



The Effects of a Unique Bergamot Supplement on Fitness Factors and Mood in Menopausal Women: An Initial Investigation

Neil E Wolkodoff^{1*}, Gerald M Haase² and Joy Curry³

¹Medical Program Director, Colorado Center for Health & Sport Science, USA

²Department of Surgery, University of Colorado Medical School, USA

³Colorado Christian University, USA

Abstract

Menopause is natural phenomenon in women that typically occurs in the early 50s. It is associated with additional health issues for women that affect general wellbeing, fitness and quality of life, as well as complicating the aging process. Many menopausal women exercise yet note that results both in the physical as well as psychological dimension lag behind results that were typical or expected before menopause. The current study looked at the impact of a nutritional supplement based upon Bergamot combined with already exercising women, and its' effect on both physiological and psychological variables. In review, the supplement produced significantly better results in both areas compared to a placebo group in exercise-matched women. This presents a previously untested addition to exercise effectiveness for this group and appears to hold promise for clinicians in the use of polyphenols, and specifically Bergamot with this population. In addition, it supports the use of the specific psychological instrument, the Utian Quality of Life scale, as a measurement tool the clinician can use with menopausal women to measure the changes from various interventions.

Keywords: Menopause; Phytonutrient; Bergamot; Exercise; Strength, VO2 Max; UQOL

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*Correspondence:

Neil E Wolkodoff, Medical Program Director, Colorado Center for Health & Sport Science, 1685 S. Colorado Blvd, #S115, Denver, CO 80222, Denver, Colorado, USA, Tel: 01-303-596-6519;

E-mail: neil@cochss.com

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Introduction

Exercise has been recommended for almost all populations as a means to better fitness, health and mood. However, not all populations receive the same benefit from the same program. Compared to premenopausal women, and in general, menopausal women have more complex needs, and in general have not had the same results per unit of time or effort in this respect [1,2]. This is a significant issue because the normal downward trends in aging are more pronounced in this population.

Menopause compounds normal aging in a number of respects for this population [3,4]. First, hot flashes are a top menopause related issue [5]. Unfortunately, exercise is often missed or interrupted when the participant does not feel "normal" [6]. In many cases, exercise has shown a mild and positive effect on psychological mood, yet not all the time and in the same degree. Therefore, it is likely that the health benefit for menopausal women has various levels of effectiveness.

Another area indirectly affected by reduced exercise from hot flashes is decreasing levels of physiological markers and levels over time. Age in both men and women has shown a correlation to reduced endurance capacity, muscle mass and strength [7]. These downward trends are compounded for menopausal women due to reduced mood-influenced exercise adherence as well as internal hormonal issues that mute exercise effects.

Another factor which further clouds both exercise prescription and the promise of results is that body composition, initial Body Mass Index (BMI) and fitness level may have more influence on this population in terms of adoption or exercise adherence [8,9]. In general, those with less ideal body composition and lower fitness are less likely to start or adhere to a fitness program. The fact that these changes for this population may have come on faster than anticipated may be a de-motivating factor.

There have been limited studies on the effects of polyphenols on fitness, only a few studies on essential oils and menopause and yet virtually nothing on Bergamot compounds and menopause,

either in physiological or psychological domains [10,11].

Materials and Methods

Eighteen women (N=18, Age=62.5, SD=6.23 years of age) were recruited who were menopausal and were consistent exercisers. This level of consistency was defined by using the U.S. Department of Health (and previously the American College of Sports Medicine) guidelines. Both organizations recommended 30 plus minutes of primarily cardiovascular or resistance exercise performed to a moderate or greater level of intensity five days per week [12,13]. While there are two other exercise types in the overall recommendations (flexibility and functional training), cardiovascular and resistance training components were emphasized because of their influence on health through increased fitness. That recommendation was used to ensure that the participants were fairly well matched in their current exercise regimens consisting of both components. There were potential participants who were excluded due to not meeting minimal exercise requirements.

