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Research Article

L-Citrulline and Beet Root Supplement Improves Nighttime Erections

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ABSTRACT

Objective: This study evaluated the impact of a nitric oxide-boosting dietary supplement on nighttime erectile function using wearable sensor technology.

Methods: Ten men (mean age 52, mean SHIM score 18) participated in a crossover study. Participants wore the FirmTech TechRing, a validated device that measures erectile firmness and duration, over four nights. Following a two-day washout period without ejaculation or (ED-Erectile Dysfunction) ED-related medications/substances, participants recorded erectile activity over two baseline nights, then ingested two tablets of a nitric oxide-boosting supplement (containing L-Citrulline, Red beet root extract, Panax ginseng, and Muira puama) one hour before sleep for two subsequent nights. Erectile quality was quantified as the area under the curve per hour of sleep (AUC/hr).

Results: AUC/hr significantly increased from a mean of 79.8 (baseline) to 117.9 (supplement nights) with a mean difference of 38.04 (95% CI: -56.75 to -19.33, p=0.0004). The number of nightly erections showed no significant change (4.05 *vs.* 4.45, p=0.42). No adverse effects were reported.

Conclusion: The supplement improved the intensity and duration, but not the frequency, of nighttime erections without side effects. These findings suggest potential benefits for erectile health and warrant further investigation, particularly in combination with other ED treatments.

Keywords: Erectile dysfunction; Nighttime erections; Nitric oxide boosters; L-Citrulline; AFFIRM; TechRing; Beet root extract; Panax ginseng root extract; Muira puama extract

INTRODUCTION

Erectile Dysfunction (ED) negatively impacts mental, emotional, and sexual health [1]. Treatment for ED can enhance quality of life, and adequate circulation is essential for erectile function. Nitric Oxide (NO) is critical for arterial vasodilation, and adequate levels are required to maintain erectile function [2]. However, NO levels decline with age, contributing to increased ED prevalence [3]. In mammals, NO is generated *via* the citrulline/arginine pathway and the nitrate/nitrite/NO pathway [4,5]. Through the NO-cGMP signaling pathway, NO elevates cyclic Guanosine Mono Phosphate (cGMP) levels, initiating a cascade that results in arterial dilation [6,7]. This vasodilation facilitates oxygen and nutrient delivery to muscle tissues, boosting energy, enhancing exercise performance, and improving recovery post-exercise [8].

NO-boosting supplements such as L-citrulline, Panax ginseng root extract, beetroot extract, and Muira puama extract enhance NO bioavailability and support cardiovascular health by lowering blood pressure and improving circulation. L-citrulline and Panax ginseng act through the citrulline/arginine pathway, while beetroot increases NO *via* the nitrate/nitrite/NO pathway [9,10]. Muira puama is believed to influence the NO-cGMP pathway. Phosphodiesterase type 5 (PDE5), highly expressed in penile tissue, degrades cGMP. PDE5 inhibitors (PDE5i) maintain cGMP levels by selectively inhibiting PDE5 activity.

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First-line ED therapies, including PDE5i and NO boosters, are typically administered orally and are preferred over second- and third-line therapies [11]. There is growing interest in combining PDE5i with NO boosters, though few studies have evaluated the efficacy of NO boosters alone [12]. Most ED research relies on subjective instruments such as the International Index of Erectile Function (IIEF), Sexual Health Inventory for Men (SHIM), and Erection Hardness Score (EHS). Objective tools like Nocturnal Penile Tumescence (NPT) assessments are less commonly used. Subjective evaluations may be influenced by emotions, memory, and interpretation, suggesting an incomplete picture of erectile health. In contrast, objective measures allow for unbiased evaluation of treatment efficacy and differentiation between psychogenic and non-psychogenic ED causes [1]. Combining both approaches may offer a more comprehensive understanding of ED.

