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The effect of Ashwagandha (*Withania Somnifera*) on anaerobic performance on elite Indian cyclist

Shweta Shenoy[1], Udesh Chaskar Bhaskaran[1], Jaspal Singh Sandhu[1], M.M. Paadhi[2]
[1]*Faculty of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar, India*
[2] *Central Council for Research in Ayurvedic Sciences (CCRAS), India*

Abstract. *Aims and objective*. This study was formulated to study the effects of Ashwagandha on anaerobic parameters on the elite Indian cyclist. *Material and Method*. It is an experimental study design developed at department of sports medicine and physiotherapy, Guru Nanak Dev University (Amritsar India), on 40 elite cyclists were randomly selected and equally assigned into two groups *viz.* experimental and control group. The experimental group was given supplementation of aqueous roots of Ashwagandha extracts, in the form of capsules while the placebo group was given starch capsules for 8 weeks. Outcome measures: parameters of anaerobic power included were watts, peak power, average power measured by Kinematic Motion System analysis and velocity was measured by 50 meters dash test.
Results. There was significant improvement in both males and females in all the parameters. Watts ($P<0.001$), peak power ($P<0.05$), average power ($P<0.05$) however there was no statistically significant improvement in velocity but it should a clinically significant improvement. Males and females were equally responsive to the ashwagandha supplementation. *Conclusion*: 8 weeks supplementation of ashwagandha leads to improvement in the anaerobic capacity of elite cyclist.
Key words: *anaerobic performance, Ashwagandha, elite Indian cyclist.*

Introduction

Anaerobic system is a short-burst of energy system lasting for 0-30 seconds. This energy system produces energy in the form of adenosine triphosphates (ATP), which refers to the energy currency that is utilized by muscle cells without the utilization of oxygen (1). Cycling is regarded as an endurance sports that mainly relies on the aerobic capacity for energy generation during sustained bouts (2). Though, the aerobic process supplies most of these adequate amounts of energy required in long lasting races, yet they do not provide adequate amounts of energy during strenuous exercise, in which conditions, the important energetic requirements are supplied by the anaerobic pathways (3).

This power production for the sprint dominance is crucial to these cyclists during the last minute of the race, wherein sprint power generated by the anaerobic energy system guides the cyclist through the finishing line and drives him to grab a podium finish (4).

Although everyone notes the importance of an - aerobic power, yet till date we find no studies seconding this statement.

Focusing towards winning a medal on the podium has influenced athletes to boost their performance, mainly relying on supplementations and various ergogenic aids (5). Although there is no shortcut to success, enhancing the power and capacity of the athlete to genetically determined upper limit is of great importance in the sports arena. Ashwagandha is an ancient Indian ayurvedic herb that is predominantly found in the South Asians countries and has been known to possess several medicinal benefits (6). Among its numerous benefits, one of its main properties is that this herb in improves overall vitality of an individual (7). A series of animal studies have demonstrated Ashwagandha to have profound effects on healthy production of white blood cells (WBC), referring it to an effective immuno-regulator and chemoprotective agent (8). This property is very much vital in sports, which directly contributes to the storage of anaerobic power of an athlete.

Though many studies to date have focused on improving aerobic (9-11) and anaerobic capacity (12) via supplementations, but there is paucity of literature on effect of herbal supplementation on the anaerobic capacity.
Therefore, this study was devised to report the effects of Ashwagandha on the anaerobic performance of the elite Indian cyclist.

