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P-109 Nanoflakes of molybdenum disulfide functionalized with catechins modulate the sperm capacitation resulting in an improvement of the IVF outcomes in a swine *in vitro* model

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Study question: Are there any potential effects derived from the exposure of spermatozoa to MoS_2/catechins nanoflakes during the process of capacitation?

Summary answer: The spermatozoa exposure to MoS_2/catechin nanoflakes do not induce toxicity on spermatozoa and modulate sperm capacitation in a swine *in vitro* model.

What is known already: Molybdenum disulfide (MoS_2)is a 2D graphene-like material widely used in a pletora of applications, such as energy storage, catalysts, sensors, lubricants and friction reducers. The unique features of this nanomaterial suggest interesting applications in the biomedical field. To date, there are no data regarding the potential effects of MoS_2 nanoflakes on the reproductive field.

Study design, size, duration: To evaluate the potential effects derived from the interaction between the sperm cells and this material, spermatozoa were exposed to MoS_2/Catechins nanoflakes at 10, 1, 0.1 ppm, using catechins as control, during capacitation. Different sperm capacitation events were studied, mainly related to their physic-chemical properties (membrane) and biochemical pathways (intracellular signaling), and then IVF experiments were performed with MoS_2/catechins and catechins (0.1 ppm). Ten independent experiments were carried out between November 2020 and November 2021.

Participants/materials, setting, methods: The sonochemical exfoliation of bulk MoS_2 in water-soluble MoS_2 nanoflakes was obtained with a flavonoid, catechin (CT), that acts as stabilizing agent remaining anchored onto the surface of the MoS_2 sheets. Sperm cells from different animals were included in this study. To evaluate the parameters exposed, different techniques were used: fluorescence microscopy, flow cytometry, western blot and *in vitro* fertilization assay.

Main results and the role of chance: No significant differences were found in terms of sperm membrane modifications (acrosome damage and membrane disorder) and sperm biochemical pathways (PKA activity, tyrosine phosphorylation patterns, intracellular calcium concentration and mitochondrial activity) between the groups of study compared to the control group. From the results arise that MoS_2/CT nanoflakes do not induce any negative effect on the parameters evaluated related to sperm capacitation. Moreover, the addition of MoS_2/CT nanoflakes and CT alone at a specific concentration (0.1 ppm) has demonstrated to increase the spermatozoa fertilizing ability in an IVF assay by increasing the number of fertilized oocytes with respect to the control group.

Limitations, reasons for caution: Despite the promising results in terms of IVF outcomes, further studies are needed to investigate the nature of the interaction between spermatozoa and the MoS_2, as well as the potential effects on embryonic development.

Wider implications of the findings: Our findings open new interesting perspectives regarding the use of 2D graphene-like materials obtained using natural/bio compounds, to implement new strategies to manage sperm capacitation.

