storage time in a control produce container (●) and a produce container comprising a near infrared light (▲).

Figure 14 shows a graphical comparison of pear quality versus storage time in a control produce container (●) and a produce container comprising a near infrared light (▲).

Figure 15 shows several non-limiting examples of the container of the present invention. Figure 15A shows a container with a lower compartment that includes a near infrared

- 9 -

source, a red source or both located at the top of the compartment. Figure 15B shows a container with a container a near infrared source, a red source or both located along one or both sides of the container. Figure 15C shows a container with a hinged lid, and comprising a near infrared source, a red source or both located at the lid of the container. This container is also shown to have a power source. Figure 15D shows a container with a near infrared source, a red source or both located along the base, sides and top of the container.

- 10 -

DESCRIPTION OF PREFERRED EMBODIMENT

The present invention relates to a method and apparatus for preserving stored produce. More particularly, the present invention relates to a method of preserving stored produce by exposing the produce to infrared light, red light or a combination thereof and to a produce container comprising a red light, infrared light or a combination thereof.

The following description is of a preferred embodiment by way of example only and without limitation to the combination of features necessary for carrying the invention into effect.

According to the present invention, there is provided a produce container comprising one or more infrared lights, one or more red lights or a combination thereof, the lights capable of illuminating produce within the container with red light, near infrared light or a combination thereof.

By the term "container" it is meant any receptacle that is capable of being used to store produce. The container may comprise an open container, for example, but not limited to any suitable container that does not comprise a top, lid or the like. In such an embodiment the produce stored in the produce container may be exposed to the environment outside the container. Alternatively, the container may be a closable container meaning that the stored produce is not exposed directly to the environment on the outside of the container during storage.

By the term "produce" it is meant any perishable product or foodstuff. Examples of food stuffs include, but not limited to, fruits, vegetables, grains, flour, meats, eggs, and dairy products such as milk, cream, cheese and the like. The term is meant to include perishable foodstuffs that may be maintained at room temperature as well as perishable foodstuffs for which refrigeration is generally advised to maintain freshness and quality. Representative examples of different types of produce include, but are not limited to fruits and vegetables such as lettuce, onions, parsley, broccoli, cauliflower, spinach, green beans, yellow beans, carrots, brussel sprouts, pears, cucumbers,

- 11 -

bananas, tomatoes, and mangos. Also encompassed by the term "produce" are juices of all types (including vegetable, mixed vegetable, orange, apple, cranberry, pineapple, and grape), beverages made from dairy products, for example, but not limited to milkshakes and the like, and beer. Additional representative examples of non-beverage produce include, but are not limited to breads, butter, cheeses, meats, sausages and the like. Examples of non-foodstuffs include, but are not limited to, flowers or cut flowers.

With reference to Figures 15A-D, the produce container (30) of the present invention may comprise a container with one or more than one wall, a base and a top of any shape or size that may be used to store or transport food stuffs or non-food stuffs. For example, which is not to be considered limiting in any manner, the container (30) may comprise a near infrared source, a red source, or both (40) located above or below a shelf or cover located within the container (70; Figure 15A), along the sides of container 30 (Figure 15B), along the lid (100) of a container (Figure 15C), or along one or more of the top, sides, and bottom of the container as required (Figure 15D). The near infrared source, red source or both may be attached to any surface of the container, or hung within the container, or placed on a shelf or cover on top of, or within the container. If any of the top or side surfaces or walls of the container are transparent, then the light source may be placed outside of the container and directed to emit light into the container.

A removable tray (40) may also be positioned within the produce container (30) or a compartment (50) within the container upon which produce may be positioned. If the near infrared source, red source or both are located above a shelf or cover (70), where the light from the source travels through the shelf or cover (70), then the shelf should be transparent or translucent. The produce container may also comprise a hinged lid or door (100; Figure 15C), and a power source (90) to power the near infrared source, red source or both, within the container. An example of a portable produce container is a portable container or cooler that may have a hinged lid, external handles (not shown), and where the power source may be supplied by battery, or directly connected to an external power supply.

- 12 -

The produce container as described herein may be refrigerated or comprise a refrigeration system to further prolong the quality of produce during storage. In an embodiment wherein the produce container of the present invention is refrigerated, preferably, the produce container is refrigerated to a temperature between about 0°C and about 15° C, preferably about 3°C to 6°C. Various refrigeration systems are known in the art and any of such systems is contemplated by the produce container of the present invention. Also contemplated by the present invention is a refrigerated produce container similar to a household refrigerator that comprises, a near infrared light source, red light source or combination thereof (40; Figures 15 A-D). Further the produce container may comprise a refrigerator that comprises more than one compartment (e.g. 50; Figure 15A) and wherein the temperatures of the compartments within the refrigerator are different.

The produce container comprises a near infrared light source, a red light source or a combination thereof. In an embodiment of the present invention wherein the produce container comprises a near infrared light source, preferably the near infrared source is capable of emitting infrared light over a wavelength range of about 790nm to about 1100 nm. Any near infrared light source may be employed in the present invention. For example, but not wishing to be limiting, the near infrared source may be produced from a gallium-arsenide source such as the infrared-935nm light emitting diodes (LED) available from Honeywell (#840-3445-004). These LEDs exhibit peak emission at about 958 nm with an average spectral bandwidth of about 50 nm at half maximum output as depicted by the spectral profile shown in Figure 1A. Alternately, the near infrared light source may be produced from an aluminum-gallium-arsenide (AlGaAs) source, for example, but not limited to an aluminum-gallium-arsenide LED available from Honeywell (#840-3470-001) with an average peak wavelength of about 916 nm and a spectral bandwidth at half maximum output of about 94nm. Figure 1B shows the spectral profile of other infrared lights that may be employed by the present invention. Thus, any suitable infrared light, as is known in the art, may be employed in the produce container of the present invention.

- 13 -

In an embodiment of the present invention wherein the produce container comprises a red light source, preferably the red source has a maximum emission peak in the range of about 600nm to about 700nm, with a peak emission in the range of between about 630 nm and about 660nm. Any red light source known in the art that is capable of emitting light with the characteristics as defined above may be employed in the present invention. For example, but not wishing to be limiting, the red source may be a LED based on gallium-aluminum-arsenide. Such LEDs exhibit peak emission at about 660nm with a spectral bandwidth of about 25nm at half power, as illustrated by the spectral profiles shown in Figure 2A and Figure 2B.

As an example, which is not to be considered limiting in any manner, the produce container may comprise one or more panels, for example, but not limited to LED panels capable of emitting red light, near infrared light or a combination thereof. A sample LED panel comprising both near infrared sources and red sources is shown in Figure 3. The panel shown in Figure 3 shows red lights (10) and near infrared lights (20) that are spatially arranged on the panel. However, the lights are not limited to being spatially arranged on the panel in a particular orientation or pattern, as would be understood by a person of skill in the art. For example, the sources may be positioned as rows, or individually as required. Furthermore, the source panel may comprise only near infrared or red sources, depending on the wavelength desired to treat the produce.

The near infrared source, red source or both of the produce container may emit light continuously or the emission of light may be discontinuous, in that the light is turned on and off for a specified duration of time. Further, for panels that comprise both red lights and near infrared lights, each type of light may be individually controlled and illuminated as required. For example, the total duration of infrared light emitted in a 24 hour cycle within the produce container may be between about 0.1 hrs and 24 hours, preferably about 0.5 hours to about 24 hours, more preferably between about 1 and about 3 hours. Similarly, the total duration of red light emitted in a 24 hour cycle within the produce container may be between about 0.1 hrs and 24 hours, preferably about 24 hours.

- 14 -

As an example, and not wishing to be limiting in any manner, a 2 hour light emission period over a 24 hours time period cycle may be divided up in any way as desired. For instance, the near infrared light, red light or both may be operational within the container as follows:

- a) continuously for a period of two hours;
 - b) for 2 x 1 hour periods each period separated by a time interval;
 - c) for 4 X 0.5 hour periods each separated by a time interval;
 - d) for 120 x 1 minute periods each separated by a time interval;
- or any other suitable period.

The intensity of the near infrared and red light sources may vary depending on the size of the compartment and the characteristics of the produce contained therein.

Preferably, the intensity is in the range of about 10 to 1000 $\mu\text{mol m}^{-2} \text{s}^{-1}$, preferably about 200 to about 500 $\mu\text{mol m}^{-2} \text{s}^{-1}$. As an example, which is not meant to be limiting, the produce container of the present invention employs red light in the amount of about 2 hours a day at an intensity of about 500 $\mu\text{mol m}^{-2} \text{s}^{-1}$ to treat produce located a distance of about 12 inches from the light. The temperature of the container is maintained at about 4°C to about 6°C.

The near infrared light source, red light source or both may be positioned in any suitable place within the produce container, for example, the walls, floor, ceiling or shelf of the interior of the container as shown in Figures 15A-D. Further, a panel or panels comprising the near infrared light, red light or both may be positioned in one or more places within the produce container. For example, but not to be limiting in any manner, a panel or panels comprising the infrared light, red light or both may be attached to or part of the bottom interior of the container, top interior of the container, side interior of the container or a combination thereof. Also contemplated, one or more panels may be attached to or form part of a shelf, for example, on top of a shelf or below a shelf in a refrigerator. Alternatively, one or more panels may hang within a produce container.

- 15 -

Other produce storage places, for example, but not limited to cupboards, shelves, drawers, cabinets, closets and the like may be considered produce containers according to the present invention, provided that they are equipped with one or more near infrared source, one or more red source, or a combination thereof, as described herein. Alternatively, the produce container of the present invention may comprise a transport container equipped with one or more red light sources, near infrared light sources or a combination thereof, for transport of produce such as, but not limited to grains, fruits and vegetables, dairy products, meat products or other types of produce. Representative examples of transport containers include, but are not limited to rail transport containers, shipping transport containers, truck containers, and air containers.

In still an alternate embodiment, a produce container according to the present invention may comprise a basket or the like that comprises one or more near infrared sources, red sources or a combination thereof, for example the source may be located at the bottom of the basket so that the emitted light passes through the produce placed above the source. Without wishing to be limiting, such an embodiment may be employed to hold or store produce at room temperature. For example, some consumers prefer to store fruits and vegetables such as tomatoes, bananas, mangos and other produce at room temperature. In such a situation, a consumer may store such produce at room temperature, for example, on a kitchen counter or other suitable place until the produce is ready to be eaten.

It is also contemplated that the produce container of the present invention may comprise multiple compartments and that each individual compartment of a multi-compartment produce container may have one or more lights or light panels as described above. Similarly, it is contemplated that individual compartments within a multi-compartment produce container may have different light sources, for example, either near infrared lights or red lights or a suitable combination of both. Further, individual compartments may differ in the number, type, output power, intensity or any combination of these characteristics. Thus the present invention contemplates produce containers, including, but not limited to refrigerated produce containers

- 16 -

comprising multiple compartments wherein the type of light source and illumination power of a first compartment is different from that within a separate compartment.

The container (30) or compartments (50) within a container may also be lined with a material that is reflective to infrared light, red light or both (see 80; Figure 15A), thereby permitting light that impinges onto a surface of the container to be reflected back into the container and potentially toward produce. Preferably the reflective material comprises a metallic or mirrored coating, or other polished surface capable of reflecting infrared light, red light or both. In addition, as would be known to a person of skill in the art, the reflective material may also comprise a polished plastic surface or the like, provided it is capable of reflecting at least some amount of infrared light, red light or combination thereof that impinges on it. Preferably, greater than about 20% of the light is reflected, more preferably greater than about 40% of the light is reflected, still more preferably greater than about 60% of the light is reflected from the reflective material.

Where one or more panels are employed in a produce container of the present invention, preferably shelves or cover (70; Figure 15B) within the produce container are made of a material substantially transparent to near infrared light, red light or both, for example, glass or plastic. The shelves may also comprise a plurality of bars with spaces in between or a solid, sheet-like material with perforations to allow light to pass through the spaces in the bars or perforations, respectively.

In a further embodiment of the present invention, there is provided a refrigerated produce container comprising a plurality of crisper drawers, each crisper drawer comprising one or more near infrared lights, or panels comprising one or more near infrared lights, one or more red lights or panels comprising red lights, or a combination thereof. As an example, which is not meant to be limiting in any manner, the refrigerated produce container comprises 4 separate crisper drawers wherein two of the drawers comprise a red source and two of the drawers comprise a near infrared source. In a further embodiment of the invention, which is not meant to be limiting, each crisper drawer may comprise separate humidity controls, temperature

- 17 -

controls or both. In such an embodiment, produce such as fruits and vegetables may be stored in crisper drawers equipped with separate humidity and temperature control settings. In an alternate embodiment, the produce container may be equipped with a mister. For example, but not wishing to be limiting, the produce container may comprise a grocery store produce container optionally comprising a mister to increase humidity in the vicinity of the produce.

Produce stored in the produce container or refrigerated produce container may be stored wrapped, covered, or uncovered, for example exposed to the air in the container. Preferably, produce is stored in a sealable bag or the like that is substantially transparent to near infrared light, near infrared light or both. In an embodiment, the sealable bag comprises polyethylene or polyvinylchloride plastic, preferably having a thickness up to about 5 mm, preferably 3mm, more preferably about 1mm. For example, but not to be considered limiting, produce may be stored in plastic bags, for example Ziploc® bags or the like, or covered or wrapped with plastic wrap.

