Nutrafoods (2020) 1:169-175 DOI 10.17470/NF-020-0023

Original Research

Impact of 8 weeks of supplementation with *Withania somnifera* on strength in trained individuals

Abstract

Withania somnifera (WS) is a traditional Ayurvedic herb. In addition to Ayurveda texts, the modern medical literature reports many potential health benefits of WS, including its possible use as a supplement as an ergogenic aid. Only recently, the efficacy of WS as an adjuvant to resistance training programmes was assessed. Most of the studies investigating this research area have mainly considered untrained subjects. In this regard, the aim of this study was to evaluate the impact of eight weeks of WS supplementation on strength training adaptations in trained individuals. Sixteen trained male individuals (25.7 ± 3.0 years; 74.7 ± 6.9 kg; 178.9 ± 4.5 cm; 23.3 ± 1.1 BMI), with at least four years of resistance training experience, participated in the study. Individuals continued with their resistance–strength training programmes, while diets and supplementation strategies remained unchanged. Eight of the 16 subjects (treated group) were supplemented with WS (500 mg/d WS powder extract, withanolides 2.5%) for a period of eight weeks, while the other eight subjects (control group) were not supplemented. To evaluate strength, one-repetition maximum tests (1RMs) were performed in four selected exercises at the beginning (T1), in the middle (T2) and at the end (T3) of the study.

Compared to the untreated group, treated individuals showed a significant increase in total maximal strength (the sum of 1RM results) (p=0.05); however, no significant differences emerged from any single exercise maximal strength comparisons. These preliminary data suggest that, in these experimental conditions, eight weeks of supplementation with WS does not appear to contribute significantly to the induction of strength training adaptations in trained individuals.

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Keywords: Ashwagandha, Ayurvedic, resistance training, strength, adaptogens

Introduction

Withania somnifera (WS) or ashwagandha, also known as “Indian ginseng” or “Indian winter cherry”, is a plant within the *Solanaceae family*. WS is widely distributed both as a spontaneous plant and as a cultivated plant in drier parts of tropical and subtropical zones, in particular, India and China [1, 2]. Ayurvedic medicine texts testify to the existence and utilization of WS medical formulations, with more than 3000 years of history [2]. Traditional Ayurveda texts describe a wide range of uses for ashwagandha, including the improvement of “bala”, which means “power, strength” in the Sanskrit language [3]. In addition to old Ayurveda texts, the modern Indian medical literature reports the many potential health benefits of WS, including its possible use as a supplement as an ergogenic aid [3–8].

While most published studies have focused on the therapeutic effects of WS, in recent years there has been a growing interest in the impact of WS extracts on physical performance [1–8].

The possible ergogenic effects of WS supplementation are attributed to adaptogenic, anabolic, anti-inflammatory, cardiopulmonary, neuroprotective and antioxidant actions [1–13].

Two main areas where the impact of WS on physical performance has been studied are strength and endurance capacity [3–8]. Studies on endurance capacity focused primarily on cardiorespiratory adaptation enhancement and the impact of WS on haemoglobin (Hb) levels and the red blood cell (RBC) count was described, these being the key determinants of the cardiovascular performance of endurance athletes [6–8]. However, there are still only a few studies published on this topic and these were conducted mainly within the Indian untrained population and/or in endurance athletes [6, 7].

Strength improvements are the result primarily of morphological and neurological adaptations [14, 15]. Studies evaluating the impact of WS during resistance training protocols focused on body composition changes (in particular, muscle mass) and strength improvements. Recent studies conducted in men with limited training experience or those who were recreationally active reported significant improvements in terms of both body composition and strength [3, 4].

Data from clinical and animal studies on supplementation dosage identified a range from 250 to 1000 mg/day as being effective in producing relevant therapeutic effects without any kinds of adverse effects [4, 16, 17].

The bioactive components that may be responsible for the various effects ascribed to WS include steroidal lactones (withanolides, withaferins), saponins and alkaloids (for example, isopelletierine, anaferine, withanine) [1].

