ABSTRACT

Pugliese, A. J. The effects of 90 days of Km supplementation on aerobic capacity and general well-being of healthy adults. MS in Adult Fitness/Cardiac Rehabilitation, May 1996, 60pp. (J. Porcari)

Km is a potassium/mineral supplement produced by Matol Botanical, Inc. It is one of the most widely sold liquid supplements and is comprised of 14 botanicals. This study investigated the effects of 90 days of Km supplementation on aerobic capacity and general well-being. Thirty apparently healthy adults were divided into control and experimental groups. Both groups completed a treadmill VO_2max test and General Well-Being Schedule (GWBS) at the beginning and completion of the study. The experimental group was supplemented with Km liquid (30 ml, taken 15 ml 2x/day) for 90 days. A 3-day diet analysis was also collected. Results of the treadmill tests and the GWBS from pre- to posttest were compared with paired t-tests, and a 3-way ANOVA was used to compare the groups. There were no significant ($p > .01$) differences in resting hemodynamics or maximal physiological responses from pre- to posttesting. There was also no significant ($p > .05$) differences between control and experimental groups for the same variables. The experimental group increased their general well-being significantly ($p < .01$) from pre- to posttesting by approximately 9.1 points. It is concluded that 90 days of Km supplementation does not increase aerobic capacity in healthy adults but may improve an overall sense of well-being.

THE EFFECTS OF 90 DAYS OF KM SUPPLEMENTATION ON AEROBIC CAPACITY AND GENERAL WELL-BEING OF HEALTHY ADULTS

A MANUSCRIPT STYLE THESIS PRESENTED

TO

THE GRADUATE FACULTY

UNIVERSITY WISCONSIN-LA CROSSE

IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE

MASTER OF SCIENCE DEGREE

BY

ARI PUGLIESE

MAY 1996

COLLEGE OF HEALTH, PHYSICAL EDUCATION, AND RECREATION
UNIVERSITY OF WISCONSIN-LA CROSSE

THESIS FINAL ORAL DEFENSE FORM

Candidate: Ari J. Pugliese

We recommend acceptance of this thesis in partial fulfillment of this candidate's requirements for the degree:

Master of Science in Adult Fitness/Cardiac Rehabilitation

The candidate has successfully completed his/her final oral examination.

John P. Porcari — July 20, 1995
Thesis Committee Chairperson Signature — Date

Sandra Ploeg — July 20, 1995
Thesis Committee Member Signature — Date

C. Scott Robertson — July 20, 1995
Thesis Committee Member Signature — Date

This thesis is approved by the College of Health, Physical Education, and Recreation.

Gary Tyeson — 7-28-95
Associate Dean, College of Health, Physical Education, and Recreation — Date

Joe Ann Sellers — 7 August 1995
Dean of UW-L Graduate Studies — Date

ACKNOWLEDGEMENTS

I would like to express my deepest thanks to the following people for helping me to complete my thesis:

To Dr. John Porcari, for his patience and time spent with me throughout the year as my thesis chairperson and professor. His door was always open to me when I needed help.

To Dr. Sandy Price and Dr. Stu Robertshaw for participating on my thesis committee and providing valuable insight.

To the "Dodgeman" for assisting me in the laboratory and providing heart rate monitors on demand.

To Laurayne for providing her wordprocessing expertise. Her important role in the completion of all our theses should not go unnoticed.

To my family for providing love and support (emotional and financial) throughout the year.

Last but surely not least, I would like to thank my beautiful girlfriend, Jeanneane. She was instrumental (in many ways) to the completion of this research project.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

INTRODUCTION

Athletes at all levels of competition are constantly searching for a means to obtain a competitive edge over their opponents. Often these means include utilizing substances known as ergogenic aids. Ergogenic aids are defined as any substance or device used to improve exercise and athletic performance and may be grouped into several categories; mechanical, psychological, physiological, and nutritional. When discussing nutritional ergogenic aids, marketing ploys have convinced consumers that active people can benefit from large doses of nutritional supplements. As a result, the supplement business has blossomed into a multibillion-dollar industry (Smith & Worthington-Roberts, 1989). Nutritional ergogenic aids include macronutrients (protein and carbohydrates), micronutrients (vitamins and minerals), and other dietary substances not required in human metabolism such as caffeine and herbal compounds.

Km potassium/mineral supplement (Km) is one of the most widely sold nutritional supplements. Produced by Natol Botanical Inc., Montreal, Canada, Km is a compilation of 14 botanicals. With over 20 million bottles sold, this formula has been consumed by people from many countries for 70 years. Although there has not been a controlled study looking at the effects of Km, consumers claim that the formula "has changed their lives". As well as an overall feeling of well-being, athletes claim that Km enables them

to train harder and longer. Km is marketed as a food supplement and Matol Botanical International does not make any therapeutic claims about the formula. The daily recommended amount of Km contains about one-third the recommended dietary allowance (RDA) of potassium and small amounts of calcium, iron, and iodine. Although the botanicals in Km contain many vitamins, including B-complex, vitamins E and C, the quantities are difficult to identify. Therefore the vitamin content of Km is not stated.

The ergogenic effects experienced by athletes taking Km may be due to the vitamin and mineral constituents, the therapeutic benefits of the botanicals, or the placebo effect. There has been extensive research investigating the usage of vitamin and mineral supplementation on human performance. Since vitamins and minerals are involved in the regulation of a wide variety of metabolic processes in the body, it has been thought that megadosing may be beneficial.

Research to date has yet to consistently quantify if supplementation of vitamins and/or minerals has a significant ergogenic effect (Williams, 1985). It appears that a normal varied diet, in amounts providing adequate fluids and calories, can provide all the vitamins and minerals an athlete can use, if appropriately varied foods are selected (Weight, Myburgh, & Noakes, 1988).

It is more likely that the therapeutic actions of the

botanicals found in Km are responsible for the ergogenic effects reported. While clinical studies have been conducted on many of the individual botanicals, a study involving the combined mixture in Km has not been reported to date. The research conducted on the individual botanicals is limited and conclusions from the studies are difficult to make. This is primarily due to the research being centered around disease prevention and not performance. Also, the properties of the individual botanicals many be different when combined together.

The purpose of this study was to determine the effects of 90 days of Km supplementation on aerobic capacity and general well-being of apparently healthy adults.

METHODS

Subjects

Thirty (16 males and 14 females) apparently healthy volunteers were recruited from the University of Wisconsin-LaCrosse (UW-L) and the surrounding community. The subjects were between the ages of 27-49 years with men less than 40 and women less than 50 years. The subjects were of "average" fitness level or below, based upon their current exercise habits. All subjects completed a medical history and an informed consent form approved by the Human Subjects Committee at UW-L prior to beginning the study (see Appendices A & B). Participation in this study excluded subjects taking prescription or nonprescription medication,

and any form of nutritional supplement. The subjects were randomly assigned to either a control or experimental (supplement) group. Finally, a practice session was scheduled with each successfully screened subject.

Practice Session

Approximately 1 week prior to pretesting, a practice session was held. At this time the researcher gave directions to each subject regarding mounting and dismounting the treadmill safely (treadmill model #24-72, Quinton Instruments, Seattle, WA), proper body positioning, and walking technique while on the treadmill, the use of the heart rate monitor, and the use of the headgear, mouthpiece, and nose clip to be used for the collection of expired gases. The Q-Plex open circuit gas analyzer was explained. The researcher then gave time for the subject to practice walking on the treadmill with all the equipment in place. Next, the modified Balke treadmill protocol and the Borg Rating of Perceived Exertion (RPE) Scale were explained. Any questions that the subjects had were answered during this time. An appointment for the pretest was made and written instructions were given to each subject regarding information about their testing day procedures. Finally, each subject was given a 3 day diet and exercise log. Instructions were given and they were asked to complete the log before the pretest session.

Pre- and Posttest Sessions

Subjects were asked not to exercise for 24 hours or eat for 3-4 hours prior to their scheduled test. The subjects were instructed to report to the UW-L Human Performance Laboratory in comfortable exercise clothes and shoes. The subject's 3 day diet logs were collected and analyzed using the Nutritionist IV (1993) computer software package. Before testing, the Q-Plex was prepared and calibrated by entering ambient room conditions, synchronizing calibration gases to the appropriate settings, and volume calibration via injecting a known volume of 2.850 L into the pneumotach.

Upon arrival, each subject was weighed without shoes to the nearest .1 kg, and height was measured to the nearest 1 cm. A Polar Vantage XL model heart rate monitor (Polar Inc., Stamford, CT) was used to monitor heart rates. The subjects wore a chest band that contained a transmitter located directly over the heart. This transmitter sends signals to a receiver worn on the wrist which displays the subject's heart rate. Following a 5 minute rest, heart rate and blood pressure were monitored. Blood pressure was taken on the left arm through auscultation. At this time the subjects completed the General Well-Being Schedule (Public Health Service, 1977) (see Appendix C). Next, the headgear and mouthpiece were fitted and secured to the subject. A noseclip was affixed so that expired air only passed through the breathing tube and into the Q-Plex open circuit spirometer.

