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THE EFFECT OF BISPHENOL A AND ANTIOXIDANTS ON SOD AND SIRT1 GENES IN SWINE OOCYTES

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Abstract:*The evaluation of in vitro maturation parameters and the molecular factors influencing them is crucial for improving oocyte quality and reproductive performance in swine. This study evaluates the effects of bisphenol A (BPA) and exogenous antioxidants, namely quercetin and N-acetylcysteine (NAC) on the relative gene expression of SIRT1 and SOD in swine cumulus–oocyte complexes (COCs). From 33 ovaries harvested from sows, 68 COCs were collected via follicular aspiration and classified based on morphological criteria before and after in vitro maturation (IVM) in TCM-199 medium supplemented with hormones. COCs were subjected to four experimental conditions: control (V1), quercetin (10 µg/ml, V2), NAC (5 mM, V3), and BPA (50 µM, V4). Total RNA was extracted and analyzed via RT-qPCR to determine relative SIRT1 and SOD expression levels using β-actine as a reference gene. Real-time qPCR analyses revealed that antioxidant supplementation significantly modulated gene expression, highlighting that protective compounds enhance cellular defense traits. Notably, supplementation with N-acetylcysteine increased SOD expression to 2.08 and SIRT1 expression to 1.95 compared to the control group, whereas quercetin elevated SOD to 1.52 and SIRT1 to 1.68. Conversely, exposure to the endocrine-disrupting chemical BPA impaired redox homeostasis, decreasing SIRT1 expression to 0.48 and SOD expression to 0.45. Supplementation of the IVM medium with antioxidants, particularly N-acetylcysteine and quercetin, enhances cellular defense mechanisms and supports oocyte quality by upregulating SIRT1 and SOD expression, whereas BPA exposure disrupts redox homeostasis and impairs antioxidant capacity in porcine oocytes.*

• Introduction

In vitro maturation (IVM) of porcine oocytes is an important component of assisted reproductive technologies and provides biological material for studies investigating oocyte physiology, fertilization and early embryonic development. The success of IVM depends on the acquisition of both nuclear and cytoplasmic competence, which requires coordinated cellular and molecular processes. Bisphenol A (BPA) is an endocrine-disrupting compound that has been investigated for its potential adverse effects on reproductive function. Previous studies cited in the source material report that BPA exposure may interfere with porcine oocyte maturation, including meiotic spindle organization and chromosome alignment.

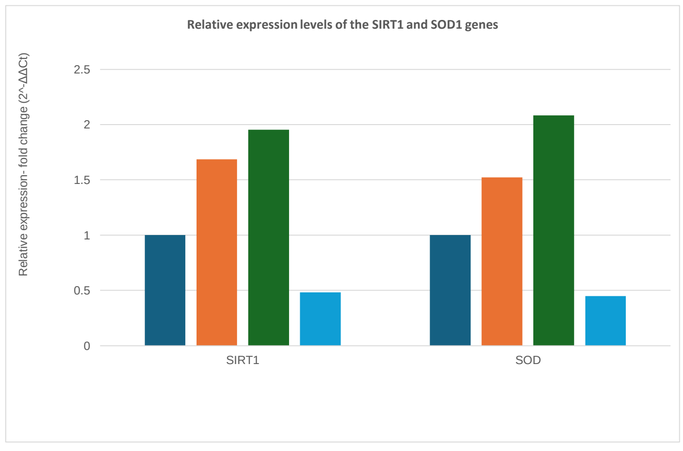
The present study aimed to investigate the effects of quercetin, N-acetylcysteine and bisphenol A on the relative expression of SIRT1 and SOD1 in porcine oocytes matured in vitro. Four experimental groups were considered: a control group, a quercetin-treated group, an NAC-treated group and a BPA-treated group. Gene expression was evaluated by reverse transcription quantitative polymerase chain reaction (RT-qPCR), using β-actin as the reference gene. By comparing the expression of these genes among the experimental groups, the study sought to characterize the molecular responses associated with the addition of antioxidants or BPA to the oocyte maturation medium.

• Material and method

Cumulus–oocyte complexes (COCs) were recovered by aspirating ovarian follicles measuring 3–5 mm in diameter using 5-mL syringes fitted with 18-gauge needles. COCs were cultured for 22 h in hormone-supplemented maturation medium, followed by a further 22 h of culture under the same conditions without additional hormones. Four experimental groups were established according to the treatment applied: control, quercetin, BPA and NAC.

• Results and discussions

A total of 68 cumulus–oocyte complexes (COCs) were recovered from 33 porcine ovaries.For SIRT1, the relative expression values were 1.68 in the quercetin group and 1.95 in the NAC group. In contrast, the BPA group showed a lower value of 0.48 relative to the control.Relative expression reached 1.52 in the quercetin group and 2.08 in the NAC group, whereas the BPA group showed a value of 0.44 relative to the control.Overall, both genes showed the same descriptive pattern across the experimental groups: relative expression was higher in the antioxidant-treated groups than in the control, whereas lower values were observed in the BPA-treated group.



• Relative expression of *SIRT1* and *SOD1* genes

• Conclusions

The highest relative expression levels of both SIRT1 and SOD1 were observed in the N-acetylcysteine (NAC)-supplemented group. The quercetin-supplemented group showed increased relative expression of SIRT1 and SOD1 compared with the control group. The bisphenol A (BPA)-exposed group exhibited lower relative expression levels of both genes compared with the control group, suggesting a potential association between BPA exposure and altered cellular antioxidant defense mechanisms.