Title: METHOD OF IMPROVING CARDIOVASCULAR HEALTH

Blood Pressure Response for Hypertensive (SHR) Rats

* p < 0.05 vs. Control  
+ p < 0.05 vs. control and Saff

**Abstract:** A nutritional supplement including β-cryptoxanthin is found to be effective at lowering blood pressure in mammals. β-cryptoxanthin therefore may be used to maintain cardiovascular health by lowering blood pressure, preventing high, elevated blood pressure and/or maintaining healthy blood pressure. Administration of β-cryptoxanthin in combination with safflower oil is particularly effective.
METHOD OF IMPROVING CARDIOVASCULAR HEALTH

[001] This application claims priority to United States Patent Application Serial No. 60/875,956 filed December 20, 2006, which is incorporated herein in its entirety by this reference.

Background of the Invention

[002] The invention relates generally to methods of improving cardiovascular health and, more specifically, to the administration of β-cryptoxanthin to mammals in an effective dose to improve the cardiovascular health of the mammal.

[003] Heart disease and stroke are the most common cardiovascular diseases. They are the first and third leading causes of death for both men and women in the United States, accounting for nearly 40% of all annual deaths. More than 910,000 Americans die of cardiovascular diseases each year. Although heart disease and stroke conditions are more common among people aged 65 or older, the number of sudden deaths from heart disease among people aged 15-34 has increased.

[004] In addition, more than 70 million Americans currently live with a cardiovascular disease. Coronary heart disease is a leading cause of premature, permanent disability in the U.S. workforce. Stroke alone accounts for disability among about 1 million Americans. More than 6 million hospitalizations each year are because of cardiovascular diseases.

[005] The economic impact of cardiovascular diseases on the nation's health care system continues to grow as the population ages. The cost of heart disease and stroke in the United States is projected to be $403 billion in 2006, including health care expenditures and lost productivity from death and disability.

[006] There is a need, accordingly, for safe, efficacious and cost-effective treatments for preventing or ameliorating cardiovascular diseases and associated health implications.

Summary of the Invention

[007] The invention relates to the administration of β-cryptoxanthin to mammals, including humans, as a method of improving cardiovascular health. It has been demonstrated for the first time that the oral administration of β-cryptoxanthin reduces blood pressure in mammals and will lead to improved cardiovascular health.
Brief Description of the Figures

[008] Fig. 1 is a chart of mean arterial pressure (MAP) for hypertensive (SHR) rats recorded daily over 14 days of dosing either β-cryptoxanthin in safflower oil (SHR-BCX), BCX combined with a soy extract in safflower oil (SHR-BCX-Soy), safflower oil only (SHR-Saff), or nothing (SHR-Control).

[009] Fig. 2 is a chart of mean arterial pressure (MAP) for normal (WKY) rats recorded daily over 14 days of dosing either BCX in safflower oil (WKY-BCX), BCX combined with a soy extract in safflower oil (WKY-BCX-Soy), safflower oil only (WKY-Saff), or nothing (WKY-Control).

[010] Fig. 3 is a chart of heart rate (HR) for hypertensive (SHR) rats recorded daily over 14 days of dosing either BCX in safflower oil (SHR-BCX), BCX combined with a soy extract in safflower oil (SHR-BCX-Soy), safflower oil only (SHR-Saff), or nothing (SHR-Control).

[011] Fig. 4 is a chart of heart rate (HR) for normal (WKY) rats recorded daily over 14 days of dosing either BCX in safflower oil (WKY-BCX), BCX combined with a soy extract in safflower oil (WKY-BCX-Soy), safflower oil only (WKY-Saff), or nothing (WKY-Control).

Detailed Description of Preferred Embodiments

[012] Human essential hypertension is characterized by impaired endothelium-dependent vasodilation, caused by oxidative stress, β-cryptoxanthin is demonstrated herein, for the first time, to have anti-hypertensive effects, in addition, β-cryptoxanthin is demonstrated to lower blood pressure and reduce heart rate, thereby exerting a cardiovascular protecting action.