Several studies have demonstrated the possible efficacy of WS in improving resistance training-related performance [3, 4]. However, few studies have considered elite athletes or well-trained athletes involved in a pure strength programme to assess the impact of WS supplementation in more advanced adaptation conditions. The purpose of this study was to investigate the impact of 500 mg/d WS supplementation on strength in well-trained individuals involved in a strength-prevalent resistance training programme throughout an eight-week supplementation protocol.

Materials and methods

An overview of the study protocol is shown in **Fig. 1**. Sixteen trained male individuals (see the population characteristics in **Table 1**), with at least four years of resistance training experience, voluntarily agreed to participate in the study after giving informed consent. Eight individuals (control group) continued with their training programmes, diets and supplementation strategies (no interventions or changes to training programmes, diets or supplementation were carried out). For the remaining 8 subjects (treated group), their diet and training also remained unchanged, but they were supplemented with WS (500 mg/d WS powder extract, withanolides 2.5%) for a period of 8 weeks. The supplement was consumed once daily in the morning with cold tap water. To evaluate strength, one-repetition maximum tests (1RMs)[18, 19] were performed in 4 selected exercises (bench press, barbell squat, lat machine, seated barbell military press) at the beginning (T1), in the middle (T2) and at the end (T3) of the study. Tests started with a specific warm-up of 3 or 4 sets starting from light loads (45–50% 1RM), progressively increasing the load until the 1RM was reached (defined as the maximum amount of weight that a person can lift for a given exercise)[20]. After voluntary allocation of subjects to the control or treated group, and after the first round of tests, a difference in baseline 1RM results was noted. However, from the anamnestic interviews carried out at the beginning of the study, all participants within both groups reported more than 4 years of medium- to high-level resistance training experience, aligning with the population characteristics described in the study aim. These baseline differences may be explained by inter-individual variation with respect to certain characteristics, as described by Hughes *et al.*[15].

All of the data in the text, tables and figures are represented as the mean ± standard deviation (SD) or the median and interquartile range (IQR). The normal distribution and homogeneity of variance, as determined by the Shapiro–Wilk and Levene's test, respectively, were assessed for all data before analysis.

A paired t test or the Wilcoxon test was performed in order to analyze the differences in strength within the same group from the beginning to the end of the training protocol, and repeated measures ANOVA (RMANOVA) was conducted to evaluate the changes in strength at the three different timepoints (T1, T2 and T3). An independent samples t test or Mann–Whitney U test was performed to evaluate the differences between the two groups at each timepoint and from the beginning to the end of the training programme. All analyses resulting in p≤0.05 were considered statistically significant. Data that were not normally distributed are represented through box plots, and normally distributed data through bar graphs. All data analyses were carried out using SPSS version 21.0 (IBM Corporation, Armond, NY) and all of the graphs were generated with GraphPad Prism version 7.0 (GraphPad Software, San Diego, CA, USA).

	Total (n=16)				
	Mean			Range	
Age	25.7	±	3.0	22	31
Body weight (kg)	74.7	±	6.9	62.5	86.0
Height (cm)	178.9	±	4.5	171	187
BMI	23.3	±	1.1	21.4	25.4