The produce container of the present invention may employ a container similar to a household refrigerator, a grocery store refrigerator or the like. Also contemplated by the present invention are standard household refrigerators, grocery store refrigerators and the like that are retrofitted with one or more infrared light sources, red light sources or a combination thereof as described previously for the refrigerated produce containers of the present invention. In particular, panels comprising near infrared lights, red lights or a combination thereof may be employed and attached at one or more desired positions. Further, the sources may have one or more timers for illumination of produce for specific periods. Similarly, the light source(s) may have a power supply system that is separate from that of the refrigerator (e.g. 90; Figure15C).

In still an alternate embodiment of the present invention, the produce container may be employed to preserve the quality of plants and flowers, for example, but not limited to cut flowers.

- 18 -

Also contemplated by the present invention is a method of extending the quality of stored produce comprising the steps of:

- a) selecting produce to be stored;
- b) storing the produce in a produce container of the present invention, and;
- c) subjecting the produce to near infrared light, red light or a combination thereof.

The produce container in step b) may also comprise a refrigerated produce container or it may comprise a refrigeration system for maintaining produce at a temperature between about 0°C and about 15°C.

Preferably, the produce is stored for less than about 22 days, more preferably less than about 14 days, still more preferably less than about 7 days.

Referring now to Figures 4-14 there is shown results for various types of produce comparing visual quality scores over a storage period of up to twenty-two days using three different produce containers: 1) a refrigerated produce container similar to a standard refrigerator known in the art (the control) 2) a refrigerated produce container identical to the control but comprising a red light panel and 3) a refrigerated produce container identical to the control but containing an infrared light.

The setup of the produce containers and scoring of produce was performed as described in Example 1. The results of storing produce in the produce containers of the present invention compared to control produce containers are shown in Figures 4-14.

As shown in Figures 4-9 respectively, brussel sprouts, mangoes, Iceberg lettuce, tomatoes, broccoli, and cucumbers stored for up to twenty-two days in a produce container comprising either a red light or a near infrared light according to the present invention, exhibited higher quality scores than similar produce stored in the control produce container.

- 19 -

Referring now to Figure 10A, green beans stored in a produce container comprising a near infrared light source according to the present invention exhibited higher quality scores than green beans stored in a control produce container for a period of up to 18 days. Similarly, as shown in Figure 10B, green beans stored in a produce container comprising an infrared light source or a red light source exhibited higher quality scores than green beans stored in a control produce container for a period of up to 8 days.

As shown in Figure 11-14 respectively, spinach, cauliflower, carrots and pears stored for up to twenty-two days in a produce container comprising a near infrared light according to the present invention, exhibited higher quality scores than similar produce stored in the control produce container.

Collectively, the results demonstrate that the produce container of the present invention may be employed to extend the shelf life of produce, for example, but not limited to fruits and vegetables. Furthermore, the produce container may be employed to extend the shelf-life of produce for a period of from about 1 day to up to about 22 days. The produce container of the present invention may also be employed to extend the shelf life produce for up to 7 days. In alternate embodiments, the time period may be less.

The present invention may be especially advantageous for consumers that lack the time to shop for fresh produce on a daily or biweekly basis as the quality of produce in a produce container of the present invention is maintained longer in comparison to control produce containers such as, but not limited to standard refrigerators known in the art. In effect the present invention may permit the consumer to devote additional time to activities other than shopping for produce.

The above description is not intended to limit the claimed invention in any manner, furthermore, the discussed combination of features might not be absolutely necessary for the inventive solution.

The present invention will be further illustrated in the following examples. However it is to be understood that these examples are for illustrative purposes only, and should not be used to limit the scope of the present invention in any manner.

Examples

Example 1: Setup of produce containers and visual scoring of produce

Produce comprising lettuce, tomatoes, mangos, broccoli, cauliflower, spinach, green beans, carrots, cucumbers, pears and brussel sprouts is divided into three groups for storage in 1) a control produce container (ie. a standard refrigerator without any additional light other than the fridge light); 2) a produce container identical to the standard refrigerator but comprising a red light LED panel and 3) a produce container identical to the standard refrigerator but comprising an near infrared light LED panel. The light panels are placed on the middle shelf of the refrigerators shining downward and through the shelf, and onto topless crisper drawers containing produce in Ziploc® bags.

The produce containers are set to maintain approximately the same temperature. In this regard, the produce container comprising the infrared LED panel was adjusted to compensate for a slight warming effect of the panel during operation.

The produce container comprising the red light source panel is adapted for continuous emission of red light during produce storage. The produce container comprising the infrared light source panel is configured to emit infrared light for 2 X 2 hour sessions for a total illumination period of 4 hours and with 2 hours off in between.

The intensity of the near infrared (at about 935nm) or red light (at about 660nm) is at about $500 \mu\text{mol m}^{-2} \text{s}^{-1}$ to treat produce located a distance of about 12 inches from the light. The temperature of the container is maintained at about 4°C to about 6°C.

Visual Assessment of Produce

Fruits and vegetables are visually assessed on the second day and every other day thereafter for a period of up to 22 days according to the following scale:

Score 8-10: High quality. Produce exhibits no signs of deterioration and is suitable for consumption.

Score 6-7: Modest quality. Produce exhibits some signs of deterioration but is suitable for consumption.

Score 4-5: Low quality. Produce exhibits lack of freshness. Skins may be shriveled or brown spots may be apparent.

Score 1-3: Poor quality. Produce cannot be consumed. Rotted spots may be present. Bad smell may be present.

The higher the quality assessment score, the better the quality of the produce. At the time of each assessment, pictures were taken to visually verify the collected data

Example 2: Testing of produce containers: produce placed within plastic bags

All fresh produce was placed in a Ziploc® freezer bag at the beginning of the trial (day 0) and kept in bags for the duration of the trial with the exception of the time that they are removed for visual quality assessment scoring.

The results (Figure 4-14) demonstrate that red light increases the shelf life of the produce. For example, the shelf life of broccoli is increased by about 8 days, brussels sprouts by about 5 days, lettuce by about 5 days and mango by about 4 to 6 days.

Similarly, the results show that near infrared light increases the shelf life of produce. For example, the shelf life of carrots is increased by about 16 or more days, lettuce by

- 22 -

about 10 days, tomato by about 8 to about 10 days, broccoli by about 8 days, pears by about 7 or more days, mango by about 6 or more days, spinach by about 6 days and brussel sprouts by about 4 days.

Thus, the exposure of fresh produce to near infrared light has a positive effect upon visual quality assessment scores of stored fruits and vegetables such as, but not limited to carrots, lettuce, tomatoes, mangos, spinach, green beans, pears and brussel sprouts. Similarly, the exposure of fresh produce to infrared light has a positive effect upon visual quality assessment scores of stored fruits and vegetables such as, but not limited to broccoli, brussel sprouts, lettuce, mango, cucumber and tomato.

Example 3: Testing of produce containers: free produce

The procedure set forth in Example 1 was performed with the exception that produce was not retained in freezer bags during storage. As a result of this treatment, red light increases the shelf life of brussel sprouts by about seven or more days, green beans by about 2-3 days and pears by about 2-3 days. Similarly, the results suggest that near infrared light increases the shelf life of pears by about seven or more days, green beans by about 5 days and brussel sprouts by about 6 days.

Example 4: Testing of produce containers:

The procedure set forth in Example 1 was performed with the following modifications:

Crispers in all the fridges were covered by glass shelves. Produce was stored within the crisper. The near infrared and red sources were placed on top of the glass shelf so that the emitted light is directed through the glass to the produce within the crisper. No freezer bags were used to hold produce.

The duration of the infrared light was reduced from 4 hours per day (2x2hours) to 2 hours per day (1 hour between 8am and 9am and 1 hour between 5pm and 6 pm).

- 23 -

The results indicate that red light increases the shelf life of mango by about 5 or more days, brussel sprouts by about 5 days, green beans by about 4 days, lettuce by about 3 days and pears by about 3 days. Similarly, the results demonstrate that near infrared light increases the shelf life of tomatoes by about 5 or more days, pears by about 4 days, green beans by about 5 days and brussel sprouts by about 4 days, mangos by about 4 days and lettuce by about 4 days.

EXAMPLE 5: Effect of red light and infrared light on flowers

Experimental Protocol:

The effect of red light and near infrared light on the storage of flowers was studied. As controls, flowers were employed under identical conditions except that the flowers were not illuminated by any light source. Six cultivars of roses were used in the trials. The cultivars were “Escimo” (White colour), “Eternity” and “Anna” (Pink colour), “Aalsmer Gold”, “Premium Yellow” (Yellow colour), and “First Red”(Red colour). The flowers were grown in Ecuador, cut and shipped to Canada about 4-5 days before the trial began. Six flowers of each colour were used in each treatment. The light sources employed were a LED panel of red light and a LED panel of infrared light. Red light and infrared light panels are placed alone or in combination within a FRIGIDAIRE™ fridge. The control fridge has no light other than fridge light which is off during the trial. The fridges were set to produce a temperature of about 4°C to about 5°C. This range of temperatures is routinely used to store cut flowers, such as, but not limited to roses.

The cut flowers were placed in vases containing 1000mL of water, and subsequently placed in the appropriate fridge. This day is termed day “0”. Quality assessment and scoring was performed on day 0 and every second day thereafter for the duration of the trial.

Quality assessment and scoring of flowers was performed by visual assessment using the following scale:

- 24 -

1-3 (Poor Quality)- cut flowers have significant signs of deterioration and have little or no commercial value;

4-5 (Low Quality) – flowers have low commercial value and exhibit signs of lack of freshness. Some petals may be lost and/or wilted, but may still retain some commercial value;

6-7 (Modest Quality) – flowers exhibit some signs of deterioration. Some petals may be slightly damaged;

8-10 (High Quality)- fresh flower with no signs of deterioration; high commercial value.

Flowers exposed to red light were exposed continuously for 24 hours per day throughout the duration of the trial (except during scoring). 3 groups of flowers were exposed to infrared light. The first was exposed twice daily (1 hour + 1 hour) for a total period of two hours, the second was exposed one hour per a day (0.5 + 0.5 hour) and the third was exposed four times daily (for 1 hour every time) for a total period of 4 hours. The distance from the light source (red light and near infrared light emitting panels) and the tips of flowers was about 10 to about 15 cm. The total duration of each trial was determined by the senescence or death of 90-100% of the flowers, and was usually in the range of about 30 to about 40 days.

The data obtained was analysed and the means, standard deviation, standard errors and Student's t-test were calculated. Probability of the differences between control and treatments were assessed.

Results

The data obtained in the four different trials shows that both red light, infrared light or a combination thereof may be employed to extend the quality of flowers, for example, but not limited to cut flowers such as roses. The following tables summarize the data obtained in the trials at day 10 and day 24 of the trial.

Percent difference at day 10 for flowers treated with red light versus control¹:

- 25 -

White Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 0.5hrs	+ 10%
2 x 1hr	+ 12%
4 x 1hr	+ 13%

¹a positive difference indicates that flowers treated with red light exhibited higher quality assessment scores as compared to the control group on day 10 of the trial.

Pink Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 0.5 hrs	+ 5%
2 x 1hr	+ 7%
4 x 1hr	+ 4%

Yellow Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 0.5 hrs	+ 16%
2 x 1hr	+ 4%
4 x 1hr	+ 6%

Red Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 0.5 hrs	+ 3%
2 x 1hr	+ 33%

Percent difference at day 10 for flowers treated with near infrared light versus control²:

White Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 1hr	+ 16%
4 x 1hr	+ 19%

- 26 -

²a positive difference indicates that flowers treated with near infrared light exhibited higher quality assessment scores as compared to the control group on day 10 of the trial.

Pink Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 0.5 hrs	+ 12%
2 x 1hr	+ 16%
4 x 1hr	+ 22%

Yellow Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 0.5 hrs	+ 16%
2 x 1hr	+ 8%
4 x 1hr	+ 12%

Red Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 0.5 hrs	+ 6%
2 x 1 hr	+ 33%
4 x 1hr	+ 10%

DAY 24

Percent difference at day 24 for flowers treated with red light versus control³:

White Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 0.5hrs	+ 20%
2 x 1hr	+ 20%
4 x 1hr	+ 22%

³a positive difference indicates that flowers treated with red light exhibited higher quality assessment scores as compared to the control group on day 24 of the trial.

- 27 -

Pink Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 1hr	+ 55%
4 x 1hr	+ 38%

Yellow Roses

<u>Light frequency and duration</u>	<u>% difference</u>
4 x 1hr	+ 20%

Red Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 0.5 hrs	+ 6%
2 x 1hr	+ 40%
4 x 1hr	+ 20%

Percent difference at day 24 for flowers treated with near infrared light versus control⁴:

White Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 1hr	+ 31%
4 x 1hr	+ 38%

⁴a positive difference indicates that flowers treated with near infrared light exhibited higher quality assessment scores as compared to the control group on day 24 of the trial.