Subject's VO_2max was measured on a motorized treadmill using a modified Balke protocol. The treadmill test began with a 5 minute warm-up, walking at a speed of 3 mph and a 5% grade. Following the warm-up each subject began the test, walking or running at their self-selected speed and starting at a 0% grade. The speed of the treadmill remained constant and the grade progressively increased by 2.5% every 2 minutes until the subject reached volitional exhaustion. Ventilation ($L \cdot min^{-1}$), VO_2 ($L \cdot min^{-1}$, $ml \cdot kg^{-1} \cdot min^{-1}$), treadmill time (minutes), METS, respiratory exchange ratio (RER), and heart rate (beats/min) were recorded at the end of each minute. Blood pressure and ratings of perceived exertion (Borg 6-20 scale) were recorded at the end of each stage and at maximal exertion.

Criteria for maximal effort included a plateau in oxygen consumption, a heart rate within 10 beats of predicted maximal values (220-age), and an R-value greater than 1.0. Two of the 3 criteria for a maximal effort had to be met for a "true" maximal exercise test. Maximal oxygen consumption was determined as the highest 1 minute value of VO_2 attained during the test. The highest heart rate reached during the test was used as the maximal heart rate (MHR).

Immediately postexercise, a cool-down period was completed while walking at a comfortable speed and 0% grade for 5-10 minutes, or until the subject's heart rate returned to near resting state or leveled off.

Supplementation Period

The subjects in the experimental (supplement) group were given a 90 day supply of Km liquid. The daily dosage was 30 ml (2 tablespoons), to be taken 15 ml in the morning and 15 ml in the evening. The subjects were given a log book and asked to record their daily dosages as well as their weekly physical activity (see Appendix D). The control and experimental groups were instructed to maintain their current activity and eating patterns throughout the study's duration. A research assistant contacted each subject once every 7-10 days to monitor progress and answer any questions.

Statistical Analysis

Standard descriptive statistics were used to characterize the subject population. A three-way analysis of variance (ANOVA) (sex x group x pre-post) with repeated measures was used to determine if significant changes between groups occurred over the course of the study. The alpha level was set at .05 to achieve statistical significance. Paired t-tests were used to detect within group differences from pre- to posttesting. Because multiple t-tests were used, the alpha level used to achieve statistical significance was reduced to .01 according to methods of Bonferonni.

RESULTS

The pretest physical characteristics of the subjects are summarized in Table 1. Subjects (N = 30) were recruited from UW-L and the surrounding community and ranged in age from 27-49. The females in the experimental group were significantly ($p < .05$) older than the females in the control group. There were no significant ($p > .05$) differences between groups in height and weight.

Table 1. Pretest physical characteristics of subjects (M ± SD)

Group	n	Age (yr)	Height (cm)	Weight (kg)
Control				
Overall	14	36.4 ± 6.4	171.3 ± 9.3	79.6 ± 18.6
Male	7	35.7 ± 3.2	176.3 ± 6.0	92.9 ± 13.8
Female	7	37.1 ± 8.9	166.2 ± 9.6	66.3 ± 12.1
Experimental				
Overall	16	37.8 ± 6.0	174.8 ± 7.3	80.2 ± 17.0
Male	9	34.1 ± 4.4	179.0 ± 6.3	90.9 ± 14.2
Female	7	42.4 ± 4.3*	169.5 ± 4.6	66.4 ± 7.3

* = Significantly greater than female controls ($p < .05$).

During the supplementation period the subjects recorded their exercise habits in a weekly log. On average, the control and experimental groups exercised aerobically for 3-4 days a week for 30-45 minutes. Their activities included walking, jogging, biking, stationary skiing, and aerobics. The weekly log revealed that both groups maintained their exercise duration, frequency, and intensity throughout the

study. The experimental group also recorded their dosages in a log. Of 180 possible doses, both males and females missed an average of 5 dosages (range = 0-14). This indicates an average compliancy rate of 97%.

The pre- and posttest resting hemodynamic responses are presented in Table 2. There were no significant ($p > .01$) within group differences for heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) over the course of the study. No significant ($p > .05$) differences were found between the control and experimental groups for the same variables.

The physiological responses to the two maximal treadmill tests are presented in Table 3. There were no significant ($p > .01$) within group differences for any of the variables over the course of the study. No significant ($p > .05$) differences were found between the control and experimental groups for the same variables.

The scores obtained from the General Well-Being Schedule (GWBS) are presented in Table 4. Overall the experimental group had a significant ($p < .01$) increase in the GWBS of 9.1 points from pre- to posttesting. This trend was similar for males and females but neither group achieved statistical significance ($p > .01$). However, there was no significant ($p > .05$) difference between groups for changes in the GWBS.

Table 2. Pre- and posttest resting hemodynamics (M ± SD)

Group	n	Pretest	Posttest	▲
HR (bpm)				
Control				
Overall	14	80.0 ± 9.0	79.6 ± 11.4	-0.4
Male	7	82.3 ± 9.5	75.4 ± 5.4	-6.9
Female	7	77.7 ± 8.6	83.7 ± 14.5	6.0
Experimental				
Overall	16	70.3 ± 9.3	70.4 ± 8.0	0.1
Male	9	67.6 ± 8.6	67.8 ± 7.7	0.2
Female	7	73.7 ± 9.7	73.9 ± 7.4	0.2
SBP (mm hg)				
Control				
Overall	14	114.1 ± 13.7	115.9 ± 10.8	1.8
Male	7	122.9 ± 8.6	122.9 ± 8.07	0.0
Female	7	105.4 ± 10.1	108.9 ± 11.4	3.5
Experimental				
Overall	16	112.7 ± 13.2	113.9 ± 12.9	1.2
Male	9	119.1 ± 7.5	121.6 ± 8.7	2.5
Female	7	106.2 ± 5.4	104.0 ± 10.7	-2.2
DBP (mm hg)				
Control				
Overall	14	76.6 ± 5.8	75.3 ± 10.4	-1.3
Male	7	80.4 ± 5.4	79.4 ± 10.3	-1.0
Female	7	72.7 ± 5.1	71.1 ± 9.4	-1.6
Experimental				
Overall	16	71.8 ± 9.6	72.6 ± 7.1	0.8
Male	9	76.4 ± 9.4	74.9 ± 6.7	-1.5
Female	7	65.7 ± 6.2	69.7 ± 6.9	4.0

▲ = posttest-pretest

Table 3. Pre- and posttest maximal physiological responses obtained during the treadmill tests (M ± SD)

Group	n	Pretest	Posttest	▲
Wt (kg)				
Control				
Overall	14	79.6 ± 18.6	78.9 ± 18.6	-0.7
Male	7	92.9 ± 13.8	91.5 ± 14.8	-1.4
Female	7	66.3 ± 12.1	66.3 ± 12.7	0.0
Experimental				
Overall	16	80.2 ± 17.0	79.8 ± 17.0	-0.4
Male	9	90.9 ± 14.2	90.3 ± 15.2	-0.6
Female	7	66.4 ± 7.3	66.3 ± 5.5	-0.1
VE ($L \cdot min^{-1}$)				
Control				
Overall	14	107.4 ± 33.4	105.3 ± 31.8	-2.1
Male	7	135.9 ± 18.4	133.3 ± 25.3	-2.6
Female	7	78.9 ± 13.6	77.3 ± 9.6	-1.6
Experimental				
Overall	16	113.9 ± 33.1	115.8 ± 32.9	1.9
Male	9	136.1 ± 25.7	139.5 ± 22.4	3.4
Female	7	85.2 ± 12.4	85.4 ± 10.5	0.2
VO_2 ($L \cdot min^{-1}$)				
Control				
Overall	14	2.991 ± .885	2.919 ± .768	-0.072
Male	7	3.758 ± .542	3.634 ± .584	-0.124
Female	7	2.224 ± .168	2.185 ± .174	-0.039
Experimental				
Overall	16	3.271 ± 1.099	3.273 ± 1.102	0.002
Male	9	4.115 ± 0.605	4.131 ± 0.558	0.016
Female	7	2.186 ± 0.302	2.170 ± 0.323	-0.016
VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)				
Control				
Overall	14	37.5 ± 6.4	36.7 ± 5.7	-0.8
Male	7	40.8 ± 5.9	39.8 ± 5.7	-1.0
Female	7	34.2 ± 5.3	33.6 ± 5.2	-0.6
Experimental				
Overall	16	40.5 ± 10.5	40.5 ± 9.9	0.0
Male	9	46.2 ± 9.9	46.5 ± 8.5	0.3
Female	7	33.2 ± 5.8	32.8 ± 5.5	-0.4

