

The effects of New Zealand deer antler velvet supplementation on body composition, strength, and maximal aerobic and anaerobic performance

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Abstract

In the present study, we investigated the physiological and potential performance enhancing effects of New Zealand Deer Antler Velvet (NZDAV) supplementation in men. Thirty-two males between the ages of 18 and 35 with at least 4 years of weight lifting experience were randomly assigned using a double-blinded procedure into either a placebo or NZDAV treatment group. Placebo group members received sugar capsules and the NZDAV group received 1350 mg NZDAV once in the morning and again immediately prior to bed-time. Random assignment was done in matched pairs (1 placebo; 1 NZDAV). Prior to and immediately following a 10-week period of supplementation, each subject participated in a series of measurements. These procedures included the measurement of maximal aerobic capacity ($\dot{V}O_2$ max), maximal power output on a cycle ergometer, a determination of maximal strength (1-RM) for the bench-press and squat, a comprehensive blood chemistry profile, body composition analyses (DEXA), and a 3-day dietary recall. Of the original 32 subjects recruited for this study, 56% of the subjects properly completed all aspects of the study. Dropouts were evenly divided between each treatment group, leaving the placebo and the NZDAV groups each with $n = 9$ subjects. At the start of the study, there were no significant differences between the groups in their respective body composition profile variables. In the NZDAV group, percentage body fat ($p = 0.04$), fat weight ($p = 0.07$), and trunk-to-limb fat weight ratio ($p = 0.02$) either significantly declined or neared significance. For the placebo group, only the absolute 1-RM values for the bench press (Pre: 123.2 ± 24.0 kg; Post: 128.3 ± 27.5 kg, 4.1% change; $p = 0.04$) and the squat (Pre: 150.5 ± 28.2 kg; Post: 156.6 ± 30.4 kg, 4.1% change; $p = 0.04$) improved after the intervention period. When normalized for kilograms of total body weight, the placebo group did not show any significant differences for the 1-RM measurements in either the bench press or the squat exercises. In contrast, the NZDAV group showed significant improvements in the 1-RM values both in absolute terms and relative to total body weight. In absolute terms, the 1-RM for the bench press of this group increased 4.2% (Pre: 120.0 ± 23.6 kg; Post: 125.0 ± 25.7 kg; $p = 0.02$) while the squat

1-RM improved 9.9% (Pre: 159.3 ± 42.7 kg; Post: 175.0 ± 43.5 kg; $p = 0.002$). When expressed relative to total body weight, 1-RM values for the bench press and squat also significantly improved ($p = 0.02$) by 4.0% and 10.1%, respectively, in the NZDAV group. One of the most interesting findings of this study was the fact that there was also a significant improvement in aerobic capacity in the NZDAV treatment group. In litres \cdot min⁻¹, $\dot{V}O_2$ max increased significantly by 9.8% from the pre- to post-treatment period (4.30 ± 0.45 to 4.72 ± 0.60 litre \cdot min⁻¹; $p = 0.002$). When expressed relative to total body weight in kilograms, $\dot{V}O_2$ max remained significantly elevated by 9.4% (46.5 ± 8.1 to 50.0 ± 8.9 ml \cdot kg⁻¹ \cdot min⁻¹) in the NZDAV group following the training-supplement intervention. In conjunction with these findings, we observed no significant negative alterations in blood chemistries. However, we did observe a significant reduction in LDL cholesterol (12.2%), which improved the LDL/HDL ratio by 8.4%. The results of this study suggest that NZDAV may have positive effects on body composition and strength/power in men undergoing resistance training.

Keywords: deer antler velvet, strength training, performance, aerobic power, anaerobic power

Introduction

In the present study, we investigated the physiological and potential performance enhancing effects of New Zealand Deer Antler Velvet (NZDAV) supplementation in men. Deer antler velvet reportedly enhances immune function, improves athletic performance, muscle recovery after exercise, enhances sexual functioning in both men and women, improves disease recovery, enhances cardiovascular function, and may be a superior source of insulin-like-growth factors for manufacturers. While there have been several studies aimed specifically at the potential health benefits of deer antler velvet using in-vitro and in-vivo animal research models (Clifford *et al.* 1979; Wang *et al.* 1988a; Wang *et al.* 1988b; Zhang *et al.* 1994; Zhou *et al.* 1999; Allen *et al.* 2002), to date there are no published placebo controlled human clinical trials on physiological function and performance. Thus, the primary purpose of this study was to investigate what effects 1350 mg of NZDAV supplementation twice a

day had on body composition, maximal strength, maximal aerobic power, and maximal power output before and after 10 weeks of resistance training in men aged 18 to 35 years old. In addition, comprehensive blood profiles were taken to evaluate if any detrimental effects occurred over the 10-week treatment period in blood lipids, and liver and kidney function.