Pink Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 0.5 hrs	+ 12%
2 x 1hr	+ 22%

Yellow Roses

<u>Light frequency and duration</u>	<u>% difference</u>
-------------------------------------	---------------------

- 28 -

4 x 1hr	+ 14%
2 x 1hr	+ 7

Red Roses

<u>Light frequency and duration</u>	<u>% difference</u>
2 x 1 hr	+ 25%
4 x 1hr	+ 14%

Water Usage of flowers treated with red light, near infrared light, or both

Water usage by flowers treated with near infrared light, red light or both was examined. The results indicate that flowers treated with red light, infrared light or both exhibited increased water uptake by about 3 to about 5 ml per week, per flower over the duration of the trial as compared to control flowers. The correlation coefficient between the visual quality scores and water usage for white, red and yellow roses varied from +0.7 to +0.9 indicating a high correlation between the two parameters. Without wishing to be bound by theory, red light, near infrared light or both may increase the rate of respiration and/or photosynthesis in the flowers thereby causing the flower to consume more water.

The average percentage difference in quality assessment scores for all cultivars and all trials was determined to be about +15% for flowers treated with red light and about +12% for flowers treated with near infrared light. These results suggest that red light, near infrared light, or a combination thereof enhances the preservation of flowers, such as, but not limited to cut roses, thereby prolonging product life. The results also suggest that a variety of treatment times with infrared light, near infrared light or a combination thereof may be employed to preserve the quality of flowers, such as cut flowers during cold storage.

Therefore, the present invention further contemplates treating flowers, such as, but not limited to roses with near infrared light, red light or a combination thereof. Any flower may be treated with red light, near infrared light or a combination thereof. In an

- 29 -

embodiment the flowers may comprise, but are not limited to “Eschimo” roses, “Eternity” roses, “Anna” roses, “Aalsmer” roses, premium yellow roses or any combination thereof. The roses may be planted or cut. In addition the present invention may be employed with plants, such as, but not limited to potted plants and trees.

It is also contemplated that the flowers, plants or both be treated with red light, near infrared light or a combination thereof at a particular temperature, for example, but not limited to in the range of about 0°C to about 30°C, preferably about 3°C to about 10°C, more preferably about 4°C to about 5°C. In alternate embodiments, it may be desirable to treat a plant or flower with red light, near infrared light or a combination thereof at about room temperature, for example, in the range of about 17°C to about 30°C. Temperatures within the upper part of the range may be particularly advantageous for treating tropical plants and flowers. Further, in addition to treating the flower or plant with red light, near infrared light or a combination thereof, the flower or plant may also be subject to other conditions, for example, but not limited to particular humidity ranges, photoperiods, gas conditions (content of air, nitrogen, oxygen, carbon dioxide), and the like.

All citations are herein incorporated by reference.

The present invention has been described with regard to preferred embodiments. However, it will be obvious to persons skilled in the art that a number of variations and modifications can be made without departing from the scope of the invention as described herein.

- 30 -

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OF PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

- 1) A produce container comprising one or more than one red light source, one or more than one near infrared light source, or a combination thereof.
- 2) The produce container of claim 1, wherein said produce container is refrigerated or comprises a refrigeration system capable of maintaining the interior of the container at a temperature between about 0°C and 15°C.
- 3) The produce container of claim 2, wherein said produce container is maintained at a temperature between about 3°C and about 6°C.
- 4) The produce container of claim 1, wherein said produce is selected from the group consisting of a fruit, a vegetable, meat, milk, cream, an egg, a dairy product, a dairy product beverage, a fruit juice, beer, a bread, butter, cheese, flowers, cut flowers, plants, and a combination thereof.
- 5) The produce container of claim 4, wherein said fruit and said vegetable are selected from the group consisting of lettuce, onion, parsley, broccoli, cauliflower, spinach, green bean, yellow bean, carrots, bean sprout, brussel sprout, tomatos, cucumber, mango, pear, and a combination thereof.
- 6) The produce container of claim 1, wherein said one or more than one near infrared light source emits over a wavelength of about 790 nm to about 1100 nm, with a peak emission at about 950nm.
- 7) The produce container of claim 1, wherein said one or more than one near infrared light source is generated from a source comprising gallium-arsenide or aluminum-gallium-arsenide.
- 8) The produce container of claim 1, wherein said one or more than one red light

source emits over a wavelength of about 600nm to about 700nm with a peak emission in the range of between about 630nm to about 660nm.

9) The produce container of claim 1, wherein said one or more than one red light source is produced from a source comprising gallium-aluminum-arsenide.

10) The produce container of claim 1, wherein said one or more than one red light source, one or more than one near infrared light source are located on one or more than one panel.

11) The produce container of claim 10, wherein said one or more than one panel is:

- a) attached to, or part of, one or more than one interior sides of the container;
- b) attached to, or part of, the bottom interior surface of the container;
- c) attached to, or part of, the top interior surface of the container;
- d) hanging from within the container
- e) attached to, or part of, the underside of a shelf within the container;
- f) attached to, the or part of, the upper surface of a shelf of within the container, or;
- g) any combination of a) through f).

12) The produce container of claim 11, said container comprising a plurality of compartments, each compartment comprising said one or more than one panel.

13) The container of claim 12, wherein each of said plurality of compartments comprise independent systems for regulating temperature, humidity or both.

14) The container of claim 1 wherein said near infrared light source, red light source, or both, is capable of illuminating produce with light in the range of about 10 to about 1000 $\mu\text{mol m}^{-2} \text{s}^{-1}$.

15) The container of claim 1 wherein said near infrared light source, red light source, or both, is capable of illuminating produce with light in the range of about 200 to

- 32 -

about $500 \mu\text{mol m}^{-2} \text{s}^{-1}$.

- 16) A method for prolonging the quality of produce comprising the steps of
- a) selecting produce;
 - b) storing said produce in a produce container comprising one or more red lights, one or more near infrared lights or a combination thereof, and;
 - c) subjecting said produce within said container to near infrared light, red light or a combination thereof.
- 17) The method of claim 16 wherein both near infrared light and red light is used.
- 18) The method of claim 17 wherein said near infrared light and red light are independently regulated in duration of illumination, duration of non-illumination, and intensity.
- 19) The method of claim 17 wherein said near infrared light is employed for a total duration of between about 0.1 hours and 24 hours.
- 20) The method of claim 19 wherein said near infrared light is employed for a total duration of between about 2 hours and about 4 hours.
- 21) The method of claim 20 wherein said red light is employed for a total duration of between about 0.1 hours and about 24 hours
- 22) The method of claim 16 wherein said produce is stored in a sealable translucent bag or the like that is substantially transparent to red light, near infrared light or a combination thereof.
- 23) The method of claim 16, wherein said produce container is refrigerated or comprises a refrigeration system.
- 24) A produce container comprising one or more than one red light, one or more than

- 33 -

one near infrared light or a combination thereof, wherein said container comprises a compartment selected from the group consisting of a drawer, a cupboard, a cabinet, a closet, a pantry, a refrigerator, a basket, a covered, and an uncovered box or tin.

25) A produce container comprising one or more than one red light, one or more than one near infrared light or a combination thereof, wherein said container is selected from the group consisting of a refrigerator, a portable cooler, a grocery store refrigerator, a grocery store fruit and vegetable display and a produce transport container.

26) The method of claim 16, wherein said produce is a flower

27) The method of claim 26, wherein said flower is a cut flower.

28) The method of claim 26, wherein said flower is a rose.

29) The method of claim 28 wherein said rose is selected from the group consisting of Eschimo roses, Eternity roses, Anna roses, Aalsmer roses, Premium Yellow roses and First Red Roses.

