In vitro bisphenol A impairs testicular energy metabolism and spermatogenesis through nuclear estrogen receptors activation in zebrafish

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Energy metabolism and the availability of energy substrates play a critical role in spermatogenesis. However, aquatic organisms, particularly fish, are highly vulnerable to xenobiotics such as bisphenol A (BPA), which is closely related to the impairment of physiological and biochemical processes. Therefore, the aim of this study was to investigate the in vitro effects of BPA and the involvement of nuclear estrogen receptors (ESR) on testicular energy metabolism and spermatogenesis in zebrafish. Testes were incubated with DMSO, 10 pM or 10 µM BPA for 72 h through an organotypic culture. Additionally, testes were pre-incubated in the presence or absence of ESRα/β antagonist, ICI 182,780. After, reverse transcription followed by real-time polymerase chain reaction was performed to analyze gene expression. Moreover, the proportion of the surface of testicular cells was analyzed using Ilastik software. Thus, the results revealed that the relative expression of pyruvate kinase M1/2a (*pkma*) and outer dense fiber protein 3b (*odf3b*), a spermatids gene marker, was reduced by 10 pM BPA. The reduced expression of odf3b and the reduced proportion of spermatids and spermatozoa by BPA were through ESRα/β activation. In addition, the relative expression of alanine aminotransferase (*gpt2*), 6-phosphofructo-2-kinase/fructose-2,6-bisphosphatase (*pfkfb2a*), lactate dehydrogenase (*ldhba*) and estrogen-related receptor expression was reduced by 10 µM BPA. In contrast, the relative expression of glycogen phosphorylase (*pygl*), monocarboxylate transporter 4, synaptonemal complex protein 3, estrogen receptors β1 and β2 was increased by 10 µM BPA. The reduced relative expression of *pfkfb2a* and ldhba, as well as increased expression of *pygl* by 10 µM BPA were through ESRα/β activation. Overall, these results indicate that exposure of male fish to environmental concentrations of BPA may impair testicular energy metabolism by altering gene expression and spermatogenesis through ESRα/β activation.