Table 3. Continued

Group	n	Pretest	Posttest	▲
RPE				
Control				
Overall	14	19.6 ± 0.6	19.4 ± 0.9	-0.2
Male	7	19.9 ± 0.4	19.4 ± 1.13	-0.5
Female	7	19.4 ± 0.8	19.4 ± 0.5	0.0
Experimental				
Overall	16	19.3 ± 0.5	19.4 ± 0.5	0.1
Male	9	19.2 ± 0.4	19.4 ± 0.5	0.2
Female	7	19.4 ± 0.5	19.4 ± 0.5	0.0
RER				
Control				
Overall	14	1.11 ± 0.05	1.11 ± 0.06	0.0
Male	7	1.13 ± 0.04	1.14 ± 0.03	0.01
Female	7	1.10 ± 0.06	1.09 ± 0.07	-0.01
Experimental				
Overall	16	1.15 ± 0.05	1.15 ± 0.05	0.0
Male	9	1.15 ± 0.03	1.14 ± 0.04	-0.01
Female	7	1.16 ± 0.07	1.17 ± 0.05	0.01
HR (bpm)				
Control				
Overall	14	183.4 ± 9.0	184.6 ± 8.4	1.2
Male	7	188.1 ± 9.1	190.1 ± 6.7	2.0
Female	7	178.6 ± 6.3	179.0 ± 6.0	-0.4
Experimental				
Overall	16	183.2 ± 12.5	183.3 ± 13.3	0.1
Male	9	188.0 ± 12.9	188.6 ± 13.8	0.6
Female	7	177.0 ± 9.6	176.6 ± 9.6	-0.4

▲ = posttest-pretest

Table 4. Pre- and posttest scores obtained from the General Well-Being Schedule (M ± SD)

Group	n	Pretest	Posttest	▲
Control				
Overall	14	79.4 ± 17.2	80.6 ± 17.4	1.2
Male	7	75.7 ± 14.1	79.4 ± 16.0	3.7
Female	7	83.0 ± 20.3	81.9 ± 19.9	-1.1
Experimental				
Overall	16	80.3 ± 13.5	89.4 ± 8.7*	9.1
Male	9	84.4 ± 12.0	90.3 ± 9.7	5.9
Female	7	75.0 ± 14.3	88.1 ± 7.7	13.1

▲ = Posttest-pretest
* = Significant change within group from pre- to posttesting ($p < .01$).

DISCUSSION

This study tried to determine if 90 days of Km supplementation could improve the aerobic capacity and general well-being of healthy adults. It was found that the maximal physiological responses obtained during the treadmill test did not significantly change as a result of 90 days of supplementation. Also there were no changes in resting hemodymanics over the course of the study.

To the author's knowledge, there has not been a controlled study investigating the effects of Km on exercise performance. There has been research conducted on the individual botanicals, but it is centered around disease prevention and not performance. Although difficult to quantify, the botanicals found in Km are rich in many vitamins and minerals. There has been extensive research

investigating the use of vitamin and mineral supplementation on human performance. The results of the current study will be compared to recent studies surrounding vitamin and mineral supplementation.

Studies involving vitamin and mineral supplementation have generally found similar results to those of the current study. Singh, Moses, and Deuster (1992) found that maximal aerobic capacity did not improve after 90 days of a high potency multivitamin-mineral supplement. Weight et al. (1988) supplemented athletes over a 9 month period. None of the maximal physiological responses to exercise were increased. A study of similar duration by Telford, Catchpole, Deakin, Hahn, and Plank (1992) used a vitamin and mineral supplement and again showed no improvements in physical performance.

In the previous studies the subjects consumed a varied diet and were not deficient in any nutrient. This research indicates that supplementing subjects without nutrient deficiencies does not increase performance measures. In the present study, diets were recorded for 3 typical days and analyzed using the Nutritionist IV software package (1993). The results are summarized in Appendix E.

The RDA for adult males and females who partake in moderate levels of physical activity are 2,300-2,900 and 1,900-2,200 kcal/day (National Research Council, 1989), respectively. It was found that all groups consumed the

necessary amount of kcals except the females in the experimental group (1,687 kcals). The subjects consumed a varied diet and exceeded 100% of the RDA for most vitamins and minerals. The only exceptions were that the males and females of both groups displayed inadequate levels of zinc, males in both groups failed to meet the RDA for A-tocopherol and magnesium, and the females in the experimental group were below the RDA for calcium (88%) and magnesium (89%).

It should be remembered that RDAs are neither minimal requirements or optimal levels of intake. Rather, they are safe and effective levels, taking into account the variability in requirement among people (National Research Council, 1989). It is difficult to make conclusions about individual deficiencies without knowing actual blood levels of the specific vitamins and minerals. Although, according to the 3 day diet collection, the subjects consumed a nutritionally adequate diet. This is one possible explanation why improvements in aerobic capacity were not seen.

Research involving subjects with nutritional deficiencies has found aerobic capacity to be compromised (Barborka, Foltz, & Ivy, 1943; Suboticanec, Stavljenic, Schalch, & Buzina, 1989; Van der Beek et al., 1988). Upon correction of the deficiency, aerobic capacity is restored, but not improved.

Although the experimental group did not exhibit

improvements in aerobic capacity, they did show significant pre- to posttesting increases in the General Well-Being Schedule (Public Health Service, 1977). A high score is indicative of good or positive adjustment. Although not significant between groups, there was a trend for the experimental group overall, ($p = .09$) and females ($p = .08$) to have favorable changes. According to the scores on the GWBS, all subjects were clinically stable. The current findings of this study are similar to the anecdotal evidence of improved energy levels and feeling of well-being reported by many consumers of Km.

According to Colgan (1993), consumers may be mistaking sensation with physiology. It is possible that the compilation of botanicals found in Km may produce a euphoric feeling which would explain the increase in general well-being. It is also possible that the properties of the botanical provide therapeutic benefits to the various bodily systems. Due to the scope of this study, these conclusions are difficult to make. One final explanation for the result reported would be the placebo effect. It has been noted that most athletes undertaking any nutritional manipulation, in conjunction with a belief that they will benefit, will be likely to improve their performance (Burke & Reed, 1989). Since this was not a double-blind, placebo controlled study, (the control group did not take any liquid) this issue can not be addressed.

In summary, the results from the current study found that 90 days of Km supplementation does not enhance aerobic capacity in healthy adults. Km may be a beneficial supplement as reported by the increase in general well-being. It is difficult to conclude that energy levels will be enhanced due to the nature of the scale. For example, a decrease in reported happiness or emotional control would offset an increase in energy levels.

Finally, more research involving nutritional supplements, especially herbal, as ergogenic aids needs to be performed. Consumers will continue to search for any means to enhance performance. Also, the recent interest in holistic health has people searching for ways to maximize their health. Clinical studies will give answers to much of the confusion and prevent consumers from spending needless dollars.

REFERENCES

Barborka, C. J., Foltz, E. B., & Ivy, A. C. (1943). Relationship between vitamin B complex intake and work output in trained subjects. The Journal of the American Medical Association, 122, 717-720.

Burke, L. M. & Reed, R. S. (1989). Sports nutrition: Approaching the nineties. Sports Medicine, 8(2), 80-100.

Colgan, M. (1993). Optimum sports nutrition: Your competitive edge. New York: Advanced Press.

National Research Council. (1989). Recommended dietary allowances (10th ed.). Washington, DC: National Academy Press.

Nutritionist IV [computer software]. (1993). Salem, Oregon: N-Squared Inc.

Public Health Service (1977). A concurrent validational study of the NCHS General Well-Being Schedule (DHEW publication # HRA 78-1347). Vital & Health Statistics, (Series 2-Number 73, Washington, DC: U.S. Government Printing Office).

Singh, A., Moses, F. M., & Deuster, P. A. (1992). Chronic multivitamin-mineral supplementation does not enhance physical performance. Medicine & Science In Sport & Exercise, 24(6), 726-732.

Smith, N. J., & Worthington-Roberts, B. (1989). Food for sport. Bull: Palo Alto, CA.

Suboticanec, K., Stavljenic, A., Schaloh, W., & Buzina, R. (1989). Effects of pyridoxine and riboflavin supplementation on physical fitness in young adolescents. International Journal of Vitamin & Nutrition Research, 60, 81-88.

Telford, R. D., Catchpole, E. A., Deakin, V., Hahn, A. G., & Plank, A. W. (1992). The effect of 7 to 8 months of vitamin/mineral supplementation on athletic performance. International Journal of Sport Nutrition, 2, 135-153.

Van der Beek, M. D., Dokkum, W. V., Schrijver, J., Wedel, M., Gaillard, A. W., Wesstra, A., Weerd, H. V., & Hermus, R. J. (1988). Thiamin, riboflavin, and vitamins B-6 and C: Impact of combined restricted intake on functional performance in man. American Journal of Clinical Nutrition, 48, 1451-1462.

Weight, L. M., Myburgh, K. H., & Noakes, T. D. (1988). Vitamin and mineral supplementation: Effect on the running performance of trained athletes. American Journal of Clinical Nutrition, 47, 192-195.