Materials and Methods
Participants. 40 elite track and road cyclist (elite hereby refers to participation of the athlete in at least state level) Indian cyclists (20 males and 20 females) were randomly selected for this study from around Northern Punjab region. Sample size was obtained from the online sample size calculator; (www.stat.uiowa.edu), with the power of the study 0.8694 (13).
In order to participate in this study, subjects had to meet the following inclusion criteria; aged 18 to 27 years old, having at least state level medal winners in previous cycling competitions, not consuming any other dietary supplements or ergogenic aids during the entire study duration and subjects that had understood and agreed to undergo the following study.
The study was approved by the Guru Nanak Dev University's Institutional Ethical Committee.
Subjects were then randomly assigned into 2 groups: experimental (n = 20) which consumed Ashwagandha extracts capsules, and controlled (n = 20) which consumed placebo starch capsules. In which, both sexes; males and females were divided equally.
During this study, three male subjects had been dropped out due to inconsistent attendance to training sessions. One was belonging to the placebo group and another two from the experimental group.
Baseline Measures. Basic demographic data of each subject was noted, which included age, sex, date of birth, personal best achievements (graded from scale 1-5), height (cm); using the stadiometer pole; precision of 1mm and weight (kg); using the Seca scale; precision of 0.1kg.
Assessment of Power. For these, the Kinematic Measuring System (KMS) from Fitness Technology; Australia was used to measure average power and absolute peak power of the lower limbs. The 40 cm box-jump test was used to get the average power and absolute peak power of lower limbs. The protocol used was the 30-second box jump test, whereby subjects were required to do a continuous jump from one end, to the top of the box, then landing on the other side of the box and finally returning to the beginning point. This had to be repeated non-stop for the duration of 30-seconds. Upon completion of the test, KMS will count the repetitions and display the total and segment count, total work done, average and peak power output (units displayed in Watts). Subjects were given 3 attempts, whereby the best reading of 3 trials were taken. Subjects were given an orientation session for the 40-cm box jump on a separate day, as well as 1–2 practice attempts, prior to the day of testing.
Assessment of Velocity. In this test procedure, the 50-meter Dash Test was used. Subjects were required to sprint a straight dash of a distance of 50-meters and the time (seconds; s^{-1}) was recorded. Subjects were given 3 attempts, whereby the best reading of 3 trials were taken. Subjects were also given an orientation session before the start of the test, as well as 1–2 practice attempts.
Ashwagandha supplementation.The Ashwagandha (*Withania Somnifera*) used was in the form of standardized aqueous root extract, which was obtained in the form of capsules from Dabur India Ltd. In which, had been standardized to the In–House-Specifications of Sanat Products Limited; which are the providers of Dabur India Ltd, certified by the Government of India, Ministry of Health and Family Welfare, Department of AYUSH; having the Purchase Order No. 4500579974, Challan No; 291, with the receipt No. 5000427895. The supplementation was filled in 500mg gelatin capsules. The capsules were given to all subjects in the experimental group, in an intervention of 8 weeks, with a dosage of 2 capsules (each capsule containing 500mg) daily; 1000mg/day (daily taken in the morning and evening).
Placebo supplementation. In this study, the control (Placebo) group was equally supplemented with placebo capsules containing starch powder for the duration of 8 weeks. These capsules were likewise prepared by the same company (Dabur India Ltd.), to avoid any disparities.
Statistical Analysis. Statistical analysis was prepared using Microsoft Office 2011; Excel and Statistical Package for Social Sciences (SPSS) version 16.0.The Levene's test was used to analyze the data for the level of significance. Relating values of 't' test was used to find

intragroup and Levene's was used to find intergroup differences in pre and post protocol.
As for '*t*' test of comparison between male vs. females, One-Way ANOVA and Post-Hoc Scheffe's Test was used. The *P* value used for statistical significance was 0.05 for all cases and entire results are expressed as mean ± standard deviation (SD).

Results

With reference to Table I, the average age for this study was 20 ± 2 years for controlled and 19.6 ± 1.4 years for the experimental group.
Whereas mean height and weight was 56.6 ± 8.7 kg and 164.7 ± 6.6 cm for the controlled group, while the experimental group had the weight and height of 54.9 ± 7.1 kg and 167.39 ± 8.8 cm respectively.
Results (Table II-IV) of experimental group revealed a statistical and clinically significant data; in watts, average power and peak power of lower limbs.
However, as for velocity; in the 50-meter dash test, results had proved clinically significant, but not in statistically.