[013] In studies with spontaneously hypertensive rats (SHR), the applicants found that diets supplemented with β-cryptoxanthin lowered blood pressure and heart rate in SHR. Mean arterial pressure was significantly lower in SHR fed β-cryptoxanthin, compared with a control group fed food only as well as a control group fed a diet supplemented with safflower oil (P<0.05) (Fig. 1). The heart rate response was significantly lower for SHR fed β-cryptoxanthin, compared to a control group fed food only (P<0.05) (Fig. 3). A diet supplemented with β-cryptoxanthin combined with a soy extract also showed significant results in lowering the heart rate response in SHR (Fig. 3).

[014] It will be appreciated by those skilled in the art that β-cryptoxanthin may be administered
to a subject by a variety of routes, including oral administration, or injection. The amount of β-cryptoxanthin to be administered will vary widely depending upon the subject and the nature and extent of the condition for which the β-cryptoxanthin is being administered. Typically, β-cryptoxanthin is formulated as a composition which may be administered intravenously or by oral ingestion. The composition may be ingested or intravenously administered in any dosage levels and dosage frequencies suitable for lowering blood pressure and/or lowering heart rate response.

[0015] The composition of the invention may also be a food product, including, but not limited to, a nutritional supplement. The composition may be formulated into solid or liquid preparations, for example tablets, capsules, powders, solutions, suspensions and dispersions. Liquid forms include carriers such as water and ethanol, with or without other agents such as pharmaceutically acceptable surfactants or suspending agents.

[0016] Compositions of the present invention may include β-cryptoxanthin in an amount between 0.03 mg and about 20 mg, preferably between 0.05 mg and about 6 mg, and more preferably between 0.3 and 3 mg. The compositions are administered to humans to provide β-cryptoxanthin in an amount between 0.1 mg per day and 20 mg per day, preferably between 0.15 mg per day and 6 mg per day, and more preferably between 0.8 mg per day and 3 mg per day. The compositions may include extracts of soy, including but not limited to soy isoflavone extracts, in an amount between 0.3 mg and about 250 mg, preferably between 1.3 mg and about 200 mg, and more preferably between 6 and 150 mg. The compositions are administered to humans to provide extracts of soy in an amount between 1 mg per day and 250 mg per day, preferably between 5 mg per day and 200 mg per day, and more preferably between 20 mg per day and 150 mg per day. The compositions may also include safflower oil in an amount when administered comprises between 10 mg/kg of body weight and 3 g/kg of body weight, preferably between 20 mg/kg of body weight and 500 mg/kg of body weight, and more preferably between 50 mg/kg of body weight and 300 mg/kg of body weight.

[0017] Example 1

[0018] In this example, the cardiovascular effects of β-cryptoxanthin (BCX) in chronically-instrumented, conscious rats is demonstrated. The example shows the protective role of BCX in the maintenance of hypertension in genetically hypertensive animals. Additionally, daily soy
isoflavone (SoyLife®, Acatris, Minneapolis, MN) supplementation was administered with BCX to both normotensive (WKY) and spontaneously hypertensive (SHR) rats to determine any beneficial hemodynamic contributions of soy to genetic hypertension. Animals receiving daily oral doses of BCX or BCX combined with the soy extract and comparisons of specific hemodynamic parameters (heart rate and blood pressure) were monitored for a period of two weeks in SHR rats and their genetically WKY counterparts. Plasma hydrogen peroxide concentrations were evaluated and show the effects of BCX on reactive oxygen species and their purported contribution to elevations in blood pressure in this hypertensive animal paradigm (Wilcox C.S., Reactive oxygen species: roles in blood pressure and kidney function. Curr Hypertens Rep. 2002 Apr;4(2): 160-6).

[0019] The example used 36 WKY rats and 36 SHR rats assigned to the protocols set out in Table 1.