Williams, M. H. (1985). Nutritional aspects of human physical and athletic performance (3rd ed.). Springfield, IL: Thomas.

APPENDIX A

MEDICAL HISTORY QUESTIONNAIRE

Medical History Questionnaire

Name _____ Date _____ Phone _____

Address _____ City _____ Zip _____

1. Have you ever had any of the following?
(please indicate with an X)

____ Heart attack
____ Open heart surgery
____ Angioplasty
____ Congenital heart problems
____ Congestive heart failure
____ Angina/chest pain, pressure or discomfort
____ Abnormal heart beats (palpitation)
____ Heart murmurs
____ Stroke
____ Rheumatic fever
____ Thyroid problems
____ Diabetes
____ High blood pressure
____ Swelling of the feet or ankles
____ Cramping in the lower legs or feet with exertion
____ Blackouts/fainting spells
____ Shortness of breath at rest or with exertion
____ COPD
____ Asthma
____ Arthritis
____ Low back pain
____ Joint pain or swelling
____ Other orthopedic problems
____ Recent illness, hospitalization or surgical procedure

2. Are you currently taking any medications? ___ yes ___ no
If yes, please list: _____

3. Are you currently taking any nonprescription medicines (over the counter)? ____ yes ____ no
If yes, please list: _____

4. Are you currently taking any nutritional supplements?
If yes, please list: _____

5. Do you know your cholesterol level? _____
HDL _____ LDL _____ Triglycerides _____

6. Has any blood relative had any of the following?
(please indicate with an X)

		Relation	Age of occurance
____	Diabetes	_____	____
____	High cholesterol	_____	____
____	High blood pressure	_____	____
____	Heart attack	_____	____
____	Open heart surgery	_____	____
____	Stroke	_____	____
____	Lung problems	_____	____
____	Cancer	_____	____
____	Obesity	_____	____

7. Do you currently smoke cigarettes? ____ yes ____ no
If yes, how many packs per day? ____ how many years ____

8. Do you currently exercise on a regular basis? ___yes ___no
How many times per week do you exercise? _____
How long do you exercise per session? _____
What types of exercise do you perform? _____
_____

I hereby certify all statements provided by me in this questionnaire are complete and true to the best of my knowledge.

Signature _____ Date _____

APPENDIX B

INFORMED CONSENT

INFORMED CONSENT

THE EFFECTS OF 90 DAYS OF KM SUPPLEMENTATION ON AEROBIC CAPACITY AND GENERAL-WELL BEING OF HEALTHY ADULTS

I, _____, volunteer to be a subject in a research study to determine the effects of Km potassium/mineral supplementation on aerobic capacity (VO_2max) and general well-being. I understand that participation in this project requires that I complete a maximal oxygen consumption test on a treadmill, take a daily dose of the Km supplement for 90 consecutive days, and return for another treadmill test at the end of the study. Prior to each testing session I will complete a general, well-being questionnaire. Also, I must record my daily nutritional intake for 3 days at the beginning of the supplementation period.

Prior to the initial test, I will attend a practice session. At this session I will practice walking and/or running on the treadmill and be fitted with the headgear used to measure VO_2max during testing. This session will familiarize me with the testing procedures and enable me to ask any questions I may have.

The maximal oxygen consumption test will consist of walking or running to voluntary exhaustion on a motorized treadmill. The speed of the treadmill will be self-selected and will remain constant throughout the test. The grade of the treadmill will be increased 2.5% every 2 minutes throughout the test. During this test, my heart rate will be recorded every minute and perceived exertion (Borg 6-20 scale) will be monitored at the end of every 2 minute stage. Also, I will breathe through a mouthpiece so that my exhaled air can be collected and analyzed. Although this test will require maximal effort, I understand that I can stop the test anytime I wish. As with any exercise, there exists the possibility of adverse changes (i.e., dizziness, shortness of breathe, etc.) during this test. If any abnormal observations are noted at any time, the test will be immediately terminated. In addition, I will probably feel tired or sore at the end of the test.

At the conclusion of the first test, I will be given a 90 day supply of Km liquid. The daily dose for both males and females will be 2 tablespoons (30 ml), to be taken 1 tablespoon in the morning and 1 tablespoon in the evening. I will be given a log book to record my daily dosage and physical activity. I understand that I am required to maintain my current exercise and dietary habits over the

course of the study. A research assistant will call me every 7-10 days to monitor my progress and answer any questions.

Km has been determined by the FDA to be safe and acceptable as a food supplement. Also, there are no known contraindications or adverse side effects associated with the supplement.

All testing sessions will be scheduled at my convenience. The tests will be conducted by Ari Pugliese, a graduate student enrolled in the Adult Fitness/Cardiac Rehabilitation Graduate Program under the direction of John Porcari, Ph.D. The results of each test will be thoroughly explained upon completion of the test and all data will be confidential. I do however give permission for the data to be used for research purposes.

I consider myself to be in good health and to my knowledge I am not infected with a contagious disease or have any limiting physical condition or disability, especially with respect to my heart, that would preclude my participation in the tests described above. I have read the foregoing and I understand what is expected of me. Any questions which may have occurred to me have been answered to my complete satisfaction. I therefore, voluntarily consent to be a subject in this study. Furthermore, I know I may withdraw at any time without any type of penalty.

SIGNATURE OF SUBJECT _____ DATE _____

SIGNATURE OF WITNESS _____ DATE _____

APPENDIX C

GENERAL WELL-BEING SCHEDULE

GENERAL WELL-BEING SCHEDULE

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
HEALTH SERVICES AND MENTAL HEALTH ADMINISTRATION
NATIONAL CENTER FOR HEALTH STATISTICS
HEALTH AND NUTRITION EXAMINATION SURVEY

GENERAL WELL-BEING

a. Name (Last, first, middle)	b. Deck No.	c. Sample No.	d. Sex	e. Age
	171	— — — — —	1 ☐ Male 2 ☐ Female	— —

READ – This section of the examination contains questions about how you feel and how things have been going with you. For each question, mark (X) the answer which best applies to you.

1. How have you been feeling in general? *(DURING THE PAST MONTH)* — 1.

(001)
1 ☐ In excellent spirits
2 ☐ In very good spirits
3 ☐ In good spirits mostly
4 ☐ I have been up and down in spirits a lot
5 ☐ In low spirits mostly
6 ☐ In very low spirits

2. Have you been bothered by nervousness or your "nerves"? *(DURING THE PAST MONTH)* — 2.

(002)
1 ☐ Extremely so -- to the point where I could not work or take care of things
2 ☐ Very much so
3 ☐ Quite a bit
4 ☐ Some -- enough to bother me
5 ☐ A little
6 ☐ Not at all

3. Have you been in firm control of your behavior, thoughts, emotions OR feelings? *(DURING THE PAST MONTH)* — 3.

(003)
1 ☐ Yes, definitely so
2 ☐ Yes, for the most part
3 ☐ Generally so
4 ☐ Not too well
5 ☐ No, and I am somewhat disturbed
6 ☐ No, and I am very disturbed

4. Have you felt so sad, discouraged, hopeless, or had so many problems that you wondered if anything was worthwhile? *(DURING THE PAST MONTH)* — 4.

(004)
1 ☐ Extremely so -- to the point that I have just about given up
2 ☐ Very much so
3 ☐ Quite a bit
4 ☐ Some -- enough to bother me
5 ☐ A little bit
6 ☐ Not at all

5. Have you been under or felt you were under any strain, stress, or pressure? *(DURING THE PAST MONTH)* — 5.

(005)
1 ☐ Yes -- almost more than I could bear or stand
2 ☐ Yes -- quite a bit of pressure
3 ☐ Yes -- some - more than usual
4 ☐ Yes -- some - but about usual
5 ☐ Yes - a little
6 ☐ Not at all

6. How happy, satisfied, or pleased have you been with your personal life? *(DURING THE PAST MONTH)*	6.	(006) 1 ☐ Extremely happy -- could not have been more satisfied or pleased 2 ☐ Very happy 3 ☐ Fairly happy 4 ☐ Satisfied -- pleased 5 ☐ Somewhat dissatisfied 6 ☐ Very dissatisfied
7. Have you had any reason to wonder if you were losing your mind, or losing control over the way you act, talk, think, feel, or of your memory? *(DURING THE PAST MONTH)*	7.	(007) 1 ☐ Not at all 2 ☐ Only a little 3 ☐ Some -- but not enough to be concerned or worried about 4 ☐ Some and I have been a little concerned 5 ☐ Some and I am quite concerned 6 ☐ Yes, very much so and I am very concerned
8. Have you been anxious, worried, or upset? *(DURING THE PAST MONTH)*	8.	(008) 1 ☐ Extremely so -- to the point of being sick or almost sick 2 ☐ Very much so 3 ☐ Quite a bit 4 ☐ Some -- enough to bother me 5 ☐ A little bit 6 ☐ Not at all
9. Have you been waking up fresh and rested? *(DURING THE PAST MONTH)*	9.	(009) 1 ☐ Every day 2 ☐ Most every day 3 ☐ Fairly often 4 ☐ Less than half the time 5 ☐ Rarely 6 ☐ None of the time
10. Have you been bothered by any illness, bodily disorder, pains, or fears about your health? *(DURING THE PAST MONTH)*	10.	(010) 1 ☐ All the time 2 ☐ Most of the time 3 ☐ A good bit of the time 4 ☐ Some of the time 5 ☐ A little of the time 6 ☐ None of the time
11. Has your daily life been full of things that were interesting to you? *(DURING THE PAST MONTH)*	11.	(011) 1 ☐ All the time 2 ☐ Most of the time 3 ☐ A good bit of the time 4 ☐ Some of the time 5 ☐ A little of the time 6 ☐ None of the time
12. Have you felt downhearted and blue? *(DURING THE PAST MONTH)*	12.	(012) 1 ☐ All of the time 2 ☐ Most of the time 3 ☐ A good bit of the time 4 ☐ Some of the time 5 ☐ A little of the time 6 ☐ None of the time