Prior to participation, potential subjects' health and exercise histories were reviewed to ensure there were no contra-indications to further exercise or participation in either the control or the intervention group. Specifically, potential participants were excluded who had a history of cancer, specifically breast cancer, and were instructed not to take supplements or medications that would interfere with estrogen modulation. Applications were reviewed by the Colorado Center for Health & Sport Science Institutional Review Board (IRB). Because the study agent was a supplement, there was no national registry of the study.

The study took place over 180 days. After subject selection and screening, there was a 30-day ramp-up portion to test the subjects, then 60 days of consuming either the placebo or supplement. Then subjects were tested in time order during the concluding 30 days.

After review of the application and possible waivers, participation was determined. Acceptable individuals were placed in the subject pool. The subjects were randomly assigned to either a control group (n=5) or the intervention group (n=13). Each subject either consumed the placebo or supplement (HerHeart, Bergamet NA, USA), as a single pill, one in the morning and one in the evening with meals (Figure 1).

Testing consisted of both physiological and psychological variables. The physiological measures were included to determine the effectiveness of the supplement on parameters such as weight, body composition, VO2 max and strength. Subjects were weighed, then performed a body composition test using bioelectrical impedance (RJL Systems, Clinton, MI) with scores recorded for fat weight, body fat %, and Lean Soft Tissue (LST) [14,15]. LST refers to the body water total, total body protein, carbohydrates, nonfat lipids, and soft tissue mineral. It may give more meaningful information than just lean muscle estimates, because it also reflects the other tissues that support muscle, such as tendons and ligaments.

Muscular endurance and power were measured with an isokinetic dynamometer device (HydraFitness, Belton, TX) [16,17]. This device does allow minimal acceleration from set speed by a few degrees per second versus other dynamometers where the speed is totally fixed in the testing movement. For both endurance and power, the exercises/movements of chest press, row, individual leg extension/curl and shoulder press, latissimus pull-down were used. For the upper body movements, both sides were linked and joined during testing, using

bilateral testing. In case of the leg movements, the measurements were taken separately on each side (unilateral testing), then scores combined (right plus left) for that measure, either leg extension or leg curl.

Each test was preceded by setting the machine for subject size, and then securing seating and movement arm attachments. Each movement included a warm-up of two to four repetitions for each speed, with the participant then setting their own range of motion prior to the actual test. For muscular endurance, 20 repetitions of approximately 300 degrees per second of maximal speed for each movement was used, noting the total work produced in foot pounds. At the end of all eight measures, the scores were added together for an aggregate total [16,17].

Muscular power used a similar protocol, except the speed was reduced to 60 degrees per second. In addition, each subject only performed five repetitions, and the best score in peak torque was recorded, and then aggregated with the other measures to give a picture of subject muscular power. Rest periods of 45 sec to 60 sec between each test were used to ensure the subject was recovered and ready to perform the next test. At the end of all eight measures, the scores were added together for an aggregate total.

Energy system fitness was assessed during a standard VO2 Peak/Max profile using bicycle ergometry. For this test, an Oxycon Mobile Metabolic system (Vyaire Medical, Mettawa, IL) was used paired with a *via* sprint medical ergometer [18]. The system was calibrated according to manufacturer recommendations before each test for ambient conditions, flow volume and gas measurement precision. The subject was then fitted to the ergometer for proper seat height, and then paired with a heart rate monitor and the respiratory mask that most closely fit head size. These component sizes were recorded for use in the re-test.

The protocol was for the subject to pedal at no load for two minutes to become familiar with the mask and headgear. After two minutes, the initial load was set at 20 watts. Based upon body size, wattage was increased either 20 watts per minute at that point for subjects over 200 pounds, or 10 watts per every 45 sec for those under 200 pounds. During the test, subjects referred to a ten-point Rate of Perceived Exertion (RPE) scale, which was correlated with effort to ensure maximum effort at the end of the test. During the final stage, the subject was asked to work to a level where Respiratory Exchange Ratio (CO₂ to O₂) was at least 1.10, indicating maximum effort. They were asked to hold that effort for at least 30 sec at the end of the test to ensure an accurate, maximal measurement. That wattage and level was recorded as a target point for the second test at the end of the study.