[0020] Table 1. Animals and Treatments

<table>
<thead>
<tr>
<th>treatment</th>
<th>WKY (male)</th>
<th>SHR (male)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCX</td>
<td>N=8</td>
<td>N=8</td>
</tr>
<tr>
<td>BCX + soy</td>
<td>N=8</td>
<td>N=8</td>
</tr>
<tr>
<td>Oil Controls</td>
<td>N= 8</td>
<td>N= 8</td>
</tr>
<tr>
<td>Controls</td>
<td>N= 8</td>
<td>N= 8</td>
</tr>
<tr>
<td>Baseline BCX</td>
<td>N=4</td>
<td>N=4</td>
</tr>
</tbody>
</table>

[0021] The animals (n=64) of the first 4 rows of Table 1 in this study underwent the following surgical procedure:

[0022] 1. Three days prior to the beginning of experiments, femoral arterial and venous catheters were implanted for the measurement of blood pressure and heart rate and for the collection of blood samples for the analysis of plasma CRP and cholesterol. Animals were housed in metabolic cages for chronic daily analysis for the remainder of the protocol.

[0023] 2. The animals (n=4) of the Baseline BCX row of Table 1 underwent the following procedure:

[0024] At one day prior to beginning of protocol, blood samples were obtained from 4 SHR rats and 4 WKY animals to serve as a baseline BCX benchmark. Baseline BCX cannot be obtained
from the other rats due to the volume of blood needed for analysis. These animals were sacrificed for their blood sample and were not placed on any BCX or isoflavone feed. This measurement provided a baseline measurement of BCX in the plasma from their diets prior to arriving at DMU. The other 64 animals had pooled samples taken for baseline CRP, cholesterol, and plasma hydrogen peroxide. Table 1 shows the breakdown of animals and treatment groups.

[0025] General Surgical Preparation and Methodology:

[0026] General care: SHR and WKY rats (Harlan, Indianapolis, IN) at age 10 weeks and weighing ~250g were used as experimental subjects and monitored for a two week period. All experimental protocols were performed in conscious, unrestrained animals. The animals were individually housed in wire mesh cages in temperature-controlled rooms (23 °C) with a 12-hour light/dark cycle. Each animal was allowed free access to isoflavone reduced chow (Harlan, Indianapolis, IN) and distilled water throughout the protocol(s). In addition to ad libitum food and water, animals were dosed daily by oral gavage with BCX (1.0 mg/kg, in safflower oil) or BCX + soy (1.0 mg BCX/kg + 80 mg isoflavones/kg, in safflower oil). BCX dosage levels were based on the amount of BCX humans consume when eating according to the Dietary Guidelines for Americans: 0.5-1.0 mg per day (United States Department of Health and Human Services and United States Department of Agriculture. Dietary Guidelines for Americans 2005. January 12, 2005. http://www.healthierus.gov/dietaryguidelines/; Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination Survey Data 2001-2002. http://www.cdc.gov/nchs/about/major/nhanes/nhanes01-02.htm). Dietary intake of 80 mg isoflavones per day has been shown to reduce systolic and diastolic blood pressure among high-risk, middle-aged men (Sagara, M., Kanda, T., Jelekera, M., Birt, T., Birt, C, Yamori, Y. Effects of Dietary Intake of Soy Protein and Isoflavones on Cardiovascular Disease Risk Factors in High Risk, Middle-Aged Men in Scotland, J Amer Col of Nutr, 2003; 23(1): 85-91).

[0027] SHR rats: SHR rats are normotensive at birth (compared to their WKY counterparts) and begin to demonstrate hypertension at ~5 weeks of age. After this time, mean arterial pressure (MAP) increases dramatically and maximizes to approximately 171±2.0 mmHg in adults animals (Yamori Y, Horie R, Nara Y, Kihara M, Ikeda K, Mano M, Fujiwara K. Dietary prevention of