Values are expressed as the mean ± SD; BMI = body mass index

Table 1 Characteristics of the studied population

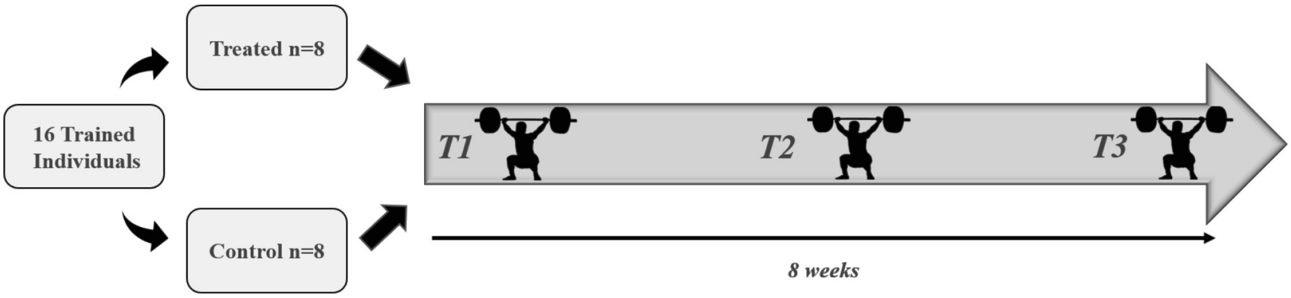
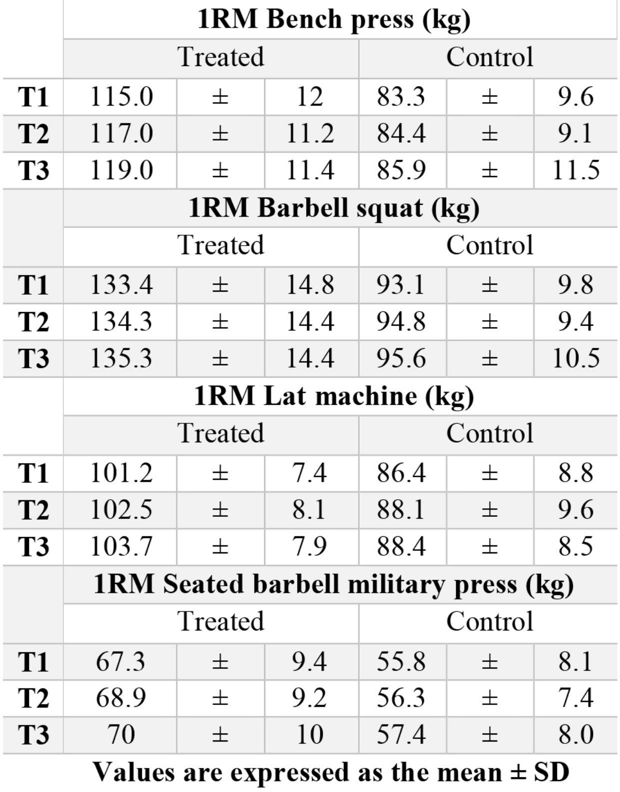


Figure 1 Study protocol

All of the individuals successfully completed the training programme. The 1RM results for both groups from T1 to T3 are summarized in **Table 2.**



	Treated			Control		
	1RM Bench press (kg)					
T1	115.0	±	12	83.3	±	9.6
T2	117.0	±	11.2	84.4	±	9.1
T3	119.0	±	11.4	85.9	±	11.5
	1RM Barbell squat (kg)					
	Treated			Control		
T1	133.4	±	14.8	93.1	±	9.8
T2	134.3	±	14.4	94.8	±	9.4
T3	135.3	±	14.4	95.6	±	10.5
	1RM Lat machine (kg)					
	Treated			Control		
T1	101.2	±	7.4	86.4	±	8.8
T2	102.5	±	8.1	88.1	±	9.6
T3	103.7	±	7.9	88.4	±	8.5
	1RM Seated barbell military press (kg)					
	Treated			Control		
T1	67.3	±	9.4	55.8	±	8.1
T2	68.9	±	9.2	56.3	±	7.4
T3	70	±	10	57.4	±	8.0