Subjects and general research protocol description

Thirty-two males between the ages of 18 and 35 with at least 4 years of weight lifting experience, but not regularly participating in an aerobic training program, were recruited. After completing a university approved consent-form, plus the initial screening and testing procedures, subjects were randomly assigned using a double-blinded procedure into either a placebo or NZDAV treatment group. Placebo group members received sugar capsules and the NZDAV group received 1350 mg NZDAV once in the morning and again immediately prior to bed-time. Random assignment was done in matched pairs (1 placebo; 1 NZDAV) to assure a treatment balance for both the placebo and NZDAV capsule assignments at the start of the study. Subjects performed their resistance-training program in a free-living environment so that the intervention was more representative of how normal supplement use occurs. Periodic checks were made to count the number of capsules in each bottle to ensure that each subject was following the supplement regime as instructed.

Pre- and post-testing variables

Prior to and immediately following the 10-week supplementation use, each subject participated in a series of measurements. These procedures included the measurement of maximal aerobic capacity ($\dot{V}O_2$), maximal power output on a cycle ergometer, a determination of maximal strength (1-RM) for the bench-press and squat,

a comprehensive blood chemistry profile, body composition by dual-energy X-ray absorption (DEXA) analyses, and a 3-day dietary recall. Each potential subject participated in a pre-study screening period during which height, weight, and blood pressure were obtained prior to the diagnostic graded maximal treadmill-screening test. Individuals with abnormal EKG or blood pressure responses during exercise were not admitted into the study. These individuals were then recommended to see their own primary care physician and treadmill test results were provided for each ineligible person.

All data are reported as means \pm standard deviation. Baseline data were analyzed to determine if there were any significant differences between groups prior to the intervention period. Since there were no significant differences observed at the start of study between the treatment groups, a two-way repeated measures ANOVA was performed. If a significant difference between either of the treatment groups or over time for the pre-to-post measurement within a treatment group was observed, a planned pair-wise orthogonal post-hoc comparison was performed.

Results

Of the original 32 subjects recruited for this study, 56% of the subjects properly completed all aspects of the study. Dropouts were evenly divided between each treatment group, leaving the placebo and the NZDAV groups each with $n = 9$ subjects. Nine subjects dropped out of the study for the following reported reasons: lack of time for all testing periods; did not want to alter his training as a result of comprehensive testing; performance constraints required for appropriate data collection; and an unrelated injury during the study period. In addition, five subjects were removed from the study by the principal investigator because they did not properly follow testing protocols such as restricting training 24-48 hours prior to an exercise trial or poor dietary/training log records.

Table 1 Body composition results. Values given are means \pm SD, and all comparisons are made pre- to post-treatment.

Variable	Placebo		NZDAV ^a	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Age	28.1 \pm 7.4	•	25.4 \pm 4.4	•
Height (m)	1.76 \pm 0.1	•	1.81 \pm 0.1	•
Weight (kg)	95.9 \pm 17.7	94.9 \pm 17.1	95.1 \pm 10.3	95.0 \pm 10.3
BMI	30.7 \pm 4.3	30.5 \pm 3.8	28.9 \pm 2.6	29.0 \pm 2.6
% Body Fat ^b	21.5 \pm 6.1	20.1 \pm 5.8 [¥]	19.5 \pm 5.1	18.2 \pm 4.4 [°]
Fat Weight (kg) ^b	21.4 \pm 8.6	19.7 \pm 8.0	18.6 \pm 5.4	17.4 \pm 4.9 [†]
Fat-Free Weight (kg) ^b	74.5 \pm 9.8	75.2 \pm 10.2	76.5 \pm 9.5	77.6 \pm 8.9
Trunk-to-Limb Fat Wt Ratio ^b	111.7 \pm 29.9	111.1 \pm 28.2	104.7 \pm 26.8	101.0 \pm 24.7 ^π

^a NZDAV = New Zealand Deer Antler Velvet; ^b Results were determined from the DEXA measurements. [¥] $p = 0.07$; [°] $p = 0.04$; [†] $p = 0.06$; ^π $p = 0.02$.