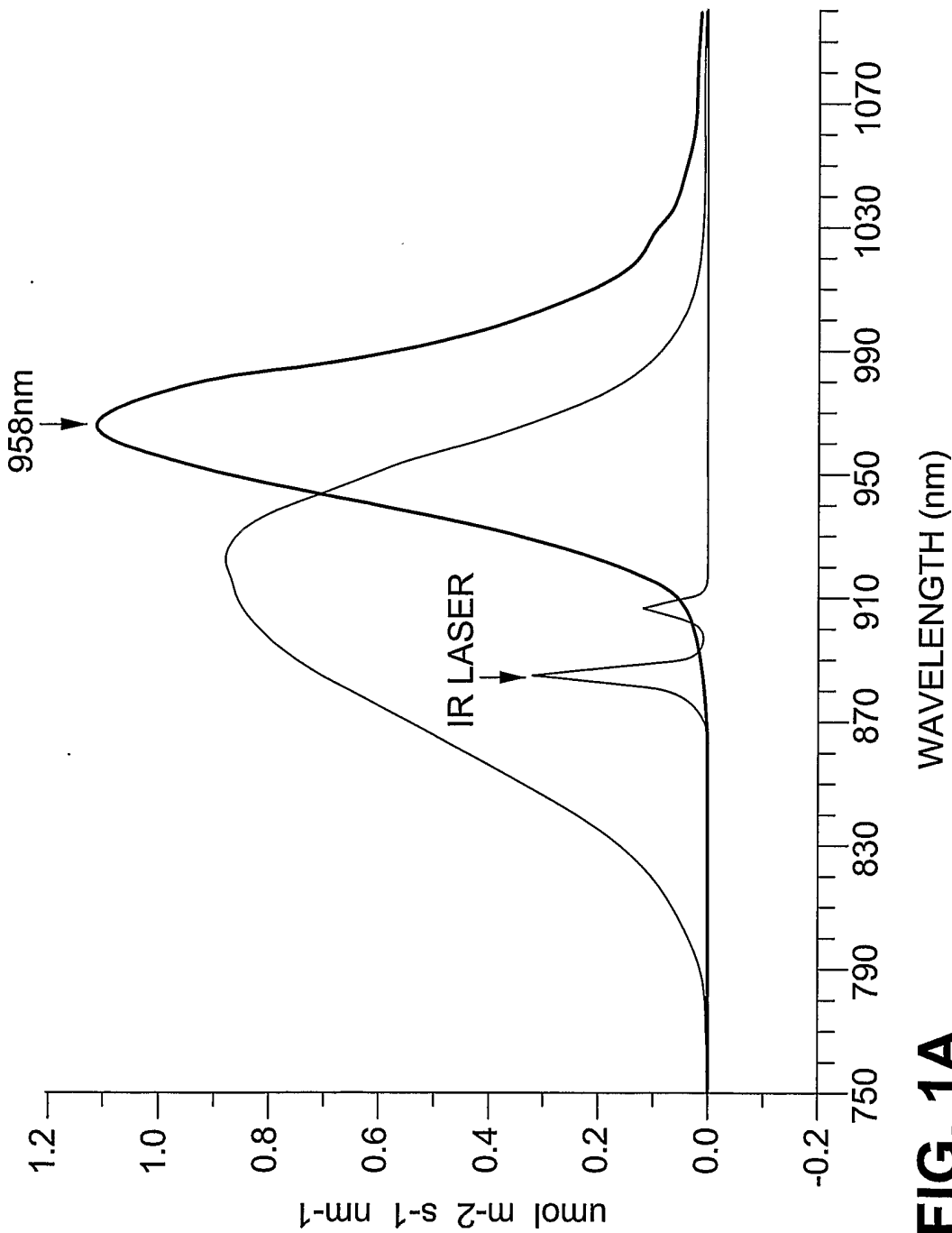


FIG. 1A

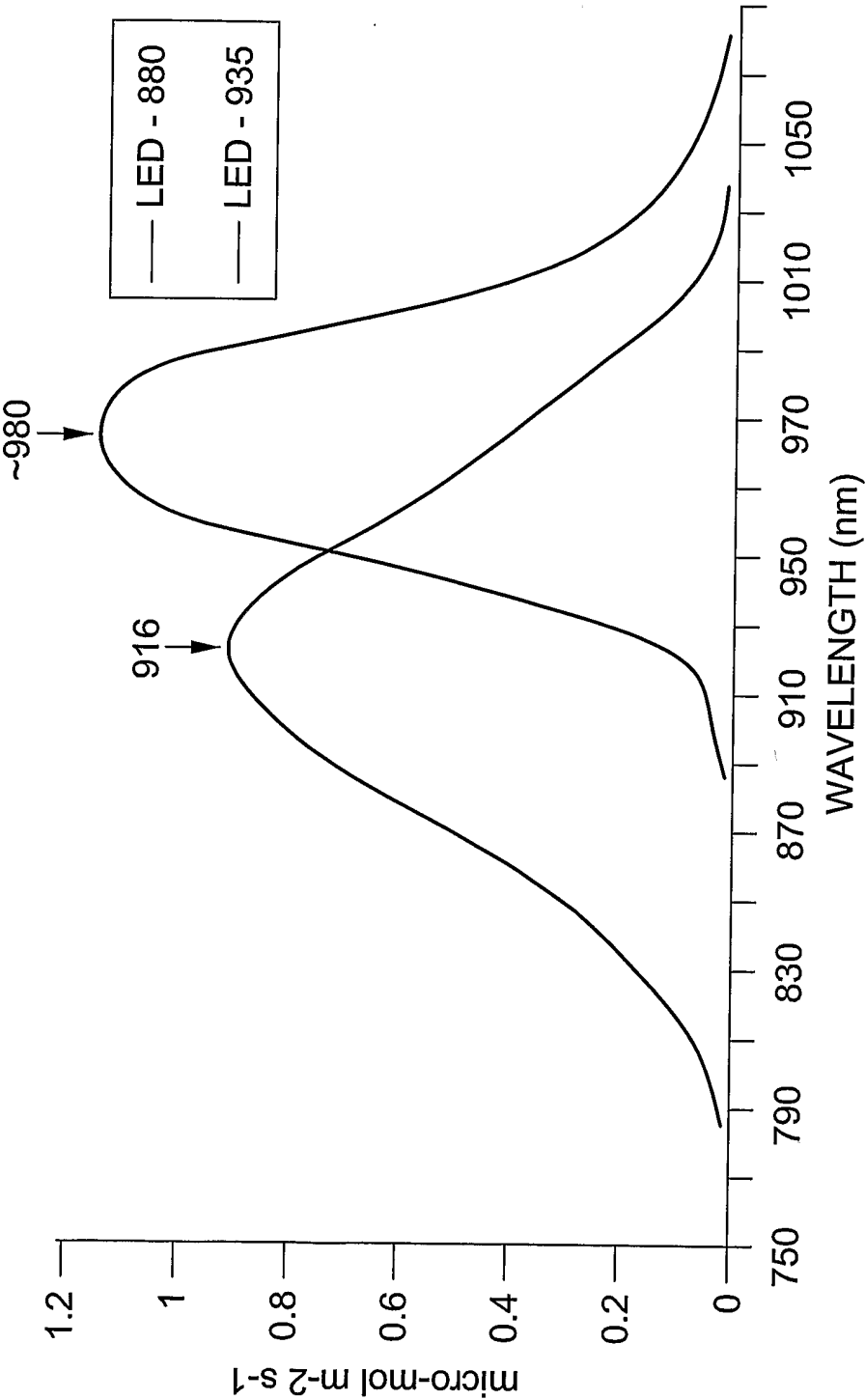


FIG. 1B

3/18

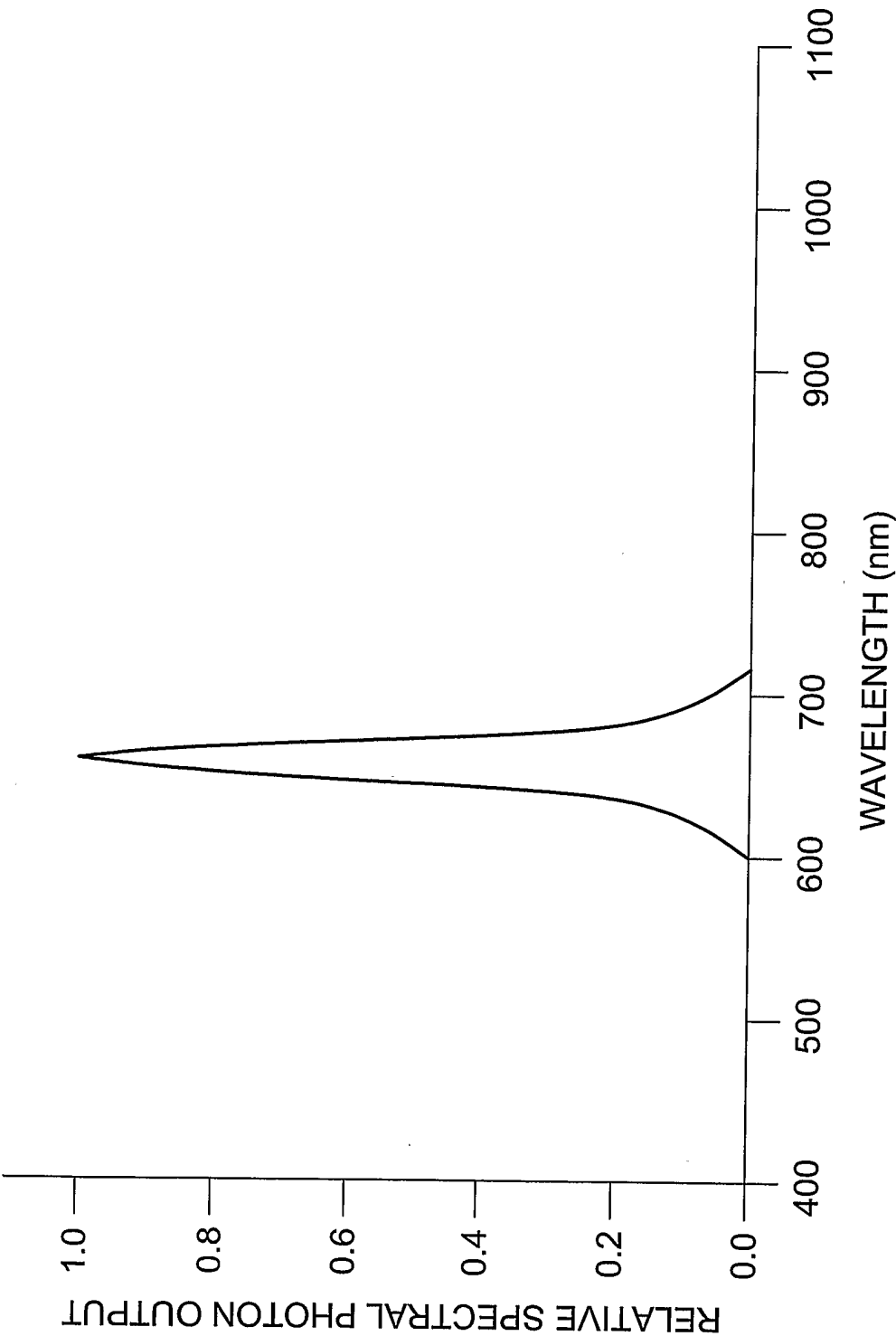


FIG. 2A

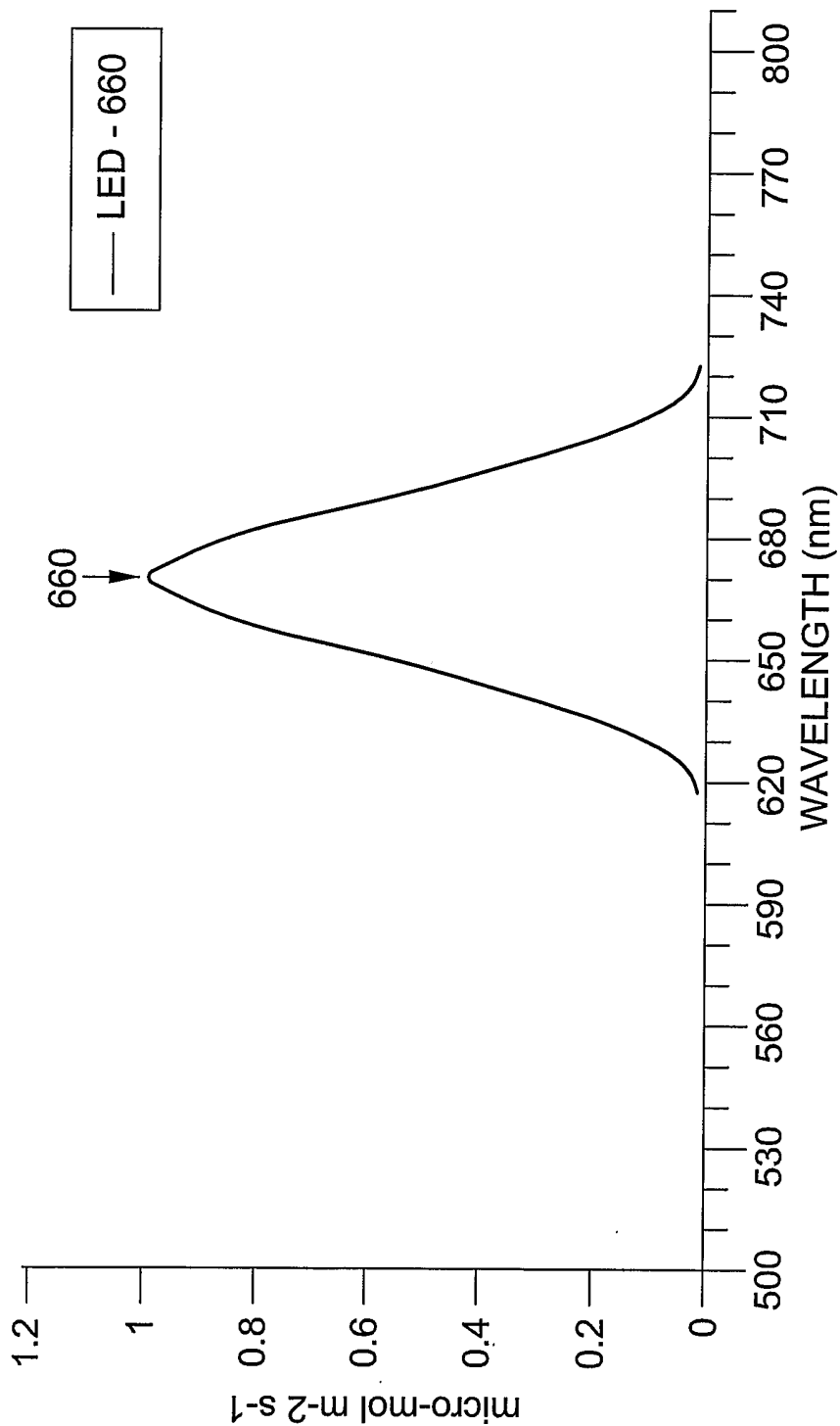
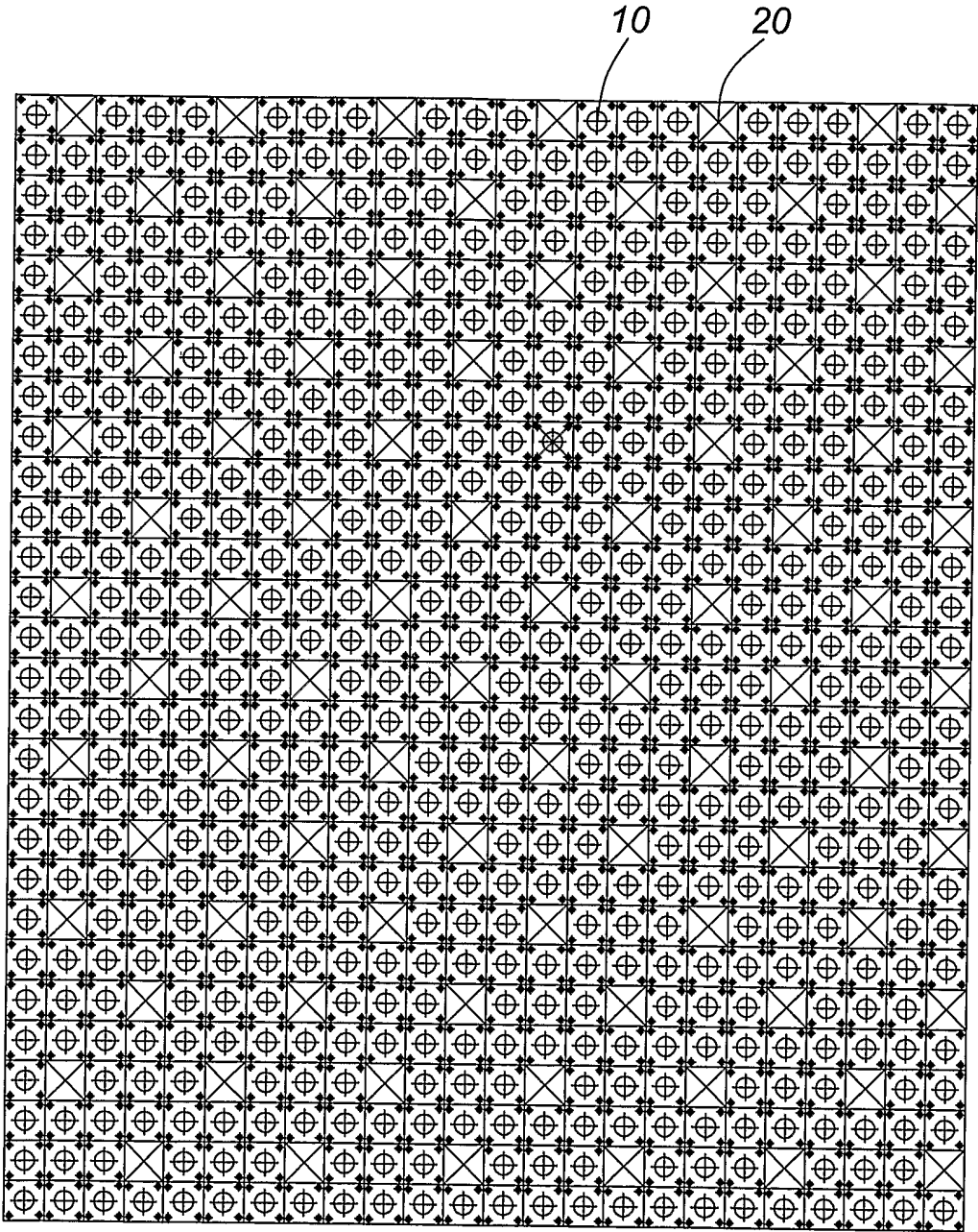