Values are expressed as the mean ± SD

Table 2 1RM results for treated and control groups (n=8) at T1, T2 and T3

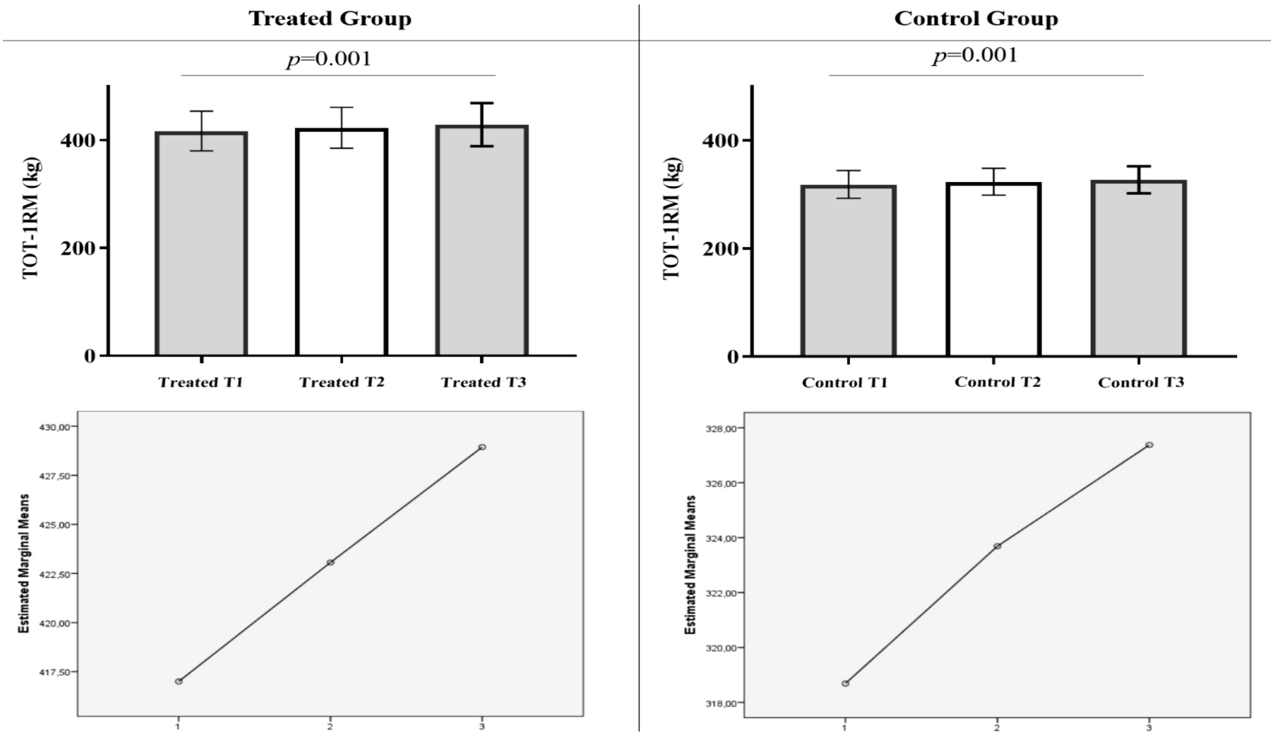
Fig. 2 shows the comparison and estimated marginal means for the total of the 1RM (that is, the sum of all of the exercise 1RMs) results (kg) for the treated group and the control group at the three different timepoints: the start of the study (T1); mid-study (T2) and at the end of the eight weeks (T3).

Individuals within both groups (treated and control) showed increased strength from T1 to T3 (**Fig. 2**).

RMANOVA showed a significant effect of the training programme (time) on maximal strength (1RM) in both groups: treated (F(2,14)=27.306, *p*=0.001, $\eta_p^2=0.796$) and control (F(2,14)=27.306, *p*=0.001, $\eta_p^2=0.796$).

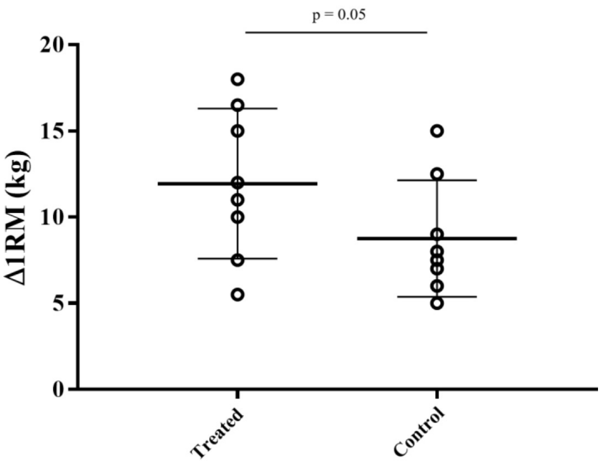
A paired t test showed a significant increase for both groups between T1 and T3: treated (t(7)=7.754, *p*=0.000), with a significant mean difference of +11.93 kg (95% CI, +8.29–+15.57), and control (*t* (7)=7.225, *p*=0.000), with a significant mean difference of +8.68 kg (95% CI, + 5.80 – +11.53).