Body composition results

At the start of the study there were no significant differences between the groups in their respective body composition profile variables, as determined by DEXA measurements (Table 1). However, after the intervention period, percentage body fat in the placebo group declined from $21.5 \pm 6.1\%$ to $20.1 \pm 5.8\%$, which neared significance ($p = 0.07$). In the NZDAV group, percentage body fat ($p = 0.04$), fat weight ($p = 0.07$), and trunk-to-limb fat weight ratio ($p = 0.02$) either significantly declined or neared significance. The NZDAV group showed the smaller variances in the pre- and post-testing measurements, which may have accounted for the findings that were significant for the NZDAV group but not for the placebo group.

Strength, maximal aerobic capacity, and maximal power results

According to the results shown in Table 2, for the placebo group only the absolute 1-RM values for the bench press (Pre: 123.2 ± 24.0 kg; Post: 128.3 ± 27.5 kg, 4.1% change; $p = 0.04$) and the squat (Pre: 150.5 ± 28.2 kg; Post: 156.6 ± 30.4 kg, 4.1% change; $p = 0.04$) improved after the intervention period. When normalized for total body weight, the placebo group did not show any significant differences for the 1-RM measurement in either the bench press or the squat. In contrast, the NZDAV showed significant improvements in the 1-RM values both in absolute terms and relative to total body weight. In absolute terms, the 1-RM for the bench press of this group increased 4.2% (Pre: 120.0 ± 23.6 kg; Post: 125.0 ± 25.7 kg; $p = 0.02$) while the squat 1-RM improved 9.9% (Pre: 159.3 ± 42.7 kg; Post: 175.0 ± 43.5 kg; $p = 0.002$). When expressed relative to total body weight, 1-RM values for the bench press and squat also significantly improved ($p = 0.02$) by 4.0% and 10.1%, respectively, in the NZDAV group.

One of the most interesting findings of this study was the fact that there was also a significant improvement in aerobic capacity in the NZDAV treatment group. In liters \cdot min⁻¹, $\dot{V}O_2$ max increased significantly by 9.8% from the pre- to post-treatment period (4.30 ± 0.45 to 4.72 ± 0.60 liter \cdot min⁻¹; $p = 0.002$). When expressed relative to total body weight in kilograms, the elevation in (46.5 ± 8.1 to 50.0 ± 8.9 ml \cdot kg⁻¹ \cdot min⁻¹; 9.4% increase) remained significant following the training-supplement intervention.

In contrast, despite the significant increase in 1-RM values observed in both groups, there were no significant changes in peak power, average power, and time-to-peak power for either group following the intervention period. However, it is important to point out that there was a reduction in peak and average power following the intervention period which was significant for the placebo group ($p < 0.05$), but not for the NZDAV group. For example, peak and average power declined 3.2% and 5.0% respectively in the placebo group while in the NZDAV peak power declined $< 1\%$ and average power declined 2.1%. In addition, after the intervention period, the NZDAV showed a greater improvement (12.9%) in the time it took to achieve peak power as compared to the 7.2% improvement observed in the placebo group.

Blood chemistry and dietary recall results

Regarding the blood chemistry results, there were only two statistically significant results observed. First, there was a significant reduction in haematocrit values pre- to post-treatment in the placebo group (46.3% down to 44.9%). In the NZDAV group, LDL cholesterol concentrations significantly declined 12.2%. Consequently, the LDL/HDL ratio also declined 8.4%, which would reduce that group's cardiovascular disease risk profile. There were no negative effects observed in either group in the enzyme markers of liver and kidney function.

Table 2 Aerobic capacity, anaerobic power, and bench press and leg squat 1-RM results. Values given are means \pm SD, and all comparisons are made pre- to post-treatment.