[0028] Catheterization: All surgical procedures were performed in animals anesthetized with sodium pentobarbital (Nembutal®, Abbott Laboratories) at a dose of 50 mg/kg, i.p. In addition, all surgery was performed under sterile conditions in a location in the laboratory dedicated for that purpose and according to those procedures adopted by the IACUC at Des Moines University-Osteopathic Medical Center. The implantations of femoral arterial and venous catheters were performed three days prior to any experimentation. The arterial and venous catheters were constructed from silicone and Tygon® tubing (Saint-Gobain Performance Plastics Corporation). The smaller silicone tubing was placed within the vessel, via the external iliac artery, to minimize tissue irritation and reaction. Normal body temperature was maintained during anesthesia via an electronically maintained dermal pad. The animals were shaved at the top of the head, back of the neck and the inner left leg. The silicone tips were inserted through a 3.0 cm incision made on the inner left leg for cannulation of the internal iliac vein and femoral artery; the arterial catheter was sutured to the leg in a manner preventing occlusion of the catheter during normal rat movement. Excess catheter was directed subcutaneously and externalized through a 2.5 cm incision made in the dermis overlying bregma. The cranial incision was made with a scalpel after which three 0.19” jeweler’s screws were attached to the cranium in a 1.0 cm² area which encompasses bregma. After externalization, the catheters were threaded through a metal spring tether. The spring tethers were permanently attached to the skull with dental acrylic adhesive using the attached machine screws as cranial anchors. The animal was then administered penicillin G, 20,000 U, i.m., allowed to regain consciousness on the heated pad and placed in a metabolic cage. When not in use, the catheters were kept patent by filling with a heparinized (1000 U/ml) sucrose solution.

[0029] Beta-Cryptoxanthin and Soy Isoflavone Materials:

[0030] Beta-cryptoxanthin was purified using the following HPLC method. Crude BCX dry cake was prepared following the procedures outlined in U.S. Patent Appl. No. 10/973,204, filed October 26, 2004, which is incorporated herein by this reference. A mobile phase is prepared by mixing 3.6 L HPLC grade methanol and 0.4 L HPLC grade methyl /erf-butyl ether (MTBE). On-half gram of BCX dry cake is weighed into an amber flask to which is added 10 ml of
methylene chloride and 90 ml of the mobile phase. The mixture is stirred for 10 min and the filtered through a 0.45 micron PTFE filter to generate the BCX injection solution. The HPLC is fitted with a Waters YMC carotenoid column (C30; 250 mm X 20;mm; 5 micron particles) and 20 ml of injection solution is injected (20 ml/min flow rate; 40 min run time; 452 run). When the BCX peak appears (approximate retention time is 24.8 min), the eluent is diverted to an amber flask until all the BCX has eluted (approximately 28 min). The collected eluent is cooled at -20°C for several hours to form crystals of BCX. If crystals fail to form, the eluent may be concentrated with a rotary evaporator (40°C water bath) until crystals form, and then the solution is cooled, preferably for several hours. The crystals are collected by filtration via a Kontes Ultraware 90 nm microfiltration assembly (Kontes Asset Management) or equivalent with a Durapore® (Millipore Corporaton) membrane filter (0.45 μm HVHP04700). The crystals may be dried in a desiccator under high vacuum.

[0031] Soy isoflavones 40% extract (SoyLife®) were purchased from Acatris. The pure BCX standard and soy isoflavones (Lor# 63D/1737/4) were formulated with certified organic deodorized high oleic safflower oil (Spruce Foods Lot#91726) as shown below in Table 2.

[0032] Table 2. BCX and BCX/Sov in Safflower Oil Formulations

<table>
<thead>
<tr>
<th>First BCX/Safflower oil mix</th>
<th>BCX Lot #</th>
<th>BCX Concentration in oil: 0.504 mg/ml</th>
<th>Safflower oil lot #: 91726</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCX Lot #</td>
<td>TC*%</td>
<td>BCX%</td>
<td></td>
</tr>
<tr>
<td>BCX053105RA</td>
<td>98.6</td>
<td>97.1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second BCX/Safflower oil mix</th>
<th>Three lot #s BCX mixed in oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCX Lot #</td>
<td>TC*%</td>
</tr>
<tr>
<td>BCX053105RA</td>
<td>98.6</td>
</tr>
<tr>
<td>BCX062905</td>
<td>100.8</td>
</tr>
<tr>
<td>BCX070105</td>
<td>98.7</td>
</tr>
<tr>
<td>Average</td>
<td>99.4</td>
</tr>
</tbody>
</table>