Figure 2 1RM result totals for T1, T2 and T3 (mean ± SD; n=8)



An independent *t* test showed a significant difference in the 1RM result totals between the treated group (+11.93 ± 4.35 kg) and the control group (+8.68 ± 3.40 kg) (*t* (7)=2.357, p=0.05, Cohen's d=0.8) (**Fig. 3**).

Figure 3 Comparison of differences from T1 to T3 for the treated and control groups (n=8)



No significant differences emerged from independent samples t test and Mann–Whitney U test comparisons with respect to the single exercise 1RM results (**Fig. 4**), with the main differences observed for the bench press (*p*=0.06) and barbell squat (*p*=0.09) exercises and smaller differences seen for the lat machine (*p*=0.62) and barbell military press (*p*=0.15) exercises.

Figure 4 Comparison of the 1RM increase from T1 to T3 (Δ kg) between treated and control groups (median and IQR; n=8)

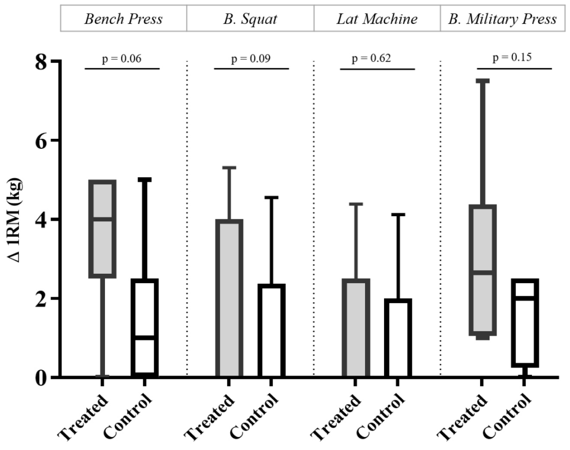


Fig. 5 and **6** represent the 1RM results for each exercise for treated (**Fig. 5**) and control (**Fig. 6**) groups. Paired t test analysis showed significant increases (*p*<0.05) in 1RM for each exercise within both groups, except for bench press data in the control group (*p*=0.06).

Figure 5 1RM results: treated group (mean ± SD; n=8)

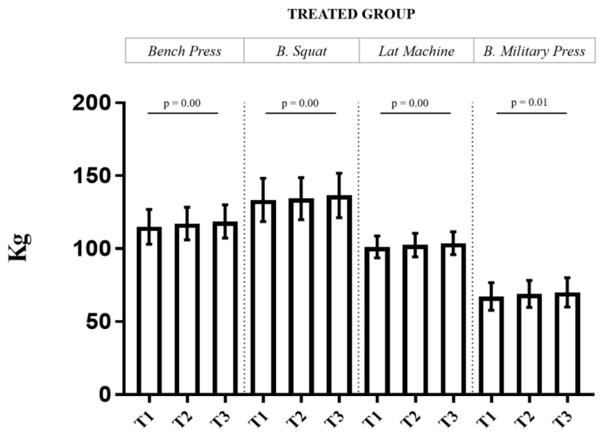
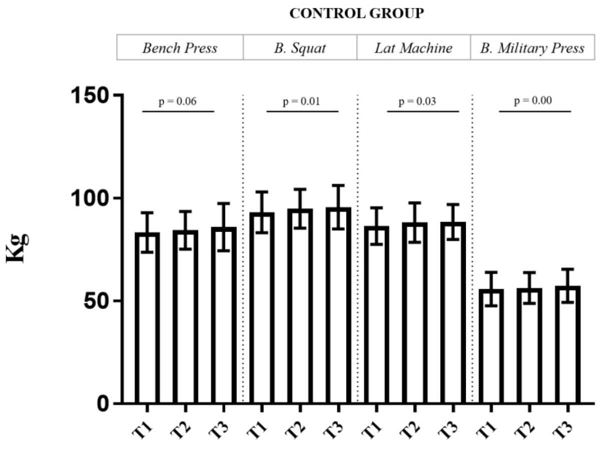


