White Tea Intake Mitigates SIRT1 Suppression in Prediabetes Skeletal Muscle: A Nutraceutical Approach to Redox Balance

Bruno Fernandes[1], Alexandra Penha[2], Ana Capitão[3], Cátia Sousa[4], Branca M. Silva*[(5,6)], Luís Rato[7]

[1]University of Évora, School of Science and Technology, Department of Biology, Évora, Portugal;

[2]University of Évora, Center for Sci-Tech Research in Earth System and Energy (CREATE), School of Health and Human Development, Department of Health and Medical Sciences, Évora, Portugal

[3] CNC-UC - Center for Neuroscience and Cell Biology, University of Coimbra and CiBB - Centre for Innovative Biomedicine and Biotechnology, University of Coimbra

[4]University of Évora, Comprehensive Health Research Centre (CHRC), School of Health and Human Development, Department of Biology, Évora, Portugal

[5]University of Beira Interior, Convento de Santo António, 6201-001 Covilhã, Portugal

[6]REQUIMTE/LAQV, Department of Chemical Sciences, Faculty of Pharmacy, University of Porto, Rua Jorge Viterbo Ferreira, 280, Porto, 4050-313, Portugal;

[7]University of Évora, Comprehensive Health Research Centre (CHRC), School of Health and Human Development, Department of Health and Medical Sciences, Évora, Portugal

(*) ***Corresponding author:*** **branca@fcsaude.ubi.pt**

ABSTRACT

Objective: Type 2 diabetes mellitus (T2DM) impairs skeletal muscle function, reducing metabolic flexibility and mitochondrial efficiency while increasing oxidative stress due to excess reactive oxygen species (ROS) and weak antioxidant defenses. Sirtuin 1 (SIRT1) and Sirtuin 3 (SIRT3), NAD^+-dependent deacetylases, support mitochondrial health and activate ROS-detoxifying enzymes. We hypothesized that prediabetes (PreDM) reduces SIRT1 and SIRT3 expression in muscle, contributing to redox imbalance and mitochondrial dysfunction. White tea (WTEA), known for its anti-hyperglycaemic and antioxidant properties, may counteract these effects. This study investigates the impact of PreDM on SIRT1/SIRT3 expression in rat skeletal muscle and whether WTEA supplementation offers protective benefits.

Methods: All rats were provided with *ad libitu*m access to a standard chow meal. At one month of age, the streptozotocin (STZ)-treated rats were divided into two groups: the PreDM+WTEA group (N=6) consumed white tea (WTEA) for the subsequent two months, while the other STZ-treated group (PreDM group, N=6), and the control group (control group, N=6) consumed water. Relative mRNA expression levels of SIRT1 and SIRT3 in skeletal muscle were quantified via quantitative polymerase chain reaction. Statistical significance was evaluated by one-way ANOVA, followed by Tukey post-test using GraphPad Prism 10.

Results: PreDM significantly reduced mRNA SIRT1 expression in skeletal muscle. Notably, WTEA supplementation restored SIRT1 transcript levels to those comparable with non-PreDM controls. No significant differences were detected in SIRT3 expression between PreDM, WTEA-treated, and control groups.

Conclusions: These findings suggest that PreDM selectively downregulates SIRT1 expression in skeletal muscle, potentially contributing to oxidative stress and metabolic impairment. WTEA supplementation appears to reverse this effect, highlighting a possible therapeutic role. In contrast, SIRT3 expression remained unchanged, indicating a possible differential regulatory response to PreDM in muscle tissue.

Keywords: Sirtuins, Skeletal muscle, Prediabetes (PreDM), Type 2 diabetes mellitus (T2DM), Oxidative stress, White tea extract (WTEA)

Author Info
Corresponding author: branca@fcsaude.ubi.pt
Presenting author (student no): luis.pedro.rato@uevora.pt

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