FIG. 2B

5/18



LED PANEL

FIG. 3

6/18

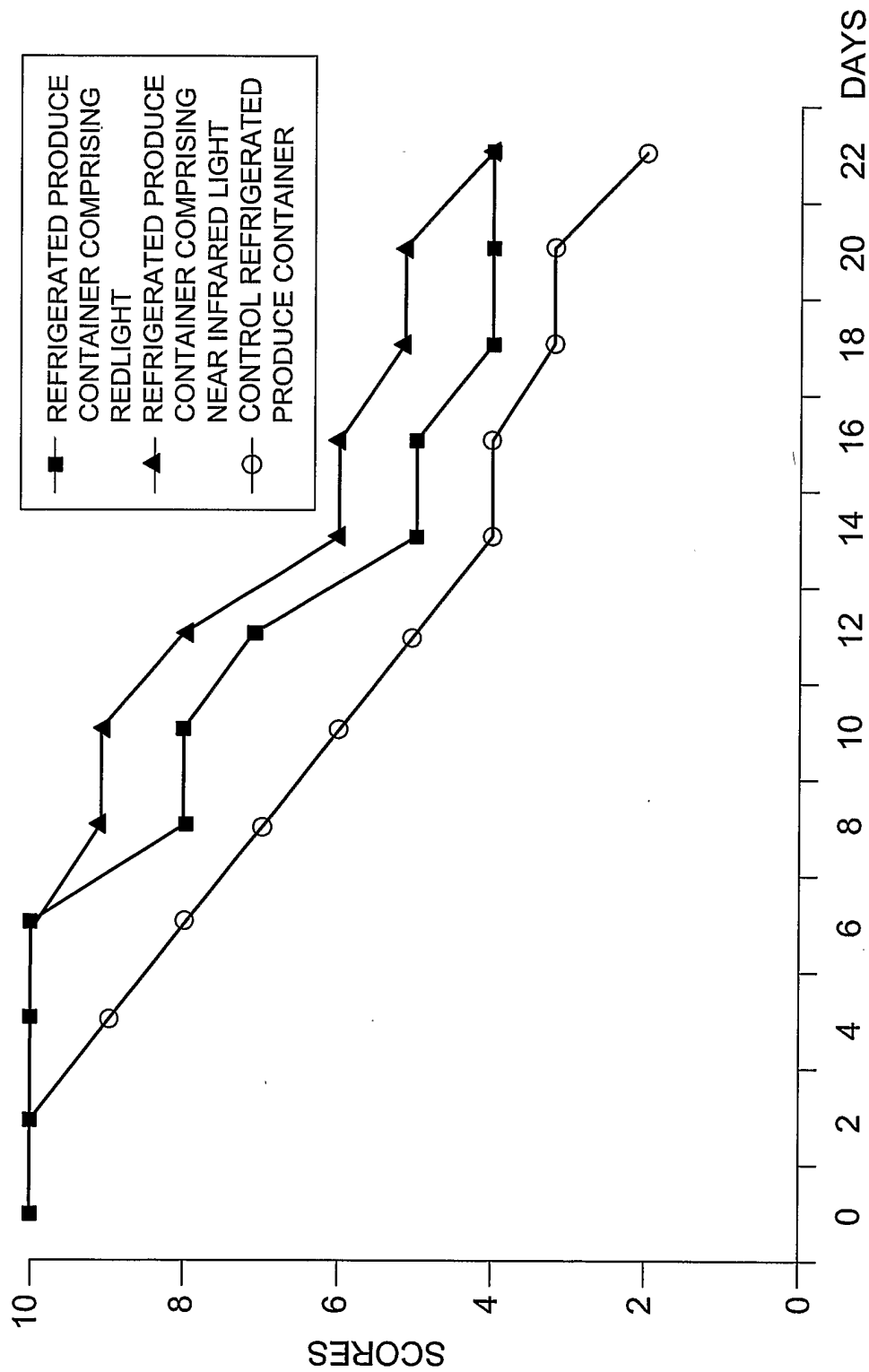


FIG. 4 COMPARISON OF THE SHELF LIFE OF BRUSSEL SPROUTS STORED IN VARIOUS REFRIGERATED PRODUCE CONTAINERS

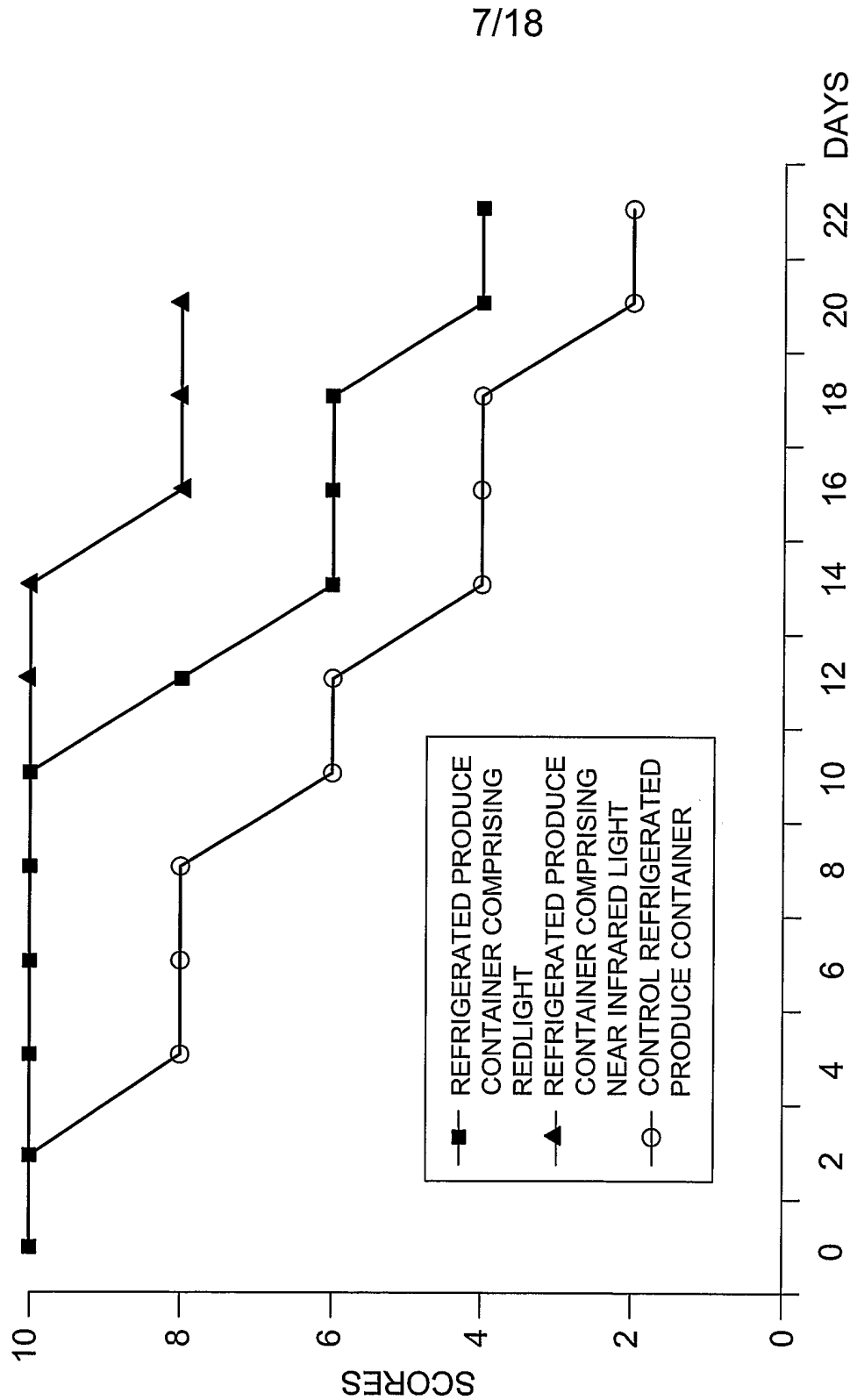
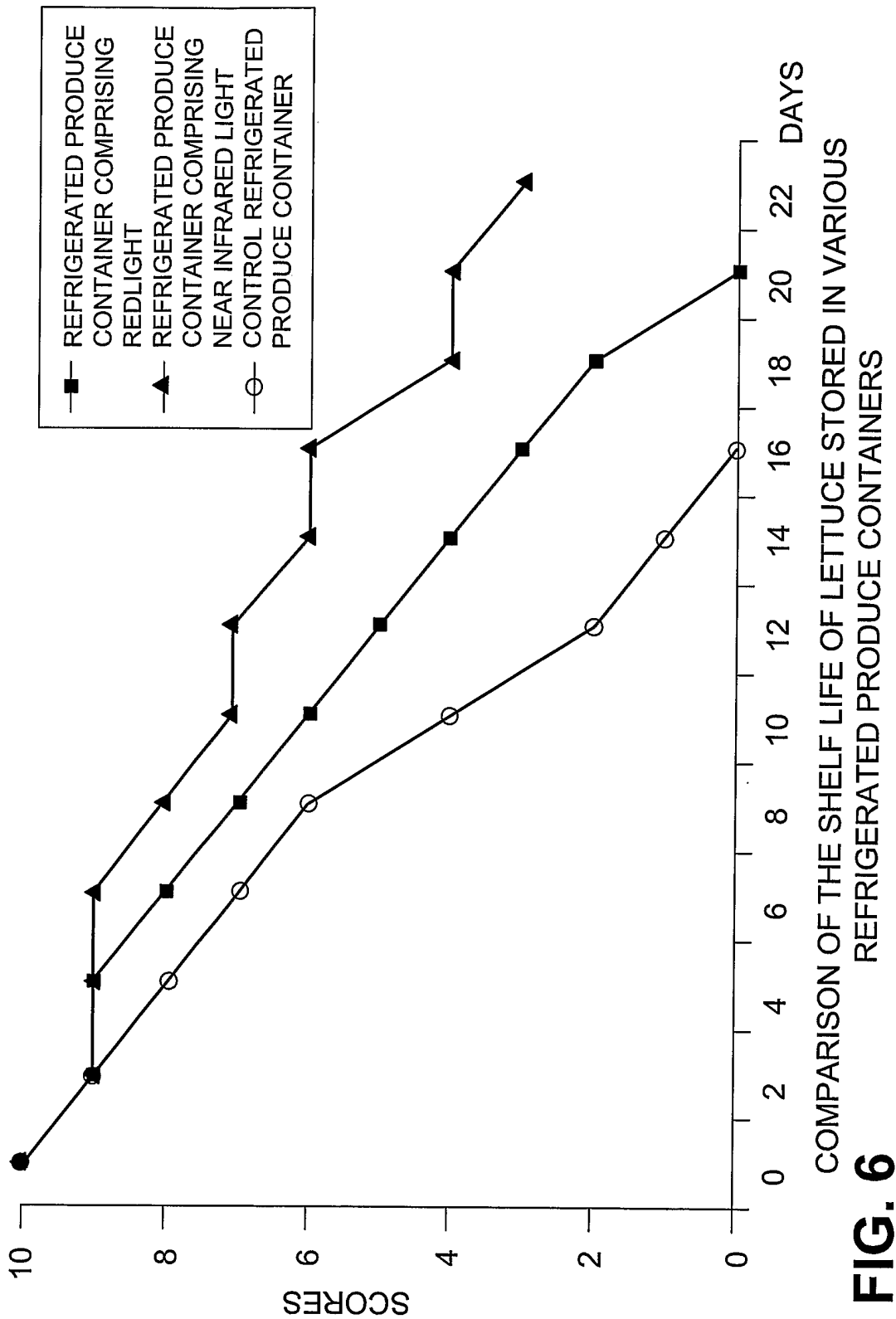