13. Have you been feeling emotionally stable and sure of yourself? (DURING THE PAST MONTH) — 13. (013)
1 ☐ All of the time
2 ☐ Most of the time
3 ☐ A good bit of the time
4 ☐ Some of the time
5 ☐ A little of the time
6 ☐ None of the time

14. Have you felt tired, worn out, used-up, or exhausted? (DURING THE PAST MONTH) — 14. (014)
1 ☐ All of the time
2 ☐ Most of the time
3 ☐ A good bit of the time
4 ☐ Some of the time
5 ☐ A little of the time
6 ☐ None of the time

For each of the four scales below, note that the words at each end of the 0 to 10 scale describe opposite feelings. Circle any number along the bar which seems closest to how you have generally felt DURING THE PAST MONTH.

15. How concerned or worried about your HEALTH have you been? (DURING THE PAST MONTH) — 15. (015)

0 1 2 3 4 5 6 7 8 9 10

Not concerned at all — Very concerned

16. How RELAXED or TENSE have you been? (DURING THE PAST MONTH) — 16. (016)

0 1 2 3 4 5 6 7 8 9 10

Very relaxed — Very tense

17. How much ENERGY, PEP, VITALITY have you felt? (DURING THE PAST MONTH) — 17. (017)

0 1 2 3 4 5 6 7 8 9 10

No energy AT ALL, listless — Very ENERGETIC, dynamic

18. How DEPRESSED or CHEERFUL have you been? (DURING THE PAST MONTH) — 18. (018)

0 1 2 3 4 5 6 7 8 9 10

Very depressed — Very cheerful

APPENDIX D

SUPPLEMENT AND EXERCISE LOG

DAILY LOG

WEEK		MON	TUE	WED	THU	FRI	SAT	SUN	SUMMARY OF WEEKLY EXERCISE
1	morn								
	eve								
2	morn								
	eve								
3	morn								
	eve								
4	morn								
	eve								
5	morn								
	eve								
6	morn								
	eve								
7	morn								
	eve								
8	morn								
	eve								
9	morn								
	eve								
10	morn								
	eve								
11	morn								
	eve								
12	morn								
	eve								
13	morn								
	eve								
14	morn								
	eve								

APPENDIX E

AVERAGE NUTRITIONAL VALUES FOR 3 DAYS

Average nutritional values for 3 days (M ± SD)

Nutrient	Group	Overall	Male	Female
Kcal (#)	Exp	2109 ± 423.7	2437 ± 593.4	1687 ± 270.4
	Con	2504 ± 452.7	2552 ± 426.3	2410 ± 587.8
Vit A (%)	Exp	210 ± 120.6	188 ± 116.6	238 ± 128.8
	Con	176 ± 85.7	163 ± 97.4	203 ± 63.9
A-Toco (%)	Exp	77 ± 86.9	54 ± 19.9	106 ± 128.7
	Con	80 ± 56.5	55 ± 30.2	129 ± 70.9
Vit B1 (%)	Exp	156 ± 62.3	140 ± 27.3	175 ± 89.0
	Con	152 ± 36.2	151 ± 40.3	153 ± 34.4
Vit B2 (%)	Exp	138 ± 48.9	132 ± 38.3	145 ± 62.5
	Con	190 ± 64.2	181 ± 28.0	207 ± 117.7
Vit B3 (%)	Exp	155 ± 51.3	165 ± 56.3	142 ± 44.9
	Con	149 ± 57.5	146 ± 71.1	157 ± 21.7
Vit B6 (%)	Exp	119 ± 33.4	117 ± 31.2	122 ± 38.5
	Con	113 ± 29.3	107 ± 31.4	125 ± 24.8
Folate (%)	Exp	175 ± 64.3	184 ± 43.3	164 ± 87.2
	Con	148 ± 71.5	156 ± 80.0	132 ± 61.8
Vit B12 (%)	Exp	234 ± 92.2	241 ± 90.0	224 ± 101.8
	Con	287 ± 80.8	303 ± 54.5	254 ± 127.5
Vit C (%)	Exp	263 ± 125.4	317 ± 126.1	193 ± 89.5
	Con	180 ± 77.5	182 ± 70.8	178 ± 107.1
K (%)	Exp	147 ± 31.8	166 ± 26.1	124 ± 21.5
	Con	159 ± 30.4	162 ± 10.9	153 ± 57.8
Fe (%)	Exp	153 ± 63.0	179 ± 58.6	120 ± 55.3
	Con	162 ± 68.5	189 ± 67.7	107 ± 23.4
Ca (%)	Exp	108 ± 41.5	124 ± 46.3	88 ± 24.5
	Con	148 ± 52.4	157 ± 34.6	131 ± 85.3
Mg (%)	Exp	94 ± 18.9	98 ± 20.5	89 ± 16.6
	Con	93 ± 24.7	87 ± 11.8	105 ± 42.1
P (%)	Exp	169 ± 44.8	191 ± 43.3	141 ± 29.2
	Con	206 ± 52.4	224 ± 40.0	170 ± 63.6
Zinc (%)	Exp	75 ± 21.7	77 ± 23.1	72 ± 21.3
	Con	86 ± 13.4	88 ± 13.0	83 ± 16.6

% = percent of RDA

APPENDIX F

GLOSSARY OF TERMS

Glossary of Terms*

Anthelmintic - an agent that destroys or expels intestinal worms

Appetizer - an agent that excites the appetite

Bitter - characterized by a bitter principle which acts on the mucous membranes of the mouth and stomach to increase appeitie and promote digestion

Carminative - an agent for expelling gas from the intestines

Cathartic - an agent that acts to empty the bowels

cholagogue - an agent for increasing the flow of bile into the intestines

Choleretic - a substance which stimulates the liver to produce bile

Demulcent - a substance that soothes irritated tissue, particularly mucous membrane

Diaphoretic - an agent that promotes perspiration

Emetic - an agent that causes vomiting

Expectorant - an agent that promotes the discharge of mucous from the respiratory passages

Rhizome (rootstock) - an underground portion of a stem producing shoots on top or roots beneath; different from a root in that it has buds, nodes, and scaly leaves

Sialagogue - an agent that stimulates the secretion of saliva

Stomachic - an agent that strengthens, stimulates, or tones the stomach

Tonic - an agent that strengthens or invigorates organs or the entire organism

* From: Lust, J. (1974). The herb book. New York: Bantam.

APPENDIX G

REVIEW OF LITERATURE

REVIEW OF RELATED LITERATURE

Introduction

Km potassium/mineral supplement (Km) is a compilation of 14 different botanicals. The historical uses are well known and in some cases clinically documented. The research to date is centered around disease prevention and not performance.

This review briefly covers the history of Km as well as the properties and uses of each individual botanical. A more thorough review of nutritional ergogenic aids is presented, focussing on multivitamin/mineral supplements and their effects on human performance.

The History of Km

As the subject of his doctorate in agrobiology, Karl Jurak developed the Km formula. His goal was to create a formula that would enhance the state of health whereby each herbal component would complement the others and work in concert with the body systems. The final product was this unique nutritional compound derived from 14 different botanicals.

Jurak provided the formula to friends, family, and colleagues for their personal use. Primarily by word of mouth, consumers became aware of this formula and it's benefits. About 60 years later on October 22, 1984, Karl's son Anthony and Robert Bolduc, a marketing specialist formed Matol Botanical Incorporated (Matol), Montreal,

Canada. Sam Kalenuik, an expert in network marketing joined the company 2 years later. Today, Matol has sold over 20 million bottles of Km and is the largest selling liquid supplement of all time (Matol Botanical Inc., 1994).