Table I. Baseline Characteristics of Study Population

Parameters	Placebo group (*n*=19)*			Experimental group (*n*=18)†		
	Min.	Max.	Mean (±SD)	Min.	Max.	Mean (±SD)
Age (years)	18	24.2	20 ± 2	18	23	19.6 ± 1.4
Weight (kg)	45	80.6	56.6 ± 8.7	47	70	54.9 ± 7.1
Height (cm)	152	180	164.7 ± 6.6	148	188	167.4 ± 8.8
BMI (kg/m^2)	17.4	25.1	20.8 ± 2.5	16.2	23.5	19.6 ± 1.9

** having 1 drop-out; †having 2 drop=outs*

Table II. Inter Group Comparison of Experimental *vs.* Placebo by Independent *t*-Test (Levene's Test)

Levene's Test for Equality of Variances			*t* test for equality of means						
Parameters	F	Sig.	T	Df	P Value	Mean Difference	Std. Error Difference	95% Confidence	
								Lower	Upper
Watts	1.870	.180	5.631	35	.000	57.915	10.285	37.036	78.795
Average Power	.205	.654	2.565	35	.015	25.972	10.124	5.419	46.525
Peak Power	6.680	.014	2.225	35	.033	15.596	7.011	1.363	29.828
50 m Dash (seconds)	.390	.536	-1.574	35	.125	-.246	.156	-.563	.071

Table III. Mean Values (±SD) of pre-post readings respective to experimental and placebo

Experimental		Variables	Placebo	
Pre-Test	Post-Test		Pre-Test	Post-Test
242.4 ± 53.8	297.8 ± 53.5	Watts	245.2 ± 33.3	242.6 ± 32.1
176.6 ± 45.8	198.41 ± 33.1	Average Power	151.6 ± 49.5	147.5 ± 39.0
199.1 ± 44.7	211.3 ± 33.6	Peak Power	200.9 ± 27.2	197.6 ± 24.3
8.7 ± 0.5	8.3 ± 0.5	50 m Dash (seconds)	8.7 ± 0.3	8.5 ± 0.4

Table IV. Mean Percentage (%) difference of pre-post readings respective to males and females

MALES		Variables	FEMALES	
Experimental	Control		Experimental	Control
17.8	-3.1	Watts	28.5	1.1
11.4	-3.9	Average Power	13.2	-1.1
8.7	-2.4	Peak Power	3.7	-0.8
-6.4	-3.2	50 m Dash (seconds)	-3.7	-1.5

Table V. Pre-post readings in males *vs.* females, respective to experimental group

Variables	Description	Sum of Squares	Df	Mean square	F	Sig.	Post-Hoc Scheffe Test	
							Group	Sig.
Watts	Between groups	90588.375	3	30196.125	27.554	.000	1 & 2	*
	Within groups	35068.375	32	1095.887			3 & 4	**
	Total	125656.750	35					
Average Power	Between groups	76513.875	3	25504.625	26.579	.000	1 & 2	Non-Sig.
	Within groups	30705.996	32	959.562			3 & 4	Non-Sig.
	Total	107219.871	35					
Peak Power	Between groups	4764.643	3	1588.214	1.274	.300	1 & 2	Non-Sig.
	Within groups	39907.965	32	1247.124			3 & 4	Non-Sig.
	Total	44672.608	35					
50 meter Dash (seconds)	Between groups	3.858	3	1.286	7.199	.001	1 & 2	Non-Sig.
	Within groups	5.716	32	.179			3 & 4	Non-Sig.
	Total	9.573	35					

Group 1 = Males Pre-Test, *$P < 0.05$; Group 2 = Males Post-Test**, P < 0.01; Group 3 = Females Pre-Test, ***P < 0.001;
Group 4 = Females Post-Test

Discussion and Conclusion

This paper aimed to study the effects of Ashwagandha on the anaerobic performance; which had thus shown a positive improvement towards the anaerobic variables, in-comparison of the experimental and placebo group.

Though, the 50-meter dash did not show a statistical significant data, yet clinically there was an improvement of 6% that was from 8.7s pre-test to 8.2s post-test.

Other variable that showed a significant improvement was; watts, which showed a significant data, with t = 5.631 (P<0.05). Where pre-test value was 242watts and post-test it had increased to 297 Watts.