AFFIRM is a commercially available NO-boosting supplement produced by AFFIRM Science, containing L-citrulline, Muira puama extract, red beetroot extract, and Panax ginseng root extract. NPTs, or nighttime erections, occur spontaneously during sleep and are used as indicators of erectile health [13]. The TechRing, a smart wearable developed by FirmTech, is a validated, non-invasive tool that uses two sensors and an AI interface to objectively monitor NPT by measuring erection firmness and duration [14-18]. The present study aimed to determine whether ingesting two AFFIRM tablets one hour before sleep improves NPT as measured by the TechRing.

MATERIALS and METHODS

Ten men (mean age 52, mean SHIM score 18) completed the study. The research protocol involved a 2-day washout period with no ejaculation, ED medications, or supplements. On Days 1 and 2, participants wore the TechRing while sleeping. On Days 3 and 4, participants took 2 AFFIRM tablets (each contains 750 mg L-Citrulline, 65 mg Muira Puama Extract 4:1, Red beet root extract 45 mg 4:1, Panax ginseng root extract 35 mg 4:1) 1 hour before sleep and wore the TechRing while sleeping. Data from the TechRing was uploaded from the FirmTech mobile app. To standardize the results between patients and between days, the area under the curve per hour (AUC/hr) of sleep was calculated as a measure of erectile activity.

RESULTS

Participants without AFFIRM supplements on Days 1 and 2 had a mean AUC/hr of 79.8 and a mean of 4.05 erections per night. Participants with AFFIRM supplements on Days 3 and 4 had a mean AUC/hr of 117.9 and a mean of 4.45 erections per night. The mean AUC/hr difference was 38.04 (p-value=0.0004, 95% confidence interval -56.75 to -19.33). This represents a 47% increase in the AUC/hr from taking 2 AFFIRM tablets one hour before sleep. There was no significant difference in the number of erections per night (p-value=0.42). No side effects were reported from taking AFFIRM supplements (Table 1).

DISCUSSION

The present study aimed to determine if ingesting 2 AFFIRM tablets 1 hour before sleep can improve nighttime erections by using the TechRing to measure mean NPT and the mean number of erections per night. It was found that AFFIRM, consisting of NO boosters L-Citrulline, Muira Puama Extract, Red Beet Root extract, and Panax Ginseng Root extract, improves erectile quality (p-value=0.0004) as measured by the Area Under the Curve per hour without harmful side effects. There was also a slight increase in erections per night, but not significantly (p-value=0.42). These results support the use of NO boosters as standalone treatments to improve the quality of erections and their potential benefits in treating ED.

As men age, they experience an increase in erectile dysfunction. One way to improve erectile function is by enhancing the vascularity of the penis through focused shockwave therapy and platelet-rich plasma injections. Another method is to strengthen the nitric oxide signal, which leads to an increase in cyclic GMP and dilates blood vessels. Of course, PDE5 inhibitors block the enzyme that breaks down cyclic GMP, and the elevated cGMP levels result in better erectile function. Boosting nitric oxide levels through dietary supplements is a safe and effective way to enhance cyclic GMP levels, which will dilate blood vessels. Nitric Oxide boosters are a safe way to amplify the Nitric Oxide signal in men who are not able to take PDE-5 inhibitors, either because of side effects, drug interactions, or underlying health issues.

Table 1: Participant's characteristics with and without AFFIRM supplements.

	AUC/hr (mean	AUC/hr (median	Number of erections (mean
No AFFIRM	79.8	79.8	4.05
Yes AFFIRM	117.9	111.01	4.45
Mean difference	38.04	31.21	0.4
p-value	0.0004	-	0.428

CONCLUSION

There is a lack of objective evidence on the synergistic effects of NO boosters and PDE5i in treating ED. Early research is promising and supports this idea of a positive interaction between treatments, especially for men with mild to moderate ED or those unresponsive to PDE5i alone. The potential synergy would be beneficial for men who are unable to take full doses of PDE-5 inhibitors due to side effects. Future research will build upon the present study to investigate the potential synergistic effects between NO boosters and PDE5i on nighttime erections.

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