Figure 6 1RM results: control group (mean ± SD; n=8)



Discussion

This preliminary study represents the first research paper, to our knowledge, investigating whether supplementation with WS can increase strength during a resistance training programme in well-trained individuals. The observed increases in strength within both groups are consistent with numerous studies that also evaluated adaptation to resistance or strength training in the absence of any supplementation.

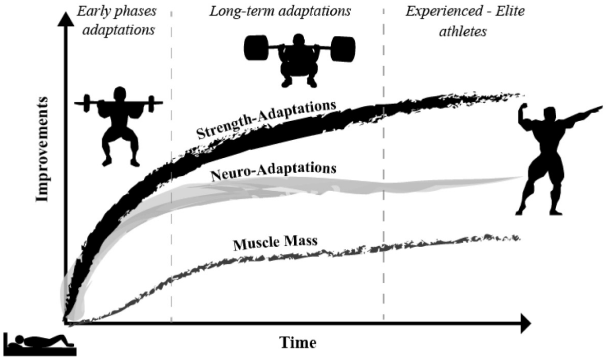
Considering the growing interest in the application of herbalism and herbal medicines to sport and exercise (for use in athletes)[3–8], and taking into account previously published studies on the impact of WS on strength in untrained individuals [3, 4], we decided to investigate if and how WS supplementation could also increase adaptations in well-trained individuals.

Previous studies conducted in untrained individuals [3, 4] showed a significant increase in strength adaptations in all, or almost all, of the analyzed exercises. We show here that supplementation with WS in well-trained individuals results in increased strength adaptations compared to untreated individuals, with a statistically significant increase in total maximal strength (p=0.05); however, no significant differences emerged from the comparison of the single exercises although mean differences were observed for the bench press and barbell squat exercises. Adaptations to strength training (mainly morphological and neurological) are strictly related to the training experience of the subject[14, 15].

The strength adaptation curve of a sedentary individual starting to train will follow an initial very fast exponential growth (months–years) mainly related to neuroadaptations. After this first phase, strength will increase slowly until a plateau phase is reached (**Fig. 7**)[15].

The adaptogenic actions of WS compounds may amplify neuroadaptations in the first phase, and so, WS may be most effective when used as a supplement in sedentary or minimally active individuals[14, 15]. In advanced-phase trained individuals, this adaptogenic effect could be attenuated because 1) individuals have already adapted to many stimuli and 2) in advanced phases, morphological adaptions have a major or at least the same importance as neuroadaptations in improving strength. The effects of WS on the nervous system described as adaptogenic and anxiolytic may be related to an increased focus and concentration during training that translates into an increased ability to recruit muscles, and increased coordination [9–12].

Figure 7 Dynamics of changes in strength, muscle mass and neural adaptations over time as described by Hughes *et al*. (2018) [Cold Spring Harb Perspect Med 8:a029769] [15]



Conclusion

This study confirms in part previous data regarding the adaptogenic effects of WS during resistance training[3,4], showing that well-trained individuals seem to have a reduced response compared to sedentary or minimally trained individuals. This could be explained by strength adaptation kinetics and by the hypothesis that the actions of WS are mainly associated with neuroadaptations. Additional studies on this topic are necessary to thoroughly investigate the actions of WS, to analyse different supplementation strategies and dosages and to evaluate strength adaptations.

Ethical standards

This article does not contain any studies carried out on animal subjects by any of the authors. All procedures followed were in accordance with the ethical standards of the responsible committees on human experimentation (institutional and national) and with the Declaration of Helsinki of 1975, as revised in 2000. Informed consent was obtained from all patients included in the study.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Acknowledgements

This work was not supported by any source of funding.

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