Average power and peak power, both indeed showed a positive data (P < 0.05), that which, t = 2.565 for average power and t = 2.225 for peak power. The mechanics behind how Ashwagandha exerts its effects remains largely unexplored.

However, the increase in power could be hypo - thesized is due to the anabolic effects of this herb.

A study done in 1994 by Grandhi et al (14) stated that this herb has shown to possess anabolic effects. It has been shown in several studies that it has effect in boosting the production of the Luteinizing hormone (LH), which also known as *lutropin* that is hormone produced by the anterior pituitary gland. LH acts in ovary in females and testicles in males.

In females, LH is secreted by the theca cells of the ovaries, causes steroidogenesis and metabolism of the ovary as a whole and of the isolated follicle and its component cell types, the granulosa and thecal cells, as well as folliculogenesis and follicular growth, oocyte maturation, follicular rupture, and corpus luteum maintenance. In males, LH has been known to stimulate the Leydig cells, which are found in the testicles that produce androgens, including testosterone (15).

Ashwagandha also has proved to possess a direct

spermatogenic influence on the seminiferous tubules of immature rats presumably by exerting a testosterone-like effect (16). Testosterone increasing effects of ashwagandha was also found in infertile males in a study done in 2010 (17). In the same study they found that the herb effectively reduces the oxidative stress as assessed by an improved levels of various antioxidants and inhibited lipid peroxidation and protein carbonyl content which would also have effect on increasing the levels of testosterone, LH and reduced the levels of FSH and prolactin in the infertile subjects used in the their study.

Various studies also have demonstrated an increase in strength and power due to the increase in testosterones levels (18, 19). The body naturally uses the androgen testosterone to enhance the protein synthesize specially in the muscles. Testosterone is the most powerful regulator of muscles and is the primary muscle-building hormone. Higher levels of testosterone in the blood stream lead to bulkier muscles and lower body fat levels.

Comparing males and females difference in the experimental group, as this study population was equally divided to males and females; a significant difference was noted in the experimental group. In percentage differences; watts in males had increased by 17.8%, in comparison to females which increased by only 28.5%, and average power values; 11.4% in males compared to 13.2% in females, while peak power showed an 8.7% increase in males compared to females 3.7%. As for the 50 meter-dash test values in males showed an improvement of 6.4% while in females it increased by 3.7% (Table IV). Statistical analysis revealed that only parameter of Watts showed a highly significant with *p* value of 0.000 (Table V). There was no significant difference in both males and females in rest of the parameters. This implies that males and females were equally responsive to the supplementation. This also suggests that Ashwagandha is herb with anabolic effects and the females showed increase in power due to steroidal effects of the herb.

Limitations of the study. This study has not focused on the mechanism of action by anaerobic power *i.e.* levels of testosterone and other anabolic hormone like FSF and LH; blood biochemistry and levels of hormones can be studied so that the exact mechanism of improvement in anaerobic power could have been drawn out. As of now we hypothesize that ashwagandha leads to increase in muscle power caused by its spermatogenic effect. Another limitation would be the duration of this drug-effect on the athletes. A further study including these mentioned factors is suggested.

Implications of the study. Based on the results of this study, this Ashwagandha supplement could be of use to athletes who are eager to go on herbal supplementation/ergogenic aid. Coaches and physical education researchers are suggested to further enhance their teams performance; in regards to sport performance. As a statistically and clinically significant data, both imply an effective increase in power and strength upon the supplementation of Ashwagandha. We conclude Ashwagandha is a substantial herb that could improve power and strength in well-trained athletes.