Variable	Placebo		NZDAV ^a	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
$\dot{V}O_2$ max (liters) ^b	3.94 ± 0.59	4.01 ± 0.58	$4.30 \pm .45$	$4.72 \pm .60$ [¥]
$\dot{V}O_2$ max (mls/kg) ^b	43.2 ± 6.9	44.0 ± 5.9	46.5 ± 8.1	50.0 ± 8.9 [¥]
Peak Power (W) ^c	690.7 ± 196.4	677.6 ± 193.2	776.9 ± 131.1	772.8 ± 160.5
Avg Power (W/0.22 km) ^c	542.6 ± 131.9	515.4 ± 144.4	619.4 ± 101.3	606.2 ± 101.4
Time To Peak Power (sec) ^c	6.9 ± 2.2	6.4 ± 1.3	7.9 ± 2.6	7.0 ± 1.4
Bench Press (kg) ^d	123.2 ± 24.0	128.3 ± 27.5 [°]	120.0 ± 23.6	125.0 ± 25.7 [¶]
Bench Press/Body Weight ^d	1.30 ± 0.18	1.35 ± 0.16	1.26 ± 0.17	1.31 ± 0.20 [¶]
Leg Squat (kg) ^d	150.5 ± 28.2	156.6 ± 30.4 [°]	159.3 ± 42.7	175.0 ± 43.5 [¥]
Leg Squat/Body Weight ^d	1.60 ± 0.31	1.68 ± 0.36	1.68 ± 0.40	1.85 ± 0.39 [¶]

^a NZDAV = New Zealand Deer Antler Velvet; ^b Treadmill test results; ^c Cycle ergometer results; ^d Strength testing results. [°] $p \leq 0.04$; [¥] $p \leq 0.002$; [¶] $p \leq 0.02$.

Discussion

The purpose of this study was to investigate what effects 1350 mg of NZDAV supplementation twice a day had on body composition, maximal strength, maximal power output, and maximal aerobic power before and after 10 weeks of resistance training in men aged 18 to 35 years old. As discussed at the start of this project summary, due to the high rate of subject drop-out, the statistical power of the current study was impaired. In spite of this, the results presented above suggest that NZDAV may be an effective ergogenic aid in four areas: 1) body composition effects related to fat mass losses associated with resistance training; 2) enhancements in upper and lower body strength in both absolute terms and relative to total body weight; 3) the possible prevention of declines in strength related over-training; and finally, 4) enhancement of aerobic capacity, and 5) a significant reduction in LDL cholesterol.

In regards to changes in body composition, the NZDAV group displayed the more positive pre- to post-treatment changes. This finding is interesting because, based on dietary recall data collected, the NZDAV group significantly increased their total energy consumption from the pre-treatment measurement period by 18.5% ($p = 0.03$). In contrast, the placebo group's intake expressed in kcal declined pre- to post-treatment by 20.1% ($p = 0.06$). Thus, if any group was to have more significant percent body fat reductions, one would have expected it to occur in the placebo group, since the total amount of worked performed according to the training logs was not significantly different between the groups. One explanation for the enhanced fat loss in the NZDAV group may be related to the combined effects of the increased intakes of both energy and of protein. Protein intake in grams per kilogram of body weight, based on the post-treatment dietary recall data, was 1.51 g/kg in the NZDAV group *versus* 1.13 g/kg in the placebo group. Furthermore, multiple regression analysis showed that for the NZDAV group only protein intake and total energy intake were independently correlated with the changes in fat weight and fat-free weight. Previous research has shown that protein intake is a primary factor in fat-free weight development in resistance training people (Lemon 1996, 1998).

In regards to the changes in total body strength, the results are somewhat surprising since the total amount of weight lifted per kilogram of body weight per day determined from the training log data was not significantly different (NZDAV 5.9% > Placebo; $p = 0.66$) between the groups. However, because the standard deviations were extremely large for this variable (56% and 19% for the placebo and NZDAV groups, respectively), it is possible that we did not find a statistical difference due to the small subject number per group. Yet, when one

looks more closely at the data, this would not explain why the NZDAV 1-RM values increased both in absolute terms and relative to this group's body weight. This was in contrast to the results observed in the placebo group. It is possible that differences in the type of exercises performed played a role. The NZDAV group showed the greatest change in strength related to 1-RM for the squat exercise, with a 10% increase as compared to 4% for the placebo group. This finding, in combination with the training log data, indicates that the NZDAV subjects spent more training time on heavier whole body lifts like the squat, which would increase a person's over-all muscular strength and potential for better strength and body composition adaptations as core strength improved.