FIG. 5 COMPARISON OF THE SHELF LIFE OF MANGOS STORED IN VARIOUS REFRIGERATED PRODUCE CONTAINERS

8/18



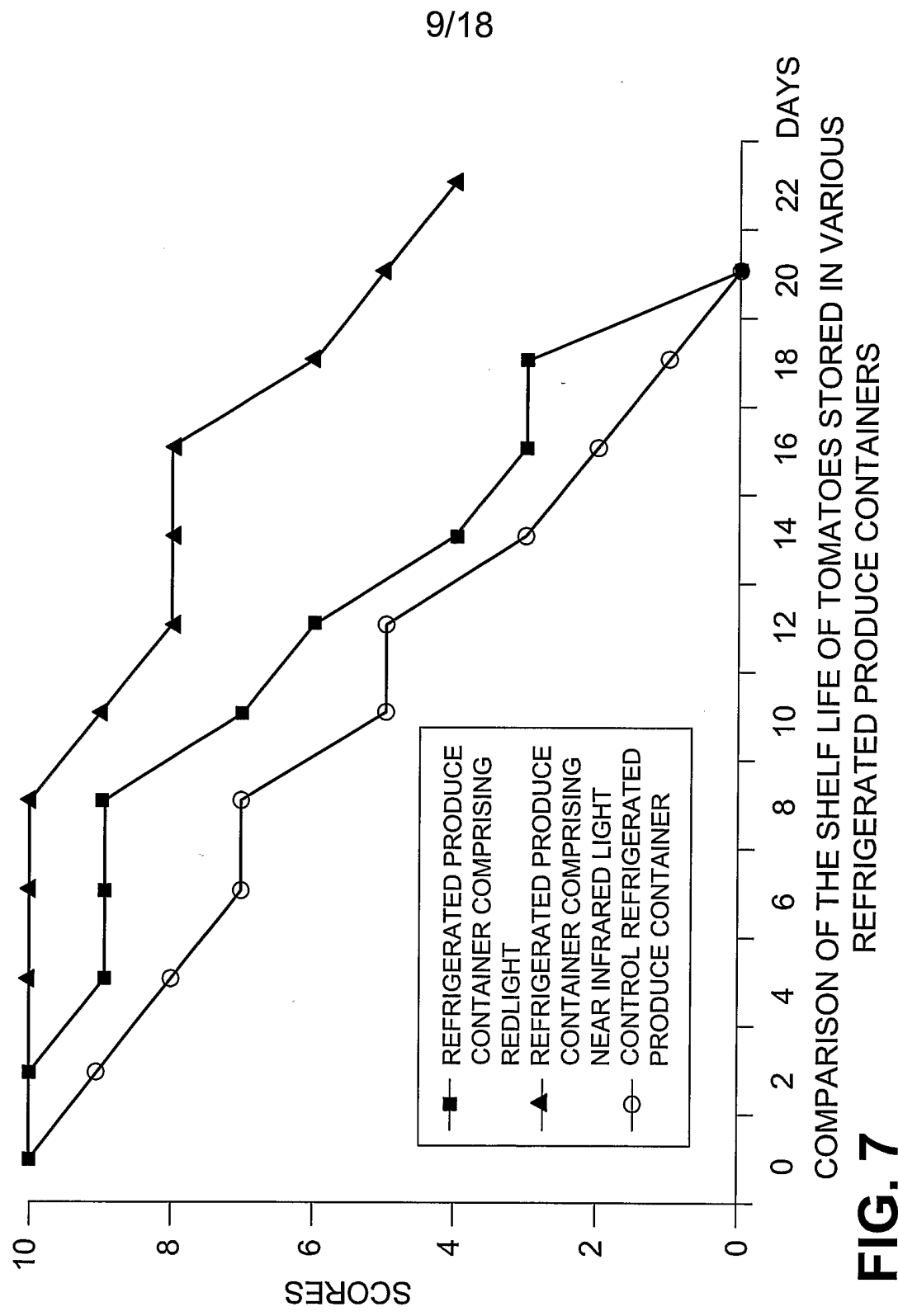


FIG. 7

10/18

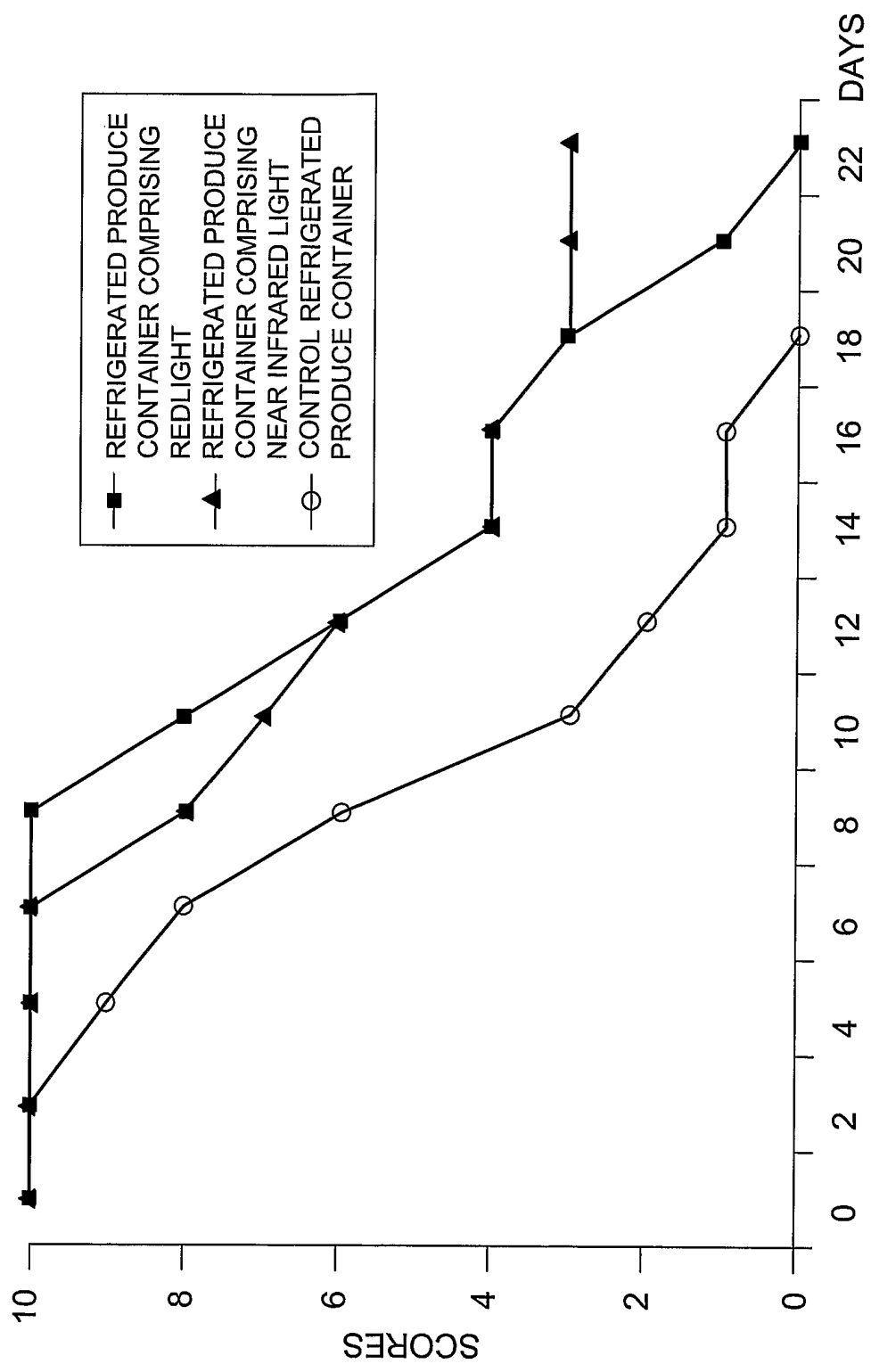
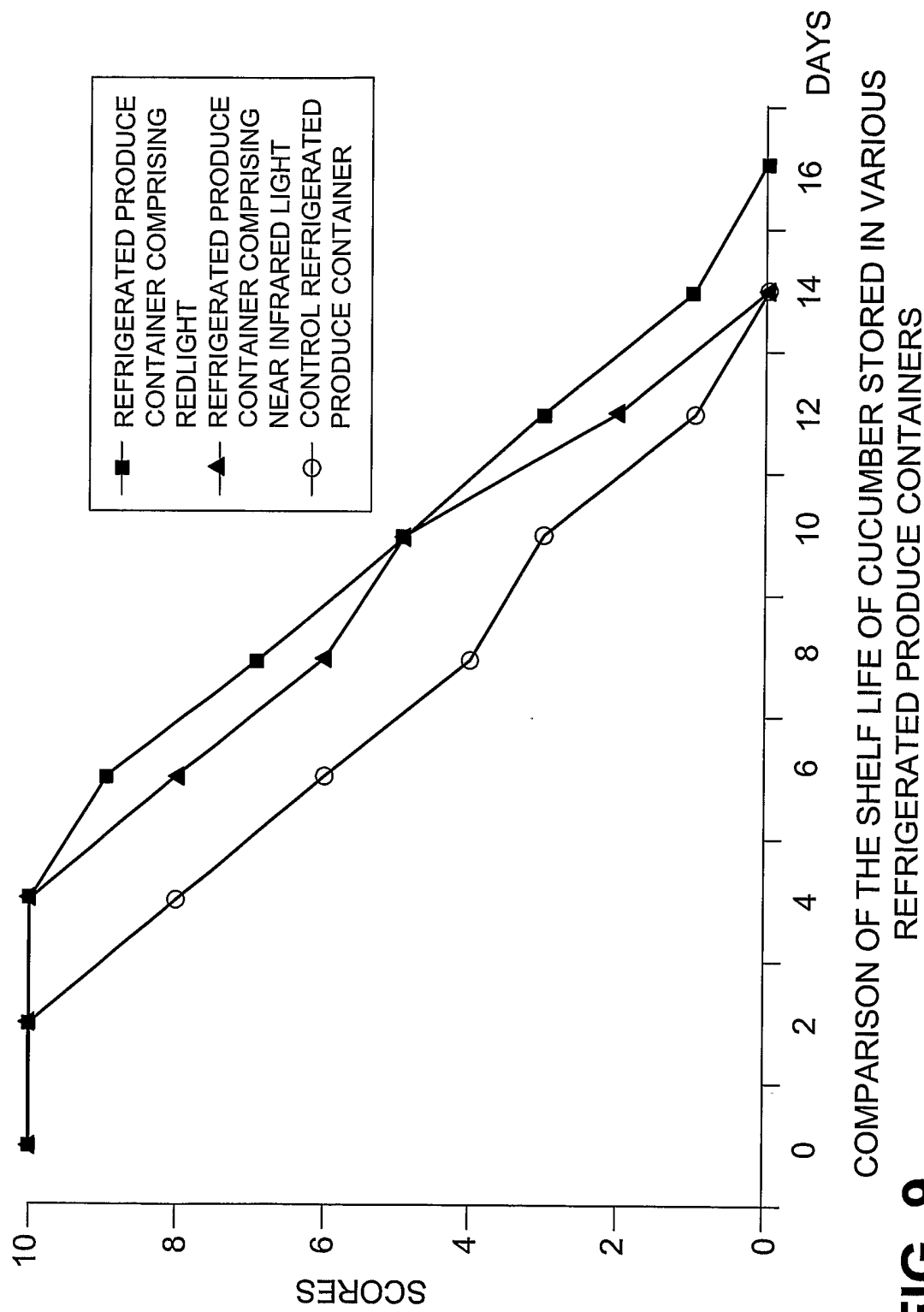