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References

1. Karp J. (2009) The three metabolic energy systems. *IDEA Fitness journal*; 6(2): 26-29.
2. Robergs RA & Roberts SO (1997). *Exercise Physiology: Exercise, Performance and Clinical Applications. St Louis*, Mosby.
3. Crielaard JM, Pirnay F (1981). Anaerobic and aerobic power of top athletes. *Eur J Appl Physiol*; 47:295-300.
4. Martin JC, Davidson CJ, and Pardyjak ER. (2007). Understanding Sprint-Cycling Performance: The Integration of Muscle Power, Resistance, and Modeling. *International Journal of Sports Physiology and Performance*; 2:5-21.
5. Gradidge P, Coopoo Y, Constantinou D (2010). Attitudes and perceptions towards performance enhancing substance use in Johannesburg boys high school sport. *SAJSM*;22(2):32-36
6. Mishra LC, Singh BB, Dagenais S (2000). Scientific basis for the therapeutic use of Withania Somnifera (ashwagandha): a review. *Alternative Medicine Revie;* 5: 34-346
7. Malhotra CL et al (1965). Studies on Withania ashwagandha. (Part I): Effect of total extract on central nervous system and smooth muscles. *Indian J Physiol Pharmacol*; 9(3):127-36

8. Singh G, Sharma PK, Dudhe R and Singh S (2010). Biological activities of Withania somnifera. *Annals of Biological Research*; 1(3): 56-63.
9. Parcell AC, Smith JM, Schulthies SS, Myrer JW, Fellingham G (2004). Cordyceps Sinensis (CordyMax Cs-4) supplementation does not improve endurance exercise performance. *Int J Sport Nutr Exerc Metab*; 14(2):236-42.
10. Mojtaba E, Davood K, Hamidreza S, Hussein D (2011). Effects of Increased FFA Availability on Aerobic Capacity During Cycling Exercise. J. *Appl. Environ. Biol. Sci*; 1(10)482-488.
11. Czuba M, Zajac A, Poprzecki S, Cholewa J and Woska S (2009). Effects of sodium phosphate loading on aerobic power and capacity in off road cyclists. *Journal of Sports Science and Medicine*; 8, 591-599.
12. Starling RD, Trappe TA, Short KR, Sheffield-Moore M, Jozsi AC, Fink WJ, Costill DL (1996). Effect of inosine supplementation on aerobic and anaerobic cycling performance ; 28(9):1193-1198.
13. Sandhu JS, Shah B, Shenoy S, Chauhan S, Lavekar GS, Padhi MM (2010). Effects of Withania Somnifera (Ashwagandha) and Terminalia Arjuna (Arjuna) on physical performance and cardiorespiratory endurance in healthy young adults. *International Journal of Ayurveda Research*; (1)3:144-149.
14. Grandhi A, Mujumdar AM, Patwardhan B. (1994) A comparative pharmacological investigation of Ashwagandha and Ginseng. J Ethnopharmacol. 4(3):131-5.
15. Channing CP, Tsafriri A. (1977). Mechanism of action of luteinizing hormone and follicle-stimulating hormone on the ovary in vitro. 26(4): 413–468.
16. Abdel-Magied EM, Abdel-Rahman HA, Harraz FM (2001). The effect of aqueous extracts of Cynomorium coccineum and Withania Somnifera on testicular development in immature Wistar rats. *J Ethnopharmacol*; 75(1):1-4.
17. Ahmad MK, Mahdi AA, Shukla KK, Islam N, Rajender S, Madhukar D, et al (2010). *Withania Somnifera* improves semen quality by regulating reproductive hormone levels and oxidative stress in seminal plasma of infertile males. *Fertil Steril:* 94:989–96
18. Sullivan DH, Roberson PK, Johnson LE,Bishara O,EvansWJ, Smith ES, Price JA. (2005) Effects of Muscle Strength Training and Testosterone in Frail Elderly Males. *Medicine and Science in Sports and Exercise*; 37(10):1664-1672.
19. Srinivas-Shankar U, Roberts SA, Connolly MJ, O'Connell MDL, Adams JE, Oldham JA and Wu FCW (2010). Effects of Testosterone on Muscle Strength, Physical Function, Body Composition, and Quality of Life in Intermediate-Frail and Frail Elderly Men: A Randomized, Double-Blind, Placebo-Controlled Study. *The Journal of Clinical Endocrinology & Metabolism*; 95(2): 639-650.

Corresponding Author
Dr. Shweta Shenoy
Faculty of Sports Medicine and Physiotherapy
Guru Nanak Dev University, Amritsar-143005
Mob: +91-9417311900
Email: *shwet1999@yahoo.com*

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