One of the more intriguing findings of this study was the improvement observed in the maximal aerobic capacity of the NZDAV group following the intervention period. Previous anecdotal literature has suggested that the growth hormone properties of NZDAV may enhance oxygen carrying capacity by increasing haemoglobin and haematocrit concentrations (Pavlenko Undated). In the current study, there were small non-significant increases in both the haemoglobin (1.4%) and haematocrit (2.8%) levels associated with NZDAV supplementation, which were not observed in the placebo group (for which both haemoglobin and haematocrit declined following the training period). However, the positive changes in haemoglobin and haematocrit would suggest an increase in oxygen carrying capacity in the NZDAV group. Additionally, during the maximal treadmill test, most subjects in the NZDAV group exhibited a reduced heart response of 5-8 beats per minute at submaximal workloads when the respiratory exchange ratio values were below 1.0 and the absolute workloads were identical to the pre-treatment period. These submaximal exercise findings, showing a reduction in heart rate with corresponding increases in haemoglobin and haematocrit values, have been previously observed following iron supplementation for the treatment of anaemia in both men and women (Gardner 1975). In addition, while it is possible that stroke volume may have increased due to enhancements in plasma and total blood volume following the intense 10-week training period leading to a reduction in submaximal exercising heart rates, changes in plasma and total blood volume are usually the primary cardiovascular adaptation of intense endurance and not resistance training (Rowell 1993). According to the training logs, the NZDAV group did not incorporate any new aerobic type exercise training that can adequately explain the improvements in aerobic capacity observed following the 10-week training and supplement period. Thus, one can conclude from these results that the small increases in both haemoglobin and haematocrit observed in the NZDAV group may have contributed to the lower

submaximal exercising heart rate responses at the same absolute treadmill speed and graded workloads, as well as the observed improvements in submaximal heart response to exercise. In addition, because deer antler velvet usage has been shown to reduce both resting systolic and diastolic blood pressure in several case study reports (Pavlenko Undated), it is possible a reduction in total-peripheral resistance during maximal exercise could have occurred enhancing skeletal muscle blood flow delivery. In combination with the small increases in haemoglobin, one would expect an enhanced maximal aerobic capacity in the NZDAV group as seen in the current study.

On Table 2, one can observe there were no significant differences observed between the placebo and NZDAV groups for peak power, average power, and time to peak power. The power testing performance trials were designed in such a way that the subjects' training routines shown in the training log data did not specifically target the cycle ergometry power test. Thus, without specific training exercises for the power testing trials, one would not expect a significant improvement after each respective intervention period unless NZDAV supplementation, independent of training, enhanced a person's neuromuscular recruitment or muscle firing pattern. To date, there is no data suggesting NZDAV has such a neuromuscular effect in humans. However, the NZDAV group did not exhibit the same declines in peak power and average power during the cycle ergometry trials as observed in the placebo group. It is possible that the NZDAV supplementation may have prevented over-training effects since the blood analysis results indicated that resting creatine kinase levels declined more in the NZDAV group (25%) compared to the placebo group (11%) from the pre-treatment to the post-treatment measurement period (data not shown). In addition, this hypothesis is supported by the fact that following an acute and extreme intensity eccentric resistance-training bout of exercise creatine kinase levels were dramatically reduced in these subjects following 10 weeks of NZDAV supplementation and resistance training, both immediately post-exercise (41.6%) and 48 hours post-exercise (45.4%) (data not shown).

Finally, the comprehensive blood results suggest that NZDAV, as consumed in the current study, did not have any adverse effects on liver or kidney function. These results also showed that NZDAV supplementation might have a minor effect on lowering LDL cholesterol. However, these results are very preliminary and will need additional data for confirmation. An analysis of covariance using a change in absolute body fat levels indicated it was possible that the changes in body composition accounted for the reduction in LDL cholesterol observed in this study.

In conclusion, this results of this study suggest that

NZDAV may have positive effects on body composition and strength/power in resistance training men. In addition, these data strongly suggests that NZDAV can significantly improve a person's maximal aerobic performance. And finally, there was no indication that the short-term use of NZDAV supplementation causes any adverse blood chemistry responses in terms of markers for liver and kidney function, while possibly improving oxygen carrying capacity within blood.

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