

**Can the *Sutherlandia* herb or resistance exercise reverse the stress inducing effects of a mild-intermittent stress procedure**

By

Ian Garth Neethling

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Supervisor: Prof. Kathryn H. Myburgh

Co-Supervisor: Dr. Carine Smith

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## Declaration

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any University for a degree.

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## Summary

This study aimed to assess the effect of mild psychological stress in male Wistar rats using incremental, intermittent stress on parameters of atrophy, including body mass, soleus and extensor digitorum longus (EDL) muscle mass, and mechanisms possibly contributing to atrophy. Serum corticosterone concentrations, 20s proteasome activity, glutamine synthetase (GS) and tyrosine amino-transferase (TAT) activities were determined. I also assessed whether *Sutherlandia* (Su) or resistance exercise was able to reverse the effects of stress on any of these parameters.

The study consisted of three experiments. Experiment 1 compared the effects of the stress procedure between a control (C, no intervention) and stress group (S, incremental intermittent stress for 1 week). Experiment 2 assessed whether 1 week of Su treatment (day 7 to 14) was able to reverse the effect of prior stress despite continued stress. The 4 experimental groups were: control placebo (CP), stress placebo (StP), control *Sutherlandia* (Csu) and stress *Sutherlandia* (Stsu). Experiment 3 assessed whether resistance exercise (running at 15 m/min in a motor driven wheel while carrying incrementally increasing lead weights for 30 min/day from day 7 to 14) was able to reverse the effect of prior stress despite continued stress. The experimental groups were C, S, control exercise (CE) and stress exercise (StE).

Experiment 1: The percentage body mass was significantly less in S vs. C ( $P < 0.01$ ). Proteasome activity increased significantly in soleus and EDL muscles in group S vs. C ( $P < 0.05$ ). No other parameter changed significantly in response to the 1 week stress protocol.  $N = 6$  for all groups except CP and Stsu with 5 each.

Experiment 2: EDL mass to body mass ratio significantly decreased in StP vs. CP ( $P < 0.05$ ), which was attenuated by Su treatment in Stsu ( $P < 0.05$ ). A

soleus proteasome activity significantly increased in StP vs. CP ( $P < 0.01$ ), which was attenuated by Su treatment comparing Stsu vs. StP ( $P < 0.05$ ). Similarly Stsu had significantly lower EDL proteasome activity than StP ( $P < 0.05$ ). The GS activity in soleus muscle and EDL muscle was significantly higher in StP vs. CP ( $P < 0.01$ ) but *Sutherlandia* treatment was unable to significantly attenuate the stress-induced increase of GS activity in either muscle.

Experiment 3: Exercise caused a significant percentage reduction in body mass in CE vs. C ( $P < 0.01$ ) and in StE vs. S ( $P < 0.01$ ) without a concomitant decrease in either soleus or EDL muscle mass. Exercise did significantly attenuate the stress-induced increase in EDL 20s proteasome activity in StE vs. S ( $P < 0.05$ ).

The results of this study suggest that *Sutherlandia* treatment was able to significantly attenuate the stress-induced decrease in relative EDL mass and that it might have its anti-catabolic effects through regulation of the 20s proteasome. Similarly resistance exercise spared relative skeletal muscle mass loss in response to stress and might also have its anti-catabolic effects through regulation of the 20s proteasome. Effects on serum corticosterone concentration and activities of GS and TAT were less conclusive.

## Opsomming

Die doel van hierdie studie was om die effekte van 'n matige sielkundige stres respons in manlike Wistar rotte te assesser deur gebruik te maak van 'n toenemende maar onderbroke stres protokol op parameters van atrofie, insluitende liggaamsmassa, soleus en EDL spiermassa en meganismes wat moontlik 'n bydrae maak tot atrofie. Serum kortikosteroon, 20s proteasoom aktiwiteit, glutamien-sintetase (GS), en tirosien aminotransferase ensiem aktiwiteit was geasseer. Ek wou ook assesser of die *Sutherlandia* (Su) krui of weerstands oefening die effekte van stres kon omkeer.