VO2 peak and Anaerobic Threshold (AT) was recorded in milliliters of oxygen per kilogram of body weight per minute (ml/kg/min⁻¹). While there are a number of valid means to assess AT, the Respiratory Exchange Ratio (RER) of 1.0 was used for consistency because of the carefully graded and ramped exercise test [19]. VO2 peak/max is a standard measure of total cardio-respiratory fitness, while AT is indicative of training levels and is a good correlate of "cruise control" or where the person can perform aerobic exercise at a comfortable level [20].

The mood and psychological state of the subject was assessed using an Utian Quality of Life (UQOL) scale, an instrument specific to menopausal women, to determine if the supplement had an

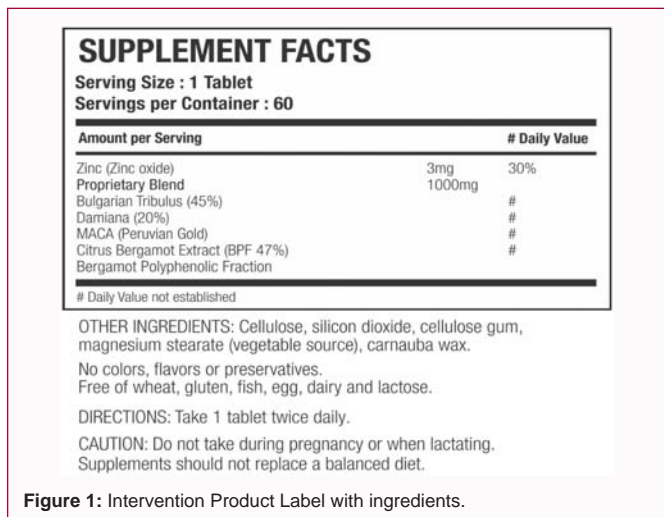


Figure 1: Intervention Product Label with ingredients.

effect on mood and psychological state [21]. This scale enables the participant to rate their quality of life or sense of well-being in the areas of Occupational QOL, Health QOL, Emotional QOL and Sexual QOL. The combined total from the four areas results in a total QOL index, which has been used successfully with both peri- and post-menopausal women [22]. The subjects were given instructions on how to use the rating scale, which used numerical responses from one to five, and the time frame to use in gauging the applicability of a response, recalling their last two weeks of averaged feelings. Results were tabulated for each area, as well as combing the scores from the four areas to give an overall view of their feelings on current quality of life.

Results and Discussion

The results are viewed in four sub-areas. Each contains starting average level, finishing measurement and basic statistics. Statistics were calculated for students' T tests and mean, Standard Deviation (SD) and significance are reported for each area. Significance was set at p value of <0.05.

For body weight, body composition and lean soft tissue, there was no change to statistically significant levels. While there was a small degree of variance from group to group, they were for all practical purposes equal in the pre and post measures for each group as evidenced in the data table (Table 1).

Both muscular endurance and power significantly increased for the intervention group compared to the control group. The intervention group significantly increased their average total muscular endurance from 1362 to 1746-foot pounds of work (Fpw), while the control group only increased from 1307 to 1321 Fpw. The control group increased their aggregate muscular power from 364 to 382 foot-pounds of peak torque (Fppt), while the intervention group increased from 425 to 538 Fppt. The changes in both categories for the intervention group were statistically significant (Table 2).

Anaerobic Threshold and VO2 Max both increased to statistically significant levels for the intervention group compared to the control group. AT measures were relatively constant for the control group, 14.3 to 13.76 ml/kg/min⁻¹. For the intervention group, AT increased from 17.18 to 19.52 ml/kg/min⁻¹, which was statistically significant. VO2 max remained relatively constant for the control group, with the first average value of 17.24 increasing to 17.52 ml/kg/min⁻¹ for the

Table 1: Age and Basic Anthropometric Measurements.