*TC = total carotenoids

[0033] Hemodynamic Data Acquisition (MAP and HR): On a daily basis, mean arterial pressure was measured directly through a catheter implanted in the femoral artery of each animal. The catheter was attached to a Cobe7 pressure transducer (Model 41-500) coupled to a MacLab® Transbridge amplifier (ADInstruments, Australia). Heart rate was measured with software triggered by the arterial pressure pulse. Analog signals were digitized using a MacLab®
A/D converter system and a Macintosh® computer (Apple Computer, Inc.). The data was acquired at a rate of 0.1 Hz. Data was collected over a period of 10-15 minutes each day. Data analysis was performed using multifactorial ANOVA (SigmaStat®, Jandel Corporation) for group comparisons. Significant differences (p<0.05) were evaluated using post hoc t-test. The results are displayed in Figs. 1-4.

[0034] Blood Pressure Results

[0035] Eight rats from each test group (SHR-BCX, SHR-BCX-Soy, WKY-BCX, and WKY-BCX-Soy) and control groups (SHR-Control, SHR-Saff, WKY-Control, and WKY-Saff) have been run using this protocol and the blood pressure means of each day are graphically displayed for the SHR rats in Fig. 1 and for the WKY rats in Fig. 2. Designations of* and + on Fig. 1 indicate statistical differences on the particular day between the groups identified in the legend. Days 4-13 showed there to be a statistically significant difference between the SHR1 controls and the SHR/BCX group. On days 4, 6, 11, and 13, there was a significant difference between the SHR-Saff oil controls and SHR-BCX. The WKY normotensive rats did not show any change in blood pressure over the 14 days vs. any of the treatments.

[0036] Statistical analysis was performed using the mean blood pressure data over the entire 14-day experiment and the data are shown in Table 3. The SHR-BCX, SHR-BCX-Soy, and SHR-Saff safflower oil controls all statistically decreased the blood pressure vs. the SHR-Control (rat chow only). The P value comparing SHR-BCX to SHR-Saff was 0.063 over the entire 14 day period, although there were individual days with statistical significance (Fig. 1). The SHR-BCX-Soy combination did not statistically affect the blood pressure vs. the SHR-Saff safflower oil controls. The WKY (normotensive rats) did not show any significant blood pressure change after supplementation with BCX, BCX-Soy, or safflower oil itself (Table 3).
Table 3. Blood Pressure Student-Neuman-Keuls Post Hoc Test
(All pairwise multiple comparison procedure)

<table>
<thead>
<tr>
<th>Comparison over 14 days</th>
<th>P value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHR-Control vs. SHR-BCX</td>
<td>&lt;0.001</td>
<td>Yes</td>
</tr>
<tr>
<td>SHR-Control vs. SHR-Saff</td>
<td>0.021</td>
<td>Yes</td>
</tr>
<tr>
<td>SHR-Control vs. SHR-BCX-Soy</td>
<td>0.011</td>
<td>Yes</td>
</tr>
<tr>
<td>SHR-BCX-Soy vs. SHR-BCX</td>
<td>0.083</td>
<td>No</td>
</tr>
<tr>
<td>SHR-BCX-Soy vs. SHR-Saff</td>
<td>0.830</td>
<td>No</td>
</tr>
<tr>
<td>SHR-Saff vs. SHR-BCX</td>
<td>0.063</td>
<td>No</td>
</tr>
<tr>
<td>WKY-BCX-Soy vs. WKY-BCX</td>
<td>0.206</td>
<td>No</td>
</tr>
<tr>
<td>WKY-BCX-Soy vs. WKY-Control</td>
<td>0.228</td>
<td>No</td>
</tr>
<tr>
<td>WKY-BCX-Soy vs. WKY-Saff</td>
<td>0.177</td>
<td>No</td>
</tr>
<tr>
<td>WKY-Saff vs. WKY-BCX</td>
<td>0.699</td>
<td>No</td>
</tr>
<tr>
<td>WKY-Saff vs. WKY-Control</td>
<td>0.570</td>
<td>No</td>
</tr>
<tr>
<td>WKY-Control vs. WKY-BCX</td>
<td>0.648</td>
<td>No</td>
</tr>
</tbody>
</table>