FIG. 8
COMPARISON OF THE SHELF LIFE OF BROCCOLI STORED IN VARIOUS REFRIGERATED PRODUCE CONTAINERS

11/18



12/18

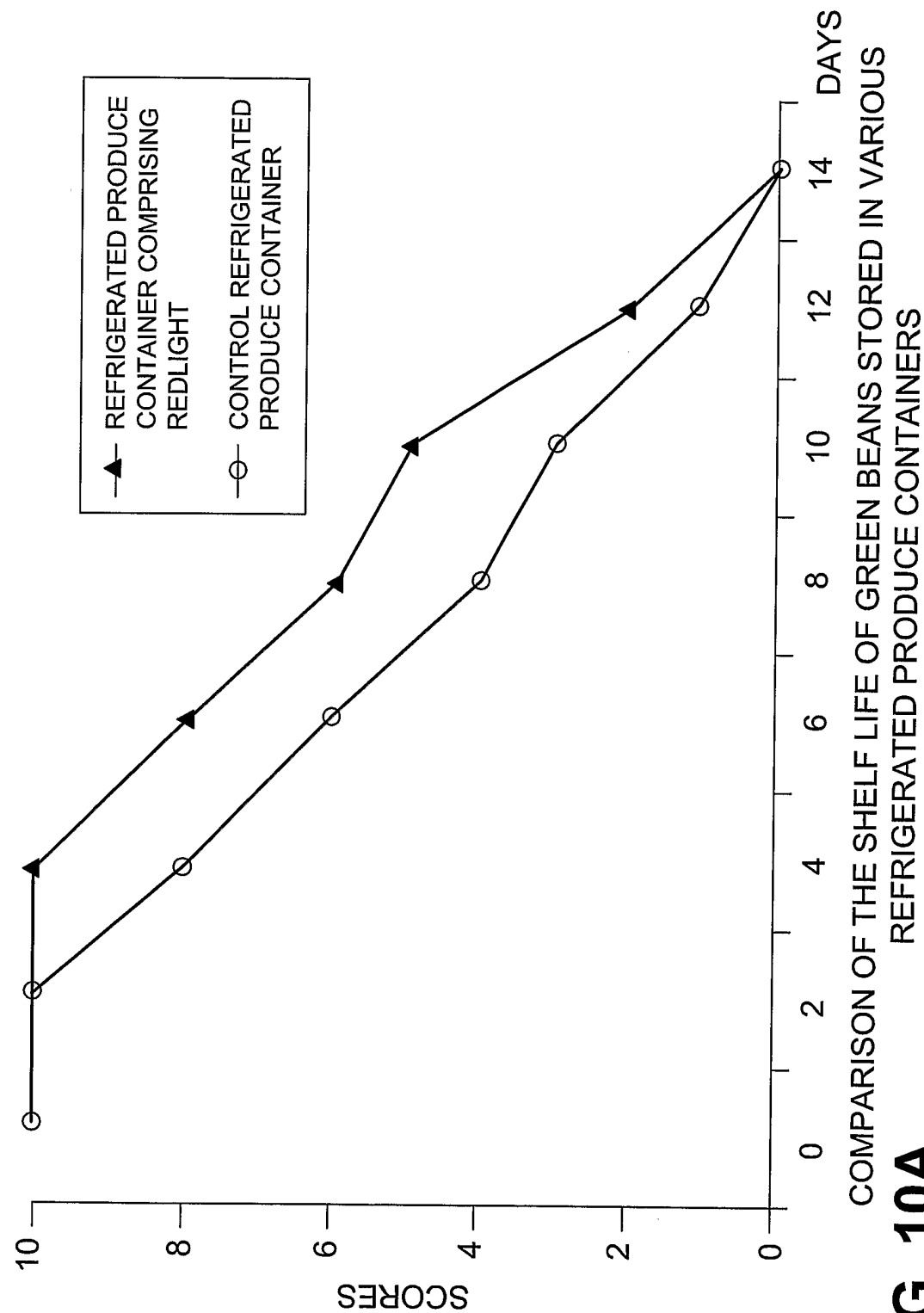
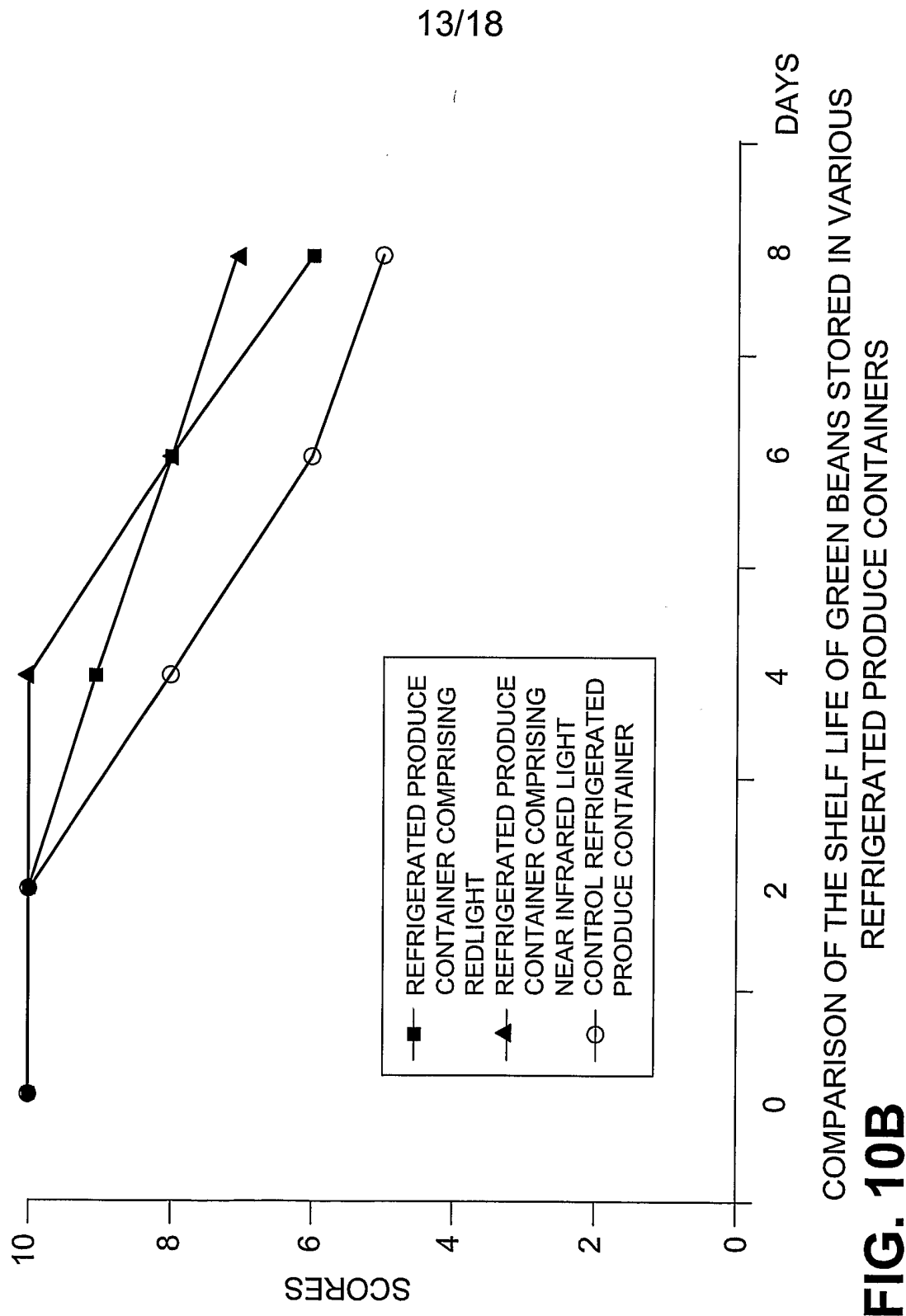
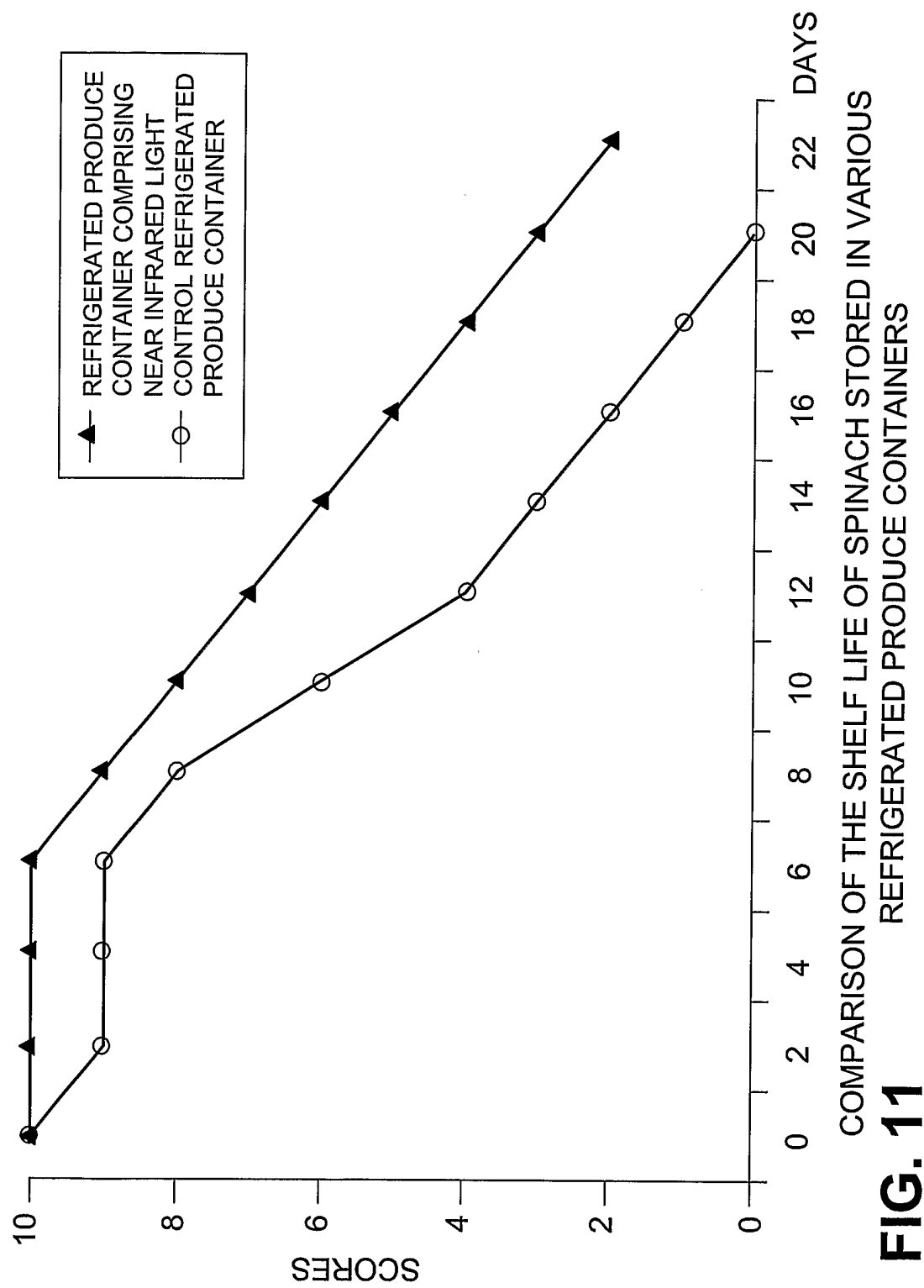
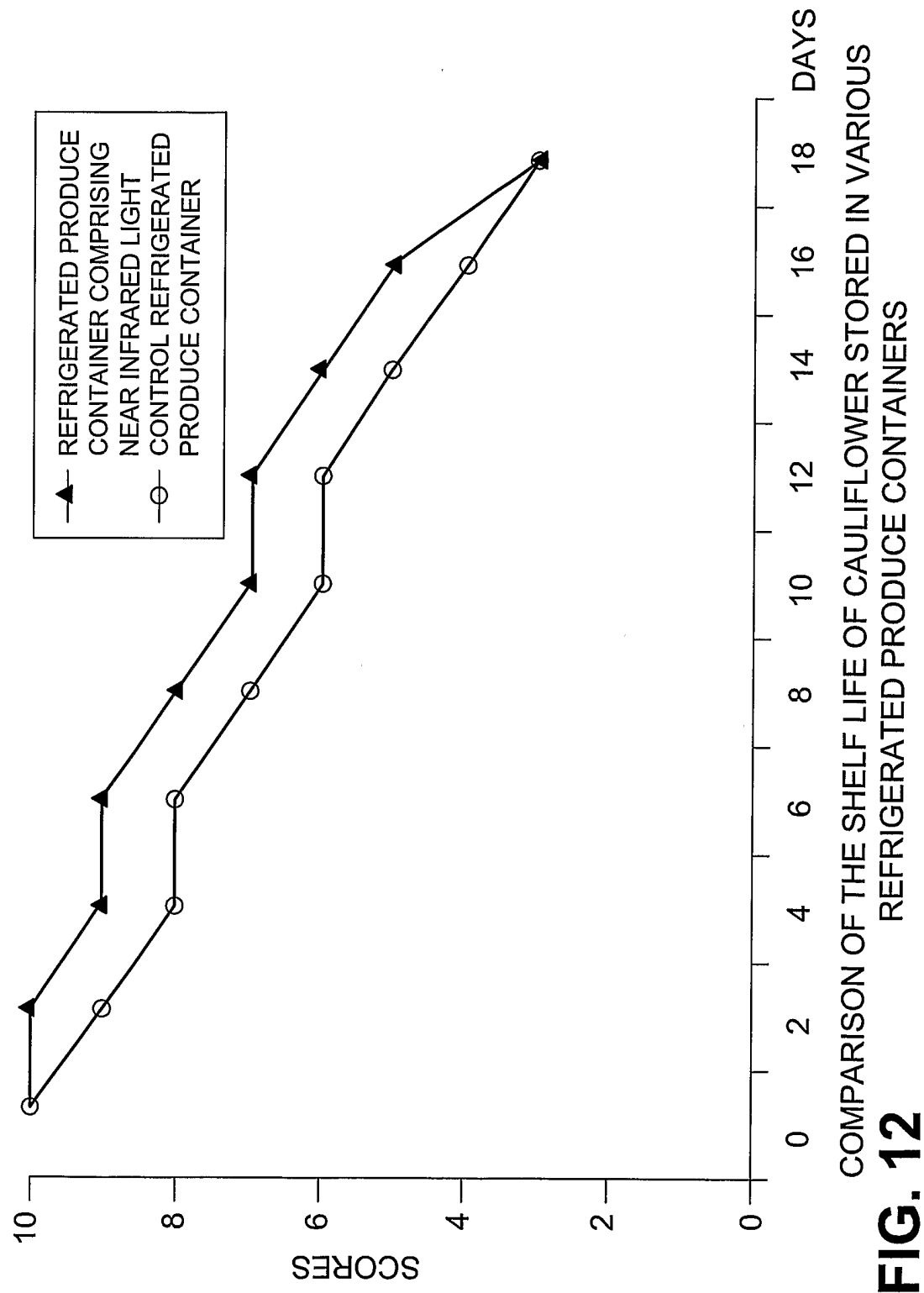