Variable	Pre	Post	Sig
Age-Control	65.8 ± 6.42		
Age-Intervention	60.15 ± 5.77		
Weight-Control	168.64 ± 27.39	169.35 ± 27.27	
Weight-Intervention	161.38 ± 38.80	159.45 ± 38.24	0.256
Body Composition%-C	31.46 ± 2.26	31.46 ± 2.68	
Body Composition%-I	30.65 ± 9.22	31.42 ± 2.68	0.441
Lean Soft Tissue-C	107.18 ± 15.38	107.92 ± 14.73	
Lean Soft Tissue-I	102.86 ± 12.23	100.45 ± 12.40	0.11

Weight and Lean Soft Tissue are reported in pounds
 Values are presented as mean±standard deviation

Table 2: Muscular Endurance and Power Results.

Variable	Pre	Post	Sig
M. Endurance - Control	1307 ± 267.19	1321 ± 216.99	
M. Endurance - Intervention	1362 ± 301.79	1746 ± 341.44	0.032
M. Power - C	364 ± 48.2	382 ± 76.97	
M. Power - I	425 ± 93.01	538 ± 99.99	0.033

Values are in ft. pounds of force
 Values are presented as mean ± standard deviation
 P<0.05

Table 3: Anaerobic Threshold & VO2 Max Results.

Variable	Pre	Post	Sig
Anaerobic Threshold - Control	14.3 ± 3.03	13.76 ± 2.62	
Anaerobic Threshold - Intervention	17.18 ± 4.75	19.52 ± 5.65	0.009
VO2 Max - C	17.24 ± 3.40	17.52 ± 3.48	
VO2 Max - I	22.44 ± 6.13	24.23 ± 5.99	0.004

Values are in ml/kg/min-1
 Values are presented as mean ± standard deviation
 P<0.05

second test. For the intervention group, the initial average was 22.11 ml/kg/min⁻¹ increasing to 24.23 ml/kg/min⁻¹, which was statistically significant (Table 3).

Total UQOL scores increased significantly for the intervention group (80 to 92), with both health (25.08 to 28.92) and sexual (10.31 to 11.31) function scores increasing significantly. Occupational satisfaction and emotional scores were not significant at the P value of <0.05, but trended positive compared to the placebo group (Table 4).

As the subjects in this study were already exercising women with consistent exercise routines, the positive changes in fitness level and mood states for the intervention group can be linked to the supplement. In both the case of muscular endurance & power as well as energy system measurements, (in this case anaerobic threshold & VO2 max), increases in fitness scores are normally the result of additional time or intensity [23,24]. The fact that those two factors were consistent during study time points further to the conclusion that the supplement had a mediating effect of significant improvements [25-28].

An important issue to this discussion is dynapenia, or loss of strength after age 50, is just as important as sarcopenia, or loss of muscle mass [29]. This condition, dynapenia, is now thought of as a critical component to older individuals moving effectively and safely in activities of daily living, fitness and sports. The fact that the intervention group had increases in power without corresponding increases in lean soft tissue, indicates that the supplement was

Table 4: Utian Quality of Measures.

Variable	Pre	Post	Sig
UQOL Total- Control	75.2 ± 14.44	73 ± 16.57	
UQOL Total- Intervention	80 ± 14.29	92 ± 12.06	0.015
Occupational QOL -C	23.6 ± 5.50	23.4 ± 5.13	
Occupational QOL -I	24.16 ± 6.30	27.38 ± 4.57	0.23
Health QOL -C	22 ± 4.35	22.6 ± 4.57	
Health QOL -I	25.08 ± 5.12	28.92 ± 4.11	0.005
Emotions QOL -C	21.3 ± 6.30	20.8 ± 5.80	
Emotions QOL -I	20.92 ± 5.57	23.92 ± 5.00	0.245
Sexual QOL -C	8.4 ± 2.07	8.4 ± 2.07	
Sexual QOL -I	10.31 ± 3.12	11.31 ± 2.83	0.011

Values are scored in a 1-5 rating scale, then totalled for that sub-area
Values are presented as mean ± standard deviation

probably at least partially responsible for these benefits, which are normally neurological in adaptation [30,31].