Die studie het bestaan uit 3 eksperimente. Eksperiment 1 het effekte van die stres prosedure vergelyk tussen 'n kontrole (C, n = 6, geen behandeling) en stres groep (S, n = 6, toenemende stres vir 1 week). Eksperiment 2 het bepaal of Su behandeling (dag 7 tot 14) die effekte van die 2 week stres protokol kon omkeer. Vier eksperimentele groepe is gebruik, kontrole plasebo (CP, n = 5), stres plasebo (StP, n = 6), kontrole *Sutherlandia* (Csu, n = 6) en 'n stress *Sutherlandia* groep (Stsu, n = 5). Eksperiment 3 het die omgekeerde effek van weerstandsoefening bepaal (hardloop in 'n motoraangedrewe wiel teen 15 m/min met lood gewigte rondom skouers vir 30 min/dag vanaf dag 7 tot 14). Vier groepe is gebruik naamlik, C (n = 6), S (n = 6), kontrole oefening (CE, n = 6) en stres oefening (StE, n = 6).

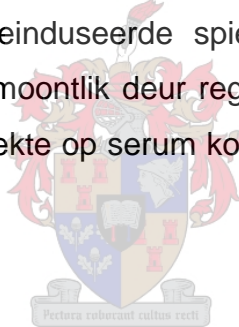
Eksperiment 1: Die persentasie liggaams massa was beduidend minder in S vs. C ( $P < 0.01$ ). Daar was 'n beduidende toename in proteasoom aktiwiteit in soleus sowel as EDL in S vs. C ( $P < 0.05$ ). Daar was geen beduidende verandering in enige ander parameter nie.

Eksperiment 2: Daar was 'n beduidende afname in EDL massa tot liggamsmassa verhouding in StP vs. CP ( $P < 0.05$ ), hierdie effek was geattenuer deur Su toediening in Stsu ( $P < 0.05$ ). 'n Beduidende verhoging in

soleus proteasoom aktiwiteit in StP vs. CP ( $P < 0.01$ ) is geattenuer deur Su toediening in Stsu vs. StP ( $P < 0.05$ ). GS aktiwiteit was beduidend verhoog in beide soleus en EDL in StP vs. CP ( $P < 0.01$ ) en Su toediening het dit nie beduidend teengewerk nie.

Eksperiment 3: Oefening het 'n beduidende afname in die persentasie liggaams-massa veroorsaak in CE vs. C ( $P < 0.01$ ) en StE vs. S ( $P < 0.01$ ) sonder dat skeletspier-massa afgeneem het. Oefening het die stres-geinduseerde toename in 20s proteasome teengewerk in StE vs. S ( $P < 0.05$ ).

Die resultate van hierdie studie toon dat *Sutherlandia* in staat was om die stres-geinduseerde afname in relatiewe EDL massa te attenuer en dat die anti-kataboliese effek dalk deur regulasie van die 20s proteasome werk. Weerstandsoefening kon ook die stres-geinduseerde spier-atrofie verhoed en die anti-kataboliese effek is weereens moontlik deur regulasie van die 20s proteasome. Daar was geen oortuigende effekte op serum kortikosteroon konsentrasie, GS of TAT aktiwiteite nie.



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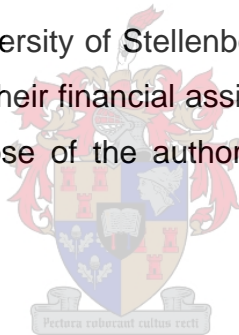
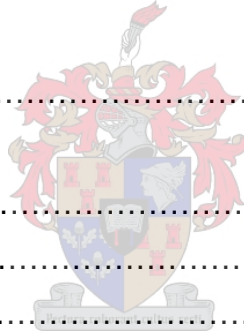


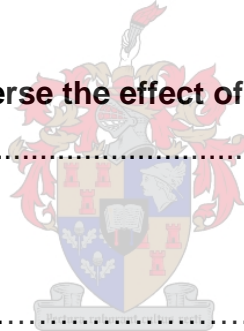
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