Heart Rate Results

Eight rats from each test group (SHR-BCX, SHR-BCX-Soy, WKY-BCX, and WKY-BCX-Soy) and control groups (SHR-Control, SHR-Saff, WKY-Control, and WKY-Saff) have been run using this protocol and the heart rate means of each day for the SHR rats are graphically displayed in Fig. 3 and for the WKY rats in Fig. 4. Designations of * and + on Fig. 3 indicate statistical differences on the particular day between the groups identified in the legend. Days 6-13 showed there to be a statistically significant lower heart rate in the SHR-BCX vs. the SHR-Control. Days 6-14 showed that the SHR-Saff oil control group had a statistically significant decrease in heart rate vs. the SHR-Control. Days 7-13 showed there to be a statistically significant lower heart rate in the SHR-BCX-soy vs. the SHR-Control.

Statistical analysis was performed using the mean heart rate data over the entire 14-day experiment and the data are shown in Table 4. The SHR-BCX, SHR-BCX-Soy, and SHR-Saff safflower oil controls all statistically decreased the heart rate vs. the SHR-Control (rat chow only). There was no statistical difference between the heart rate of the SHR-BCX and SHR-BCX-Soy groups (P=0.791). There was also no statistical difference between the SHR-Saff oil control heart rate and the SHR-BCX (P=0.964) and SHR-BCX-Soy (P=0.968). There was a statistical decrease in heart rate between the WKY-Control and both the WKY-Saff oil controls (P=0.010) and the WKY-BCX (P=COl 8) groups. There was a statistical increase in heart rate in
the WKY-BCX-Soy fed rats vs. the WKY-Saff safflower oil controls. There was no statistical difference in the other WKY test group combinations (Table 4).

Table 4. Heart Rate Student-Neuman-Keuls Post Hoc Test
(All pairwise multiple comparison procedure)

<table>
<thead>
<tr>
<th>Comparison over 14 days</th>
<th>P value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHR-Control vs. SHR-BCX</td>
<td>&lt;0.001</td>
<td>Yes</td>
</tr>
<tr>
<td>SHR-Control vs. SHR-Saff</td>
<td>&lt;0.001</td>
<td>Yes</td>
</tr>
<tr>
<td>SHR-Control vs. SHR-BCX-Soy</td>
<td>&lt;0.001</td>
<td>Yes</td>
</tr>
<tr>
<td>SHR-BCX vs. SHR-BCX-Soy</td>
<td>0.791</td>
<td>No</td>
</tr>
<tr>
<td>SHR-BCX-Soy vs. SHR-Saff</td>
<td>0.968</td>
<td>No</td>
</tr>
<tr>
<td>SHR-BCX vs. SHR-Saff</td>
<td>0.964</td>
<td>No</td>
</tr>
<tr>
<td>WKY-BCX-Soy vs. WKY-BCX</td>
<td>0.396</td>
<td>No</td>
</tr>
<tr>
<td>WKY-Control vs. WKY-BCX-Soy</td>
<td>0.953</td>
<td>No</td>
</tr>
<tr>
<td>WKY-BCX-Soy vs. WKY-Saff</td>
<td>0.011</td>
<td>Yes</td>
</tr>
<tr>
<td>WKY-BCX vs. WKY-Saff</td>
<td>0.539</td>
<td>No</td>
</tr>
<tr>
<td>WKY-Control vs. WKY-Saff</td>
<td>0.010</td>
<td>Yes</td>
</tr>
<tr>
<td>WKY-Control vs. WKY-BCX</td>
<td>0.018</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The foregoing description and drawings comprise illustrative embodiments of the present inventions. The foregoing embodiments and the methods described herein may vary based on the ability, experience, and preference of those skilled in the art. Merely listing the steps of the method in a certain order does not constitute any limitation on the order of the steps of the method. The foregoing description and drawings merely explain and illustrate the invention, and the invention is not limited thereto, except insofar as the claims are so limited. Those skilled in the art who have the disclosure before them will be able to make modifications and variations therein without departing from the scope of the invention.
We claim:

1. A method of reducing blood pressure in a mammal, comprising the step of administering a therapeutically effective dose of a nutritional supplement comprising β-cryptoxanthin.

