

# Oxidative stress parameters in blood, liver, and kidney of diabetic rats treated with curcumin and/or insulin

Heloisa Einloft Palma · Patrícia Wolkmer · Miguel Gallio · Marcos M. B. Corrêa · Roberta Schmatz · Gustavo R. Thomé · Luciane B. Pereira · Verônica S. P. Castro · Andréia B. Pereira · Andressa Bueno · Lizielle S. de Oliveira · Debora Rosolen · Thaís R. Mann · Bianca S. de Cecco · Dominguita L. Graça · Sonia T. A. Lopes · Cinthia M. A. Mazzanti

Received: 12 May 2013 / Accepted: 28 September 2013  
© Springer Science+Business Media New York 2013

**Abstract** This study evaluated the effects of curcumin and/or insulin on antioxidant enzyme activity in blood, liver, and kidney, as well as on lipid peroxidation and delta aminolevulinic dehydratase ( $\delta$ -ALA-D) activity, and a histopathological analysis of streptozotocin-induced diabetic rats. The animals were divided into six groups ( $n = 6$ ): control/saline (C); control/curcumin (CCur); diabetic/saline (D); diabetic/insulin (DIns); diabetic/curcumin (DCur); and diabetic/insulin/curcumin (DInsCur). After 30 days of treatment with curcumin and/or insulin, the animals were sacrificed and the liver, kidney, and serum were used for experimental determinations. Results of histopathological analysis showed that the treatment with insulin ameliorate renal and hepatic lesions from both DIns and DInsCur groups. TBARS levels were significantly increased in serum, liver, and kidney in D group and the administration of curcumin and insulin prevented this increase in DIns and DCur groups. The activities of catalase (CAT), superoxide dismutase, and  $\delta$ -ALA-D presented

a significant decrease in the liver and kidney D group when compared to C group ( $P < 0.05$ ). The animals treated with curcumin and insulin presented an increase of CAT activity, revealing a positive interaction between both substances. The treatments with curcumin or insulin prevented oxidative stress in blood, through modulation of enzymatic antioxidant defenses. These findings contributed to the comprehension that antioxidants from medicinal plants could be used as adjuvant in the treatment of this endocrinopathy and not as single therapy.

**Keywords** Diabetes mellitus · Antioxidant enzymes · Lipid peroxidation · Curcumin ·  $\delta$ -ALA-D

## Introduction

Diabetes mellitus (DM) is a systemic disease affecting a significant proportion of the population worldwide [1].

H. E. Palma (✉) · M. M. B. Corrêa · V. S. P. Castro · A. B. Pereira · A. Bueno · D. Rosolen · T. R. Mann · B. S. de Cecco · S. T. A. Lopes · C. M. A. Mazzanti (✉)  
Department of Small Animals, Hospital Veterinário, Universidade Federal de Santa Maria, Faixa de Camobi, Km 9, Avenida Roraima no 1000, Campus Universitário, Sala 103, Santa Maria, RS 97105-900, Brazil  
e-mail: heinloft@hotmail.com

C. M. A. Mazzanti  
e-mail: cmelazzo@yahoo.com.br

P. Wolkmer · R. Schmatz · G. R. Thomé · L. B. Pereira · L. S. de Oliveira  
Department of Chemistry, Universidade Federal de Santa Maria, Faixa de Camobi, Km 9, Avenida Roraima no 1000, Campus Universitário, Prédio 18, Santa Maria, RS 97105-900, Brazil

M. Gallio  
Department of Large Animals, Hospital Veterinário, Universidade Federal de Santa Maria, Faixa de Camobi, Km 9, Avenida Roraima no 1000, Campus Universitário, Sala 103, Santa Maria, RS 97105-900, Brazil

D. L. Graça  
Department of Pathology, Universidade Federal de Santa Maria, Faixa de Camobi, Km 9, Avenida Roraima no 1000, Campus Universitário, Hospital Veterinário, Santa Maria, RS 97105-900, Brazil