FIG. 10A



14/18





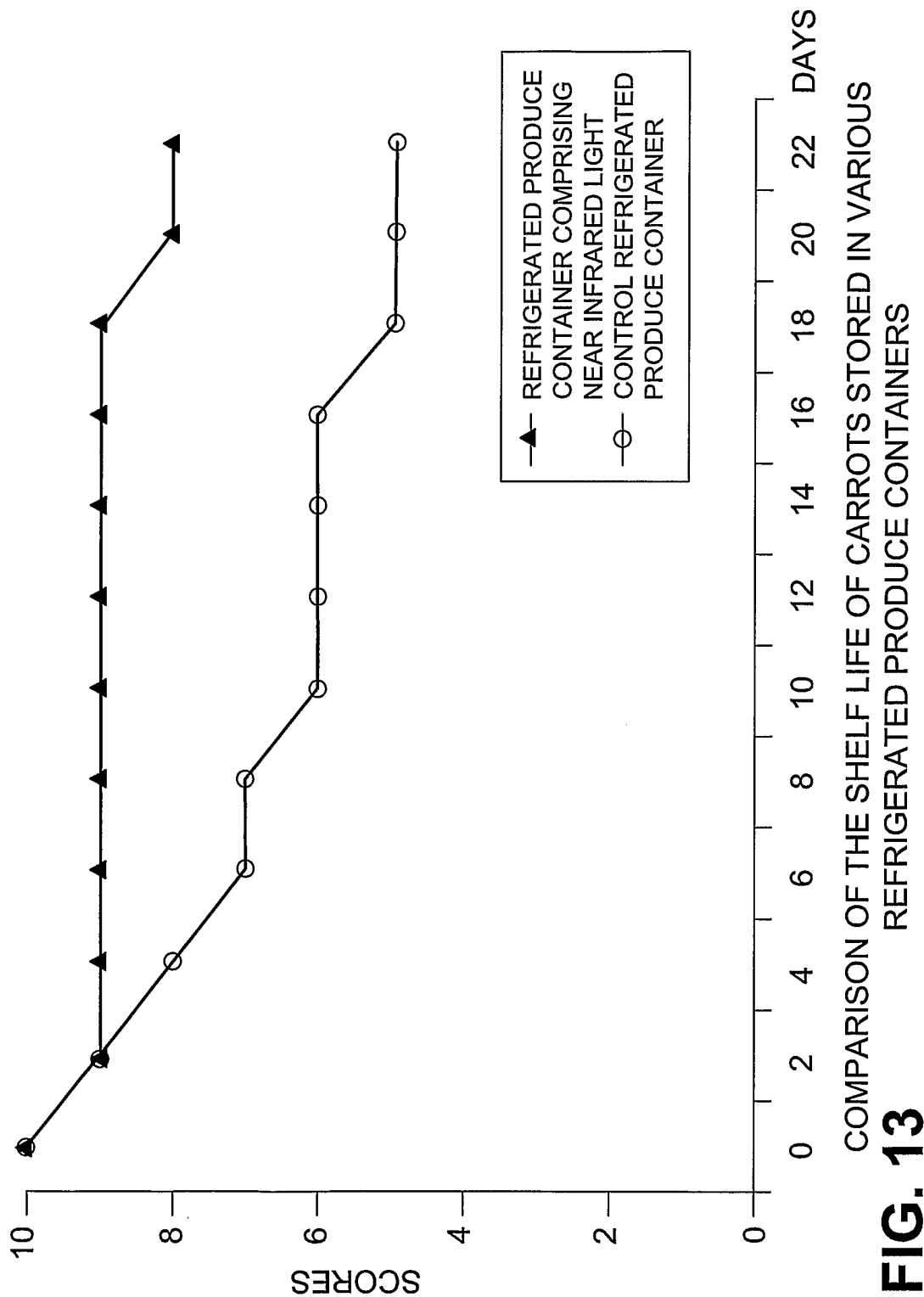
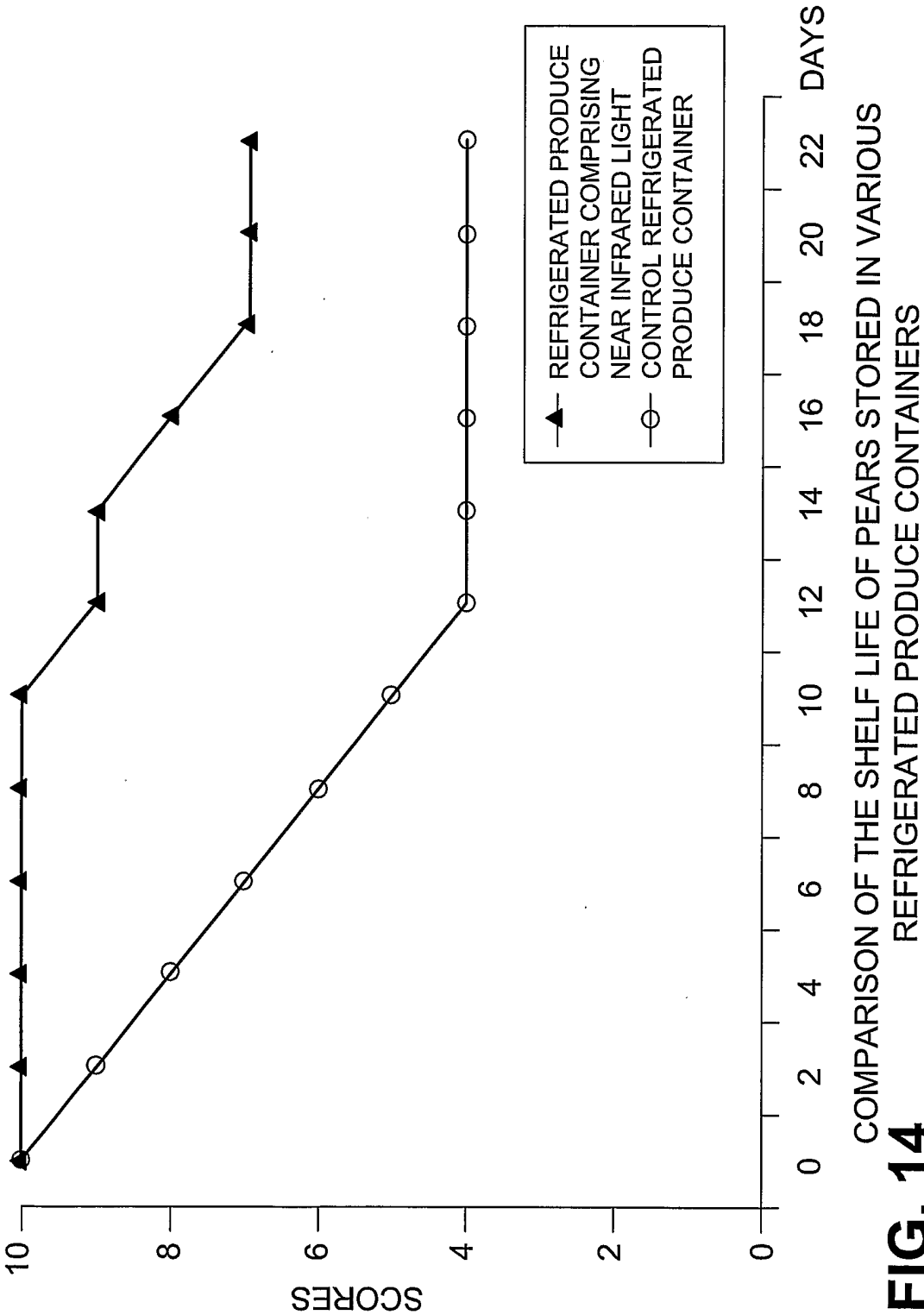


FIG. 13

COMPARISON OF THE SHELF LIFE OF CARROTS STORED IN VARIOUS REFRIGERATED PRODUCE CONTAINERS



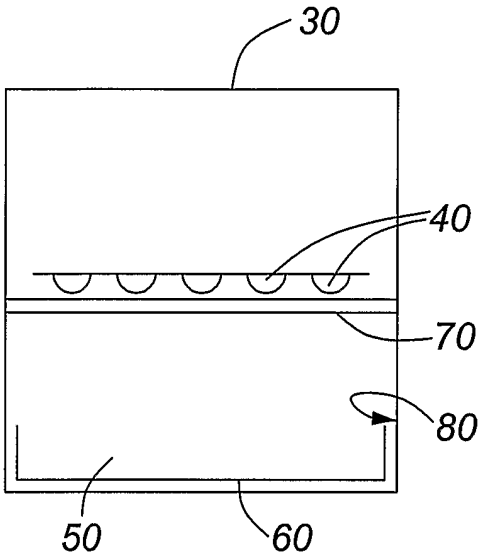


FIG. 15A

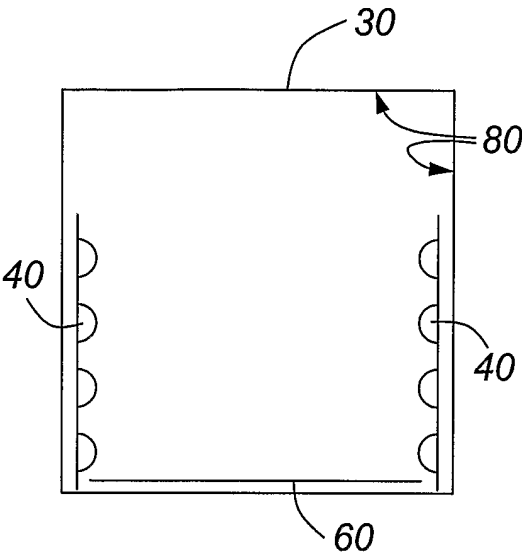


FIG. 15B

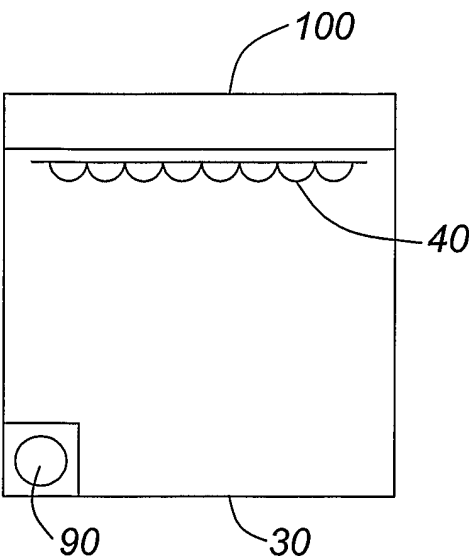


FIG. 15C

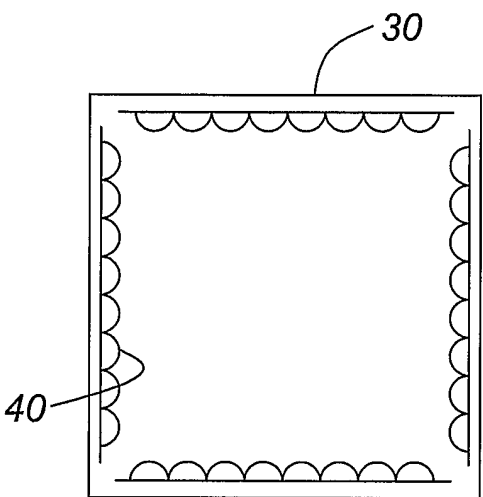


FIG. 15D

INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA2004/000717

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A23L3/26 A23B7/015 B65D85/34 B65D81/24 F25D23/00
A01N3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A23L A23B B65D F25D A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

EPO-Internal, PAJ, WPI Data, FSTA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 551 290 C (FROMRAY PARENT COMPANY LTD) 28 May 1932 (1932-05-28)	1-4, 6, 10-20, 23-25
Y	page 1, line 1 - page 2, line 59; claim 1; figures 1-3; examples 1,2	7-9, 21, 22, 26-29
X	PATENT ABSTRACTS OF JAPAN vol. 0142, no. 71 (M-0983), 12 June 1990 (1990-06-12) & JP 2 078883 A (HITACHI LTD), 19 March 1990 (1990-03-19) abstract	1-6, 10-20, 23-25
Y	US 2003/031811 A1 (WU CHUNG-HSUN ET AL) 13 February 2003 (2003-02-13) page 1, paragraphs 2,7-11; claims 1,2	22, 26-29
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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

° Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but 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

T 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

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Tallgren, A

INTERNATIONAL SEARCH REPORT

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PCT/CA2004/000717

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB 2 303 533 A (GROW LIGHT LIMITED) 26 February 1997 (1997-02-26) page 8, paragraph 3; claims 1,2,8,9; examples 1-18	7-9, 21
A	EP 0 338 838 A (NIPPON DANBOHRU CO LTD ; YOKOYAMA YOSHIMASA (JP)) 25 October 1989 (1989-10-25) column 1, line 4 - column 2, line 6; claim 1	1-29
A	US 2 215 123 A (MILTON KALISCHER) 17 September 1940 (1940-09-17) column 1, lines 1-9; claims 1-4	1-29
A	PATENT ABSTRACTS OF JAPAN vol. 0122, no. 99 (C-520), 15 August 1988 (1988-08-15) & JP 63 071162 A (TOSHIYUKI OOTA), 31 March 1988 (1988-03-31) abstract	1-29
A	PATENT ABSTRACTS OF JAPAN vol. 0182, no. 39 (M-1601), 9 May 1994 (1994-05-09) & JP 6 026753 A (TOSHIO FUKAZAWA), 4 February 1994 (1994-02-04) abstract	1-29
A	PATENT ABSTRACTS OF JAPAN vol. 0163, no. 94 (C-0976), 21 August 1992 (1992-08-21) & JP 4 131013 A (MATSUSHITA ELECTRIC WORKS LTD), 1 May 1992 (1992-05-01) abstract	1-29

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/CA2004/000717

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
DE 551290	C	28-05-1932	NONE	
JP 2078883	A	19-03-1990	NONE	
US 2003031811	A1	13-02-2003	NONE	
GB 2303533	A	26-02-1997	NONE	
EP 0338838	A	25-10-1989	DE 68909660 D1	11-11-1993
			DE 68909660 T2	10-02-1994
			EP 0338838 A2	25-10-1989
			ES 2046469 T3	01-02-1994
			JP 2131559 A	21-05-1990
			US 5030510 A	09-07-1991
US 2215123	A	17-09-1940	NONE	
JP 63071162	A	31-03-1988	JP 8017685 B	28-02-1996
JP 6026753	A	04-02-1994	JP 2093912 C	02-10-1996
			JP 8010108 B	31-01-1996
JP 4131013	A	01-05-1992	NONE	