Even more interesting was the fact that UQOL scores in total improved significantly for the intervention group in the eight weeks more dramatically compared to other studies [32,33]. In the occupational health area, a few subjects changed job duties, and a few more re-entered or exited the workforce causing a slight skew of the findings in this test. However, this parameter still trended positive for the supplement. This outcome may also be related to the scores for the emotional sub-area trending positive but not significant. Interestingly as well was the fact that the intervention subjects felt much better about their health and sexual function compared to the control group as evidenced by statistically significant changes in these two areas of the questionnaire.

Polyphenols are found in a variety of plant products, and have been the subject of a number of studies on human health and function [34]. Certain polyphenols, including quercetin, catechins, lignans, resveratrol, and curcumin may have a role in cancer prevention as well as minor exercise benefits [35,36]. These phytochemicals are natural compounds known for their antioxidant effects [37].

It is further likely the secondary ingredients in the study formulation used as the intervention compound, also had a synergistic effect with the main ingredient, Bergamot. Maca, (commonly known as "Peruvian Ginseng"), has been used for almost 3,000 years and has the known benefits of mood elevation, reduced stress and anxiety and minimizing hormonal balance symptoms [38-41]. Tribulus has demonstrated results in blood sugar and cholesterol regulation [42-44]. Another secondary compound in the supplement, Damiana, has positive effects on symptoms of depression and is postulated to aid in weight control [45,46].

Some polyphenols improve the function and health of blood vessels and may help to slow down the occurrence of thrombotic events [47]. For example, researchers have found that the catechins in tea may have the ability to mitigate arterial clogging [48]. Bergamot has had a primary research focus in cardio-metabolic conditions, where it has been demonstrated to have benefits similar to a statin [25,48]. A fair amount of research has been performed on Bergamot citrus in this regard with positive results [49-52].

The effects of polyphenols, specifically Bergamot, are dependent upon potency, dosage and concentration. At an adequate level

of potency, the research has demonstrated effects of lowering triglycerides and LDL cholesterol, blood sugar modulation, and promoting general arterial function and flow, and thus improving cardiovascular health [53-55]. Secondary benefits have included decreased inflammation, increased function in tissues where blood flow is important and possible slowing of senescence [56,57].

Given the fact that the primary ingredient aids with inflammation and circulation, it is postulated that increased muscular endurance and power, and VO2 max scores are related to increased recovery and work capacity demonstrated in this project [26,27,58-61]. This finding may be related to recovery that occurs between resistance training sets. The results may also be more broadly attributed to more complete recovery after a total training session meaning the next day the subject was able to work at a higher work rate or intensity at a sufficient intensity.

The results of the UQOL measurements, specifically parallel and confirm a study performed with same compound at the University of Catanzaro, Italy [62]. In that study, the five sub-domains of the Sexual Quotient test used all improved to statistically significant levels compared to the placebo/control group in a 90-day trial. Data was also collected on the number of self-reported hot flashes experienced on a daily basis and mood swings of both groups. The result was a significant reduction in hot flashes and a meaningful improvement in mood swings in the group taking the same supplement. While not recorded for all subjects, this mirrors the reports from the intervention subjects in our group during their post-study exit interviews.

Conclusion

In this pilot study, a unique Bergamot-based supplement improved fitness scores in already exercising menopausal women in both VO2 max and strength related variables. Just as notable is the increase of positive mood and quality of life as demonstrated by the UQOL scores for the intervention group. This indicates the UQOL is useful in the short term for the clinician to assess mood and health changes due to various interventions in menopausal women.

Certain polyphenols, as found specifically in adequate doses and concentrations of this Bergamot supplement, appear to hold promise in improving fitness and quality of life measures for menopausal women.

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