2. A method as defined in claim 1, further comprising administration of a therapeutically effective dose of a second compound selected from the group consisting of soy extracts and safflower oil.

3. A method of preventing high blood pressure in a mammal, comprising the step of administering a therapeutically effective dose of a nutritional supplement comprising β-cryptoxanthin.

4. A method as defined in claim 3, further comprising administration of a therapeutically effective dose of a second compound selected from the group consisting of soy extracts and safflower oil.

5. A method of maintaining healthy blood pressure in a mammal, comprising the step of administering a therapeutically effective dose of a nutritional supplement comprising β-cryptoxanthin.

6. A method as defined in claim 5, further comprising administration of a therapeutically effective dose of a second compound selected from the group consisting of soy extracts and safflower oil.

7. A method of maintaining cardiovascular health in a mammal, comprising the step of administering a therapeutically effective dose of a nutritional supplement comprising β-cryptoxanthin.
8. A method as defined in claim 7, further comprising administration of a therapeutically effective dose of a second compound selected from the group consisting of soy extracts and safflower oil.
Fig. 1: Blood Pressure Response for Hypertensive (SHR) Rats

- • SHR-Control
- • SHR-BCX
- △ SHR-BCX-Soy
- ■ SHR-Saff

* p < 0.05 vs. Control
+ p < 0.05 vs. control and Saff
Fig. 2: Blood Pressure Response for Normal (WKY) Rats

Protocol Day

Mean Arterial Pressure (mm Hg)
Fig. 3: Heart Rate Response for Hypertensive (SHR) Rats

- SHR-Control
- SHR-BCX
- SHR-BCX-Soy
- SHR-Saff

- x p < 0.05 BCX & Saff vs. Control
- * p < 0.05 BCX, Saff, & BCX-Soy vs. Control
- + p < 0.05 Saff vs. Control

Protocol Day:

1  2  3  4  5  6  7  8  9  10  11  12  13  14
Fig. 4: Heart Rate Response for Normal (WKY) Rats
**INTERNATIONAL SEARCH REPORT**

**International application No**

PCT/US 07/26055

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**A CLASSIFICATION OF SUBJECT MATTER**

IPC(8) - A61K 31/07 (2008 01)

USPC - 514/725

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

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**B FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

USPC 514/725

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 practicable, search terms used)

PubWest, PubWest PGPB, USPT, USOC, EPAB, JPAB, Google Scholar, Google Patents, Beta-cryptoxanthin, cryptoxanthin, provitamin A, blood pressure; cardiovascular, soy, safflower, nutritional, supplement, prevent (-ing), lower (-ing), reduce (-ing), maintain (-ing), treat (-ing)

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**C DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
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<tbody>
<tr>
<td>X</td>
<td>US 2006/0088574 A1 (MANNING et al.) 27 Apr 2006 (27 04 2006) para [0273], para [0244], para [0265], para [0266], para [0251], para [0431]</td>
<td>1,8</td>
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<tr>
<td>A</td>
<td>JOHN et al. Effects of fruit and vegetable consumption on plasma antioxidant concentrations and blood pressure a randomised controlled trial Lancet 08 June 2002 (08 06 2002), Vol 59, No 9322, Pp 1969-74 Abstract only</td>
<td>1, 3, 5 7</td>
</tr>
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</table>

Further documents are listed in the continuation of Box C

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* A - Special categories of cited documents
  *A* - document defining the general state of the art which is not considered to be of particular relevance
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**Date of the actual completion of the international search**

20 February 2008 (20 02 2008)

**Date of mailing of the international search report**

25 MAR 2008

**Authorized officer**

Lee W Young

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