Matol is a multilevel marketing company. Its products are not sold in stores, but through independent distributors. Network marketing, as it is commonly referred to, enables the source to sell products to independent distributors using ways similar to direct sales methods. This method gives independent distributors the opportunity to earn retail profits from selling products directly to retail customers and wholesale profits by selling to other distributors. If a distributor sells a certain amount of products then he or she becomes a supervisor. As a supervisor you help other people become distributors and establish their own networks, earning the difference between their percentage of discount and your own. In addition, a supervisor can earn a percentage, or royalty, on the sales volume of each supervisor in your downline network (Matol Botanical Inc., 1990).

Individual Botanicals

Km potassium/mineral supplement is a compilation of extracts from herbs, berries, roots, and barks from all over the world. Individually, these botanicals have specific properties and actions that effect different systems of the body. Traditionally, many of these botanicals have been

used in "folk" medicine for many years. Today, many of them are used in modern preparations and have been clinically proven to be effective. While most of the research to date on these botanicals are related to disease prevention, there has been speculation that they may have ergogenic effects. However, these effects have not been clinically proven (Colgan, 1993, Grunewald & Bailey, 1993).

The origin, medicinal part of the botanical, vitamin and mineral content, method of action, and the proposed uses of the following botanicals are reviewed: alfalfa, angelica, cascara sagrada, celery seed, chamomile, dandelion, gentian, horehound, licorice, passion flower, sarsaparilla, saw plametto, senega root, and thyme. Unless otherwise stated the information on the individual botanicals is taken from Lust, 1974 and Nutra-Health Data, 1990. A glossary of terms is presented in Appendix G.

Alfalfa (Medicago Sativa)

Alfalfa is a widely cultivated, perennial plant native to the Mediterranean region, but also grows well in North America and western Asia. The dried whole herb, including blossoms is used in medicinal preparations.

Alfalfa has been extensively studied. It is one of the most nutritious foods known, and is highly recommended for the human diet. The whole plant contains many important substances, including several saponins, many sterols, coumarins, flavonoids, alkaloids, acids, vitamins, amino

acids, sugars, proteins, minerals, trace elements, and other nutrients. It also is high in fiber and has anticholesterolemic properties.

The high concentration of vitamin K found in alfalfa has beneficial effects on several forms of hemolytic disease. Alfalfa also has antitumoral and antibacterial properties. In folk medicine, it has been widely used as a tonic, which is an agent that strengthens or invigorates organs and maintains balance, an appetizer, and as a diuretic to relieve urinary and bowel problems.

Angelica (Angelica Archangelica)

Angelica is a perennial plant found in coastal areas of northern Europe and Asia and is also cultivated. The dried roots and rhizomes are used in medicinal preparations. The root and seed are rich in essential oils, calcium, vitamin E, and B-12, which is rare in vegetation.

Angelica archangelica is the American variety of angelica. It has a reputation as a carminative to soothe an upset stomach. Generally it is also used as an appetizer, expectorant, stimulant, and a tonic. Prepared as a tea, angelica can stimulate the appetite, relieve flatulence and muscle spasms, and stimulate kidney action. It is useful for all sorts of stomach and intestinal difficulties, including ulcers, and vomiting with stomach cramps. It can also be used for intermittent fever, nervous headaches, colic, and general weakness.

Cascara Sagrada (Rhamnus Purshiana)

Cascara sagrada is a deciduous tree native to the mountainous areas of North America, Europe, and western Asia. The dried bark of the tree is used in medicinal preparations. Cascara sagrada is rich in essential oils, as well as B-complex, calcium, potassium, manganese, and elemental minerals.

Cascara sagrada is perhaps the most common laxative used in both herbal medicine and orthodox pharmacy. An extract of the bark is still prescribed and marketed under various brand names. It is technically classified as a stimulant laxative, since it induces peristalsis. It encourages peristalsis by irritating the bowels, but it is also useful for chronic constipation since it has a lasting tonic effect on relaxed bowels. Cascara sagrada has also been used for gallstones and liver ailments and for chronic indigestion.

Celery Seed (Apium Graveolens)

Celery is a widely cultivated plant which also grows wildly in North and South America, Europe, Asia, and Africa. The roots, leaves, and fruits or seeds are used in medicinal preparations. The seeds contain vitamins A, B, C, and iron.

Celery seed is used almost exclusively as a diuretic. Since it is very powerful, it is often used alone in severe cases of gout, edema, and dropsy. At other times, small amounts are added to diuretic herbal blends to provide

reliable action. Celery seed is sometimes used as a carminative and antispasmodic in the digestive system and has also been used on occasion for rheumatism, and as a sedative for nervousness.

Chamomile (Matricaria Chamomilla)

Chamomile is an annual herb native to southern Europe and northern Asia, and is typically cultivated in gardens. The dried flower heads are used in medicinal preparations. It is high in calcium, magnesium, iron, and trace minerals.

In Europe, chamomile is best known as the "cure all" herb which is most used for stimulating the immune system. It's active components include essential oils, flavonoids, and glycosides.

Like gentian and dandelion, chamomile is a bitter tonic with many proven properties. It is most noted for its soothing qualities. It is a strong antispasmodic, an effective antiinflammatory, sedative, antiulcerative, antibacterial, and carminative.

Dandelion (Taraxacum Officianalis)

Dandelion is abundant all over the world in meadows and pastures. The whole plant is used in medicinal preparations. Dandelion has a high nutritional value. It contains choline, essential linolenic acid (a main component of lecithin), and many vitamins including A, C, and one of the B-complexes. The herb also contains more protein, fat, carbohydrates, iron, and ash than many other leafy foods.

Dandelion has two particularly important uses: to promote the formation of bile and to remove excess water from the body in edemous conditions resulting from liver problems. The root especially effects all forms of secretion and excretion by acting to remove poisons from the body. It also acts as a tonic and a stimulant.

Gentian (Gentiana Lutea)

Gentian is native to southern and central Europe and is cultivated in the U.S. The root and rhizomes are used in medicinal preparations. Gentian is rich in the B-complex nutrients, vitamin F, niacin, inositol, and many trace elements.

Gentian root is one of the strongest bitters known. It embodies the best of the bitters' known characteristics: stomachic, cholagogue, choleretic, sialagogue, appetite stimulant, and digestive tonic. Gentian is excellent for improving appetite and digestion and for strengthening the activity of the stomach. Clinical tests routinely demonstrate the plants ability to promote secretion of digestive juices. It is useful as a blood builder during convalescence, since it raises the white blood cell count.

Horehound (Marrubium Vulgare)

Horehound is a perennial plant that is native to Europe and has been widely cultivated on a commercial basis for centuries. The dried herb is used in medicinal preparations. It is rich in vitamins, A, E, C, F, and B-

complex, and also contains iron and potassium.

Horehound has been used as a diaphoretic, diuretic, expectorant, stimulant, and a tonic. Generally, horehound is used as a remedy for coughing, hoarseness, and bronchial problems. As an expectorant, it can be taken for acute bronchitis. It is said to restore the normal balance of secretions by various organs and glands. It can be used for nervous heart conditions, to calm heart action, and it makes a good stomach tonic.

Licorice (Glycyrrhiza Glabra)

Licorice is a perennial plant found wild in southern Europe, and parts of Asia and is cultivated in many parts of the world. The dried rootstock is used in medicinal preparations. It contains vitamin E, B-complex, biotin, niacin, pantothenic acid, lecithin, manganese, and other trace minerals.

Licorice root is one of the most biologically active herbs known. It has found extensive therapeutic use throughout the world and has been the subject of an enormous amount of research. In folklore, licorice root is often used for its estrogenic properties, and about 90% of the available research confirms those characteristics.

The root has been used as a demulcent, diuretic, expectorant, and a laxative. Licorice is primarily used in medicine for bronchial problems, coughs, hoarseness, and mucous congestion. It can also be taken for stomach

problems and for bladder and kidney ailments.

Passion Flower (Passiflora Incarnata)

Passion flower grows wild in the southern part of the U.S. It is also cultivated in cooler climates. The dried plant and flower are used in medicinal preparations. Passion flower is plentiful in the nutrient complexes, especially calcium and magnesium.

Passion flower has a mild sedative effect that encourages sleep. This property has been well substantiated in numerous studies on animals and humans. It is most commonly used for nervous conditions such as insomnia, restlessness, hysteria, and nervous headaches. Numerous homeopathic drugs contain passion flower as well as professionally prepared medications.

Sarsaparilla (Smilax Officinalis)

Sarsaparilla is a tropical American perennial plant. The rootstock, fresh or dried, is used for medicinal preparations. It contains vitamin C and B-complex.

Sarsaparilla has been used all over the world as a powerful medicine. It has been used to treat rheumatism, arthritis, cancer, skin disease, venereal disease (including syphilis), fevers, and digestive disorders, and has been found to be an effective general tonic. In homeopathy, sarsaparilla is often used to treat multiple sclerosis, although this action has not been experimentally verified.

Sarsaparilla has a high concentration of saponins,

whose nature is not fully understood. They are found in several herbs used as tonics. Steroidal saponins and genins of the herb closely resemble sex hormones, and are in fact sometimes used in the synthesis of sex hormones. Given the scarcity of controlled experimental research on sarsaparilla, other indicators of the herb's saponin activity must be used. One of those clues is cross-cultural verification, the fact that so many different cultures use sarsaparilla for many of the same applications.

There is a small amount of evidence that a properly made extract of sarsaparilla provides a stimulant effect, including a stimulation of the male genitalia. The notion that the herb might be anabolic arises from its traditional use as an aphrodisiac. This may be where it gets its reputation for raising testosterone levels. There is no clinical evidence that shows that sarsaparilla is anabolic (Colgan, 1993, Grunewald & Bailey, 1993).

Saw Palmetto (Serenoa Serrulata)

Saw palmetto is found along the Atlantic coast of the southern U.S. The berries of the plant are partially dried for medicinal preparations.

Saw palmetto berry's main effects are on the digestive system where it is thought to stimulate appetite and provide excellent nutrition, and on the reproductive system, to increase the size and secreting ability of the mammary glands. The tea has also been recommended as a general

tonic to build strength during convalescence from illness. Saw palmetto is considered by some to have aphrodisiac powers.

Saw palmetto berries contain plant steroids and high concentrations of free bound sitosterols, including the very active beta-sitosterol. When injected under the skin of animals, they exhibited estrogenic activity. Commercially the berries have been used by farmers, since animals fed these berries have shown to grow fat. One might speculate that the presence of such high concentrations of sitosterols, together with the other principles in the berry, forms the basis for biological activity in man. A great deal more research would be required to verify such a mechanism.

Saw palmetto has been used as a steroid replacement in athletes, despite the lack of scientific evidence showing growth of either muscles or mammary glands. Like sarsaparilla, the reputation of saw palmetto has grown from people confusing sensation with physiology. Studies show that a strong extract of saw palmetto causes feelings of stimulation and euphoria in both male and female reproductive systems. There is no scientific evidence of an anabolic or ergogenic effect (Colgan, 1993).

Senega Root (Polygala Senega)

Senega root is a perennial plant native to eastern North America and is cultivated in Japan and Canada. The

dried rootstock and roots are used in medicinal preparations. The root is rich in magnesium, iron, and other trace minerals.

Senega root has many of the traditional uses of alternative or cleansing herbs. It has been used as a diaphoretic, cathartic, expectorant, emetic, and a stimulant. The root found its most common application in medicine as an expectorant in respiratory problems.

Thyme (Thymus Vulgaris)

Thyme is a perennial plant native to the Mediterranean region and is widely cultivated in Europe and the U.S. The dried leaves and flowering tops are used in medicinal preparations. Thyme is abundant in the nutrient thiamine, as well as containing B-complex, vitamins C and D, and trace minerals.

Thyme is well known throughout the world as a culinary spice but it has demonstrated medicinal properties. Among these is its effect on the gastrointestinal tract, where it is an antispasmodic, carminative, and anthelmintic. Thyme has been used as an antispasmodic and expectorant in the respiratory system; and is beneficial in the treatment of bronchial coughs and whooping cough. In addition, thyme has hypotensive (sedative) and cardiotonic characteristics.

Multivitamin/mineral Supplements

In today's world of athletics many competitors believe that supplementation of specific vitamins and minerals will

enhance performance and provide the competitive edge for success. While most of the research has indicated that vitamin and/or mineral supplementation has little or no effects on performance, the use of these supplements by athletes to improve performance is quite commonplace. Few formal studies have been conducted on the supplementation patterns of endurance athletes. In general, 50 to 70% of elite endurance athletes have been reported to use supplements on a daily basis (Nieman et al., 1989). The use of vitamin supplements is also prevalent among high school and college athletes. Fifty-six percent of males and 33% of females reported taking supplements (Haymes, 1991). National surveys have reported that 20 to 25% of the American public uses nutritional supplements daily and up to 50% of the public uses supplements on a regular or irregular basis (Nieman et al., 1989).

Nieman et al. (1989) and Haymes (1991) reported that the three reasons why athletes supplement is to improve performance, to compensate for less than optimal diets, and to meet the unusual nutrient demands induced by heavy exercise. They believe that vitamins will supercharge biochemical pathways enhancing work capacity and performance. One might suppose that VO_2 max could be improved since some of the vitamins (thiamin, niacin, and riboflavin) and minerals (potassium, magnesium, and calcium) play an integral role in the mitochondrial oxidative

pathways (Barnett & Conlee, 1984).

Vitamins are a class of organic substances that act primarily as regulators of numerous physiological processes in the human body. Vitamins play important roles in red blood cell formation, utilization of oxygen in the cells, metabolism of carbohydrates, fats, and proteins, and other functions which are intimately related to energy production and resultant physical performance. A mineral is an inorganic element found in nature which also has diverse functions in the body. They represent the major structural basis for the body tissues and are important components of enzymes and hormones. Minerals are also important in a number of regulatory functions in the body. Included among these functions are maintenance of normal pH through buffering action in the blood, regulation of muscular contraction processes, conduction of nerve impulses, clotting of the blood, maintenance of body fluid osmotic pressure, and regulation of normal heart rhythm (Williams, 1985).

The effects of vitamin and/or mineral supplementation on performance has been studied extensively. A review of the early, poorly controlled studies is presented, followed by the more recent, well controlled studies. Finally, recommendations for the athletes are presented.

Studies with Inadequate Research Design

Two early studies showed an increase in performance with supplementation. Barborka, Foltz, and Ivy (1943) reduced the thiamin, riboflavin, vitamin A and C, calcium, phosphorus, and iron in the diet of 4 men for 2 months. The endurance capacity, as tested by a double work test to exhaustion on a bicycle ergometer, decreased during the deficiency phase of the experiment. Upon restoration of the vitamins and minerals, an increase in work output was noted within 48 hours, and within 4 weeks of supplementation, all the subjects had increased their work output back to normal levels.

Frankau (1943) reported some beneficial effects of multiple vitamin preparations upon performance in a task (300-yard shuttle run) involving coordination and anaerobic capacity. With 10 subjects in both a placebo and experimental group, he reported a beneficial effect of a compound containing vitamin A, C, D, thiamin, riboflavin, and niacin administered over a 3 day period. A similar beneficial effect was noted in another experiment with 22 subjects in each of the placebo and experimental groups. The supplement included thiamin, riboflavin, niacin, and vitamin C over a 4 day period. No statistical analysis was utilized to evaluate the data.

Many contemporary studies have found various multivitamin and mineral compounds to increase performance.

Keul, Haralambie, Winker, Baumgartner, and Bauer (1974) had 12 male subjects perform a submaximal bicycle ergometer task at 130 watts for 2 hours. The subjects ingested a solution containing calcium, magnesium, potassium, phosphorus, thiamin, riboflavin, nicotinamide, pantothenate, saccharose, and vitamin B6, C, and E at 30, 60, and 90 minutes of exercise. Heart rate during exercise was lower when subjects used the multivitamin-mineral drink, and work efficiency was increased by 3.5%. However, there was no statistical analysis of the data. Haralambie, Keul, Baumgartner, Winker, and Bauer (1975) replicated the experiment and reported similar results, but only during the last 50 minutes of the 2 hour exercise bout. A placebo group was not used in either investigations.

Van Dam (1978), using a double blind placebo protocol, gave a multivitamin-electrolyte preparation to 20 fencers over a 3 week period and a placebo to 20 others. Small gains were observed in reaction time and hit frequency in the experimental group, but no statistical analysis was undertaken.

Ushakov et al. (1978) used the Astrand-Rhyming submaximal step test to evaluate the effect of a supplement containing several amino acids, the B-complex vitamins, vitamin A and C, nucleic acids, rutin, calcium, potassium, magnesium, and phosphorus. The step test was administered to 7 male subjects following training, a second time to

collect baseline data, and again 20 days after supplementation. A lowered heart rate (134 to 111) was noted after the supplemental period. These results could be attributed to a possible training effect.

Colgan (1982) reported a phenomenal improvement in marathoners who received a personalized vitamin supplement over a 3 to 6 month period. A double blind placebo design was utilized but a limited number of subjects was used.

Suboticanec, Stavljenic, Schalch, and Buzina (1989) looked at the effects of pyridoxine and riboflavin supplementation on physical fitness in children deficient in these vitamins. They found that aerobic capacity was impaired from the deficiency and upon correction of the vitamin deficiency, aerobic capacity was improved. Also, a study by Powers et al. (1985) showed that a vitamin-mineral supplement can prevent a decrease in running performance in young Gambian children.

A double-blind study of combined restriction of thiamin, riboflavin, and vitamins B-6 and C was carried out by Van der Beek et al. (1988) with 23 healthy males. During 8 weeks of low intake, 12 subjects ingested a diet deficient in thiamin, riboflavin, vitamin B-6 and C while 11 subjects consumed a diet supplemented with twice the RDA. They found a significant decrease in aerobic power (VO_2 max) and onset of blood lactate accumulation within 3 weeks.

A recent study by Singh, Moses, and Deuster (1992b)

looked at the nutritional status during and after a multivitamin-mineral supplement. No changes were observed in blood concentrations of vitamins A and C and measures of zinc, magnesium, and calcium. In contrast, blood concentrations of thiamin, riboflavin, vitamins B-6 and B-12, pantothenate, and biotin increased significantly.

Many of the early studies show supplementation to enhance performance, although in most cases the subject's nutritional status was poor. It is apparent that a subclinical vitamin/mineral deficiency may adversely effect performance. Whether supplementation will enhance performance in healthy subjects is not clear. The research that has shown improvements in performance has been criticized for having improper experimental design.

Double-Blind, Placebo-Controlled Studies

Barnett and Conlee (1984) administered a supplement including vitamins, minerals, amino acids, and unsaturated fatty acid complex to 10 male runners over a 4 week period. The subjects completed a submaximal treadmill run and a VO_2 max test before and after supplementation. They concluded that the supplement had no beneficial effect on performance as indicated by its inability to alter significantly any of the metabolic or physiological parameters.

Singh, Moses, & Deuster (1992a) looked at the effects on physical performance of a 90 day supplementation with a high potency multivitamin-mineral supplement. Twenty-two

healthy, physically active men were randomly assigned to a supplement or placebo group. Performance was assessed from maximal aerobic capacity, submaximal endurance runs, and isokinetic tests. They found that supplementation did not affect any of the physical performance measures.

Weight, Myburgh, & Noakes (1988) used a 9 month, placebo-controlled crossover study design to determine whether a multivitamin and mineral supplement influenced the athletic performance of 30 competitive athletes. A maximal treadmill test was performed at 0, 3, 6, and 9 months. None of the physiological variables were influenced by supplementation.

Telford, Catchpole, Deakin, Hahn, and Plank (1992) studied the effects of vitamin and mineral supplementation over 7 to 8 months of training and competition in athletes. A double-blind design was used, with groups given either the supplementation or a placebo. All athletes were monitored to ensure that their diets were adequate and the recommended daily intakes of vitamins and minerals were provided by diet alone. Sport specific and some common tests of strength as well as aerobic and anaerobic fitness were performed. The supplemented athletes failed to see any improvements in physical performance.

The few studies that used a double-blind, placebo controlled experimental design did not detect improvements in measures of performance, such as maximal oxygen

consumption, following supplementation with multivitamins and/or minerals (Barnett & Conlee, 1984; Singh et al., 1992a; Telford et al., 1992; Weight et al., 1988). Those studies in which an ergogenic effect was shown can be criticized on the basis that the prestudy vitamin and mineral status of the test subjects was not always established or that the studies were poorly controlled because they were not double blind or they failed to include a placebo control. In addition the techniques used to measure performance may have been crude and if there was a statistical analysis, it was inadequate (Belko, 1987; Singh et al., 1992a; Telford et al., 1992; Weight et al., 1988).

Vitamin/mineral deficiencies, even if marginal, may result in a decrease in athletic performance (Barborka et al., 1943; Suboticanec et al., 1989; Van der Beek et al., 1988). If subjects were initially deficient, their athletic performance likely would have improved with vitamin and mineral supplementation that corrected the deficiency. Under these circumstances supplementation was found to only improve performance back to a normal standard, but not enhance it (Barnett & Conlee, 1984; Weight et al., 1988).

Conclusion

After over 40 years of research, there is no conclusive evidence to suggest that vitamin supplementation improves performance in nutritionally adequate individuals (Belko, 1987). Well controlled studies show that a multivitamin-

mineral formulation does not enhance physical performance in subjects who consume an adequate diet, and have normal biochemical measures of vitamins and minerals. The National Research Council (1989) does not advocate increased vitamin allowances for physical activity. Nevertheless, it does recognize that increased intake would result from the additional consumption of food caused by exercise stimulated hunger. The position by the American Dietetic Association (1987) states that extended physical activity may increase the need for some vitamins and minerals, but that the need could easily be met by consuming a balanced diet in proportion to the extra caloric requirement.

REFERENCES

American Dietetic Association - Position of the American Dietetic Association: Nutrition for physical fitness and athletic performance for adults. (1987). Journal of the American Dietetic Association, 87, 933.

Barborka, C. J., Foltz, E. B., & Ivy, A. C. (1943). Relationship between vitamin B complex intake and work output in trained subjects. The Journal of the American Medical Association, 122, 717-720.

Barnett, D. W., & Conlee, R. K. (1984). The effects of a commercial dietary supplement on human performance. American Journal of Clinical Nutrition, 40, 586-590.

Belko, A. Z. (1987). Vitamins and exercise - an update. Medicine & Science In Sports & Exercise, 18(5)(suppl.), 191-196.

Colgan, M. (1982). Your personal vitamin profile. New York: Morrow.

Colgan, M. (1993). Optimum sports nutrition: Your competitive edge. New York: Advanced Press.

Frankau, I. (1943). Acceleration of co-ordinated muscular effort by nicotinamide. British Medical Journal, 2, 601-603.

Grunewald, K. K., & Bailey, R. S. (1993). Commercially marketed supplements for bodybuilding athletes. Sports Medicine, 15(2), 90-103.

Haralambie, G., Keul J., Baumgartner, A., Winker K. H., & Bauer, G. (1975). Effect of a multivitamin-electrolyte-granulate on the electrodermal reflex and on neuro-muscular excitability during extended periods of physical work. Schweizerische Zeitschrift für Sportmedizin, 23, 113-128.

Haymes, E. M. (1991). Vitamin and mineral supplementation to athletes. International Journal of Sport Nutrition, 1, 146-169.

Keul, J., Haralambie, G., Winker, K. H., Baumgartner, A., & Bauer, G. (1974). Effect of a multivitamin-electrolyte-granulate on blood circulation and metabolism in protracted effort. Schweizerische Zeitschrift für Sportmedizin, 22, 169-184.

Lust, J. (1974). The herb book. New York: Bantam.

Matol Botanical Inc. (1994). Consumer guide. (Available from Matol Botanical International, 1111 46th Avenue, Lachine, PQ Canada H8T3C5)

Matol Botanical Inc. (1990). Distributor manual. (Available from Matol Botanical International, 1111 46th Avenue, Lachine, PQ Canada H8T3C5)

National Research Council. (1989). Recommended dietary allowances (10th ed.). Washington, DC: National Academy Press.

Nieman, D. C., Gates, J. R., Butler, J. V., Pollett, L. M., Dietrich, S. J., & Lutz, R. (1989). Supplementation patterns in marathon runners. Journal of the American Dietetic Association, 89, 1615-1619.

Nutra-Health Data [Computer Database]. (1990). Beverly Hills, CA: Health Data Development.

Powers, H. J., Bates, C. J., Lamb, W. H., Singh, J., Gelman W., & Webb, E. (1985). Effects of a multivitamin and iron supplement on running performance in Gambian children. Human Nutrition, Clinical Nutrition, 39, 427-437.

Singh, A., Moses, F. M., & Deuster, P. A. (1992a). Chronic multivitamin-mineral supplementation does not enhance physical performance. Medicine & Science In Sport & Exercise, 24(6), 726-732.

Singh, A., Moses, F. M., & Deuster, P. A. (1992b). Vitamin and mineral status in physically active men: Effects of a high-potency supplement. American Journal of Clinical Nutrition, 55, 1-7.

Suboticanec, K., Stavljenic, A., Schalch, W., & Buzina, R. (1989). Effects of pyridoxine and riboflavin supplementation on physical fitness in young adolescents. International Journal of Vitamin & Nutrition Research, 60, 81-88.

Telford, R. D., Catchpole, E. A., Deakin, V., Hahn, A. G., & Plank, A. W. (1992). The effect of 7 to 8 months of vitamin/mineral supplementation on athletic performance. International Journal of Sport Nutrition, 2, 135-153.

Ushakov, A. S., Myasnikov, V. I., Shestkov, B. P., Agureev, A. N., Belakovsky, M. S., & Rumyantseva, M. P. (1978). Effect of vitamin and amino acid supplements on human performance during heavy mental and physical work. Aviation, Space, and Environmental Medicine, 49, 1184-1187.

Van Dam, E. (1978). Vitamins and sports. British Journal of Sports Medicine, 12, 74-79.

Van der Beek, M. D., Dokkum, W. V., Schrijver, J., Wedel, M., Gaillard, A. W., Wesstra, A., Weerd, H. V., & Hermus, R. J. (1988). Thiamin, riboflavin, and vitamins B-6 and C: Impact of combined restricted intake on functional performance in man. American Journal of Clinical Nutrition, 48, 1451-1462.

Weight, L. M., Myburgh, K. H., & Noakes, T. D. (1988). Vitamin and mineral supplementation: Effect on the running performance of trained athletes. American Journal of Clinical Nutrition, 47, 192-195.

Williams, M. H. (1985). Nutritional aspects of human physical and athletic performance (3rd ed.). Springfield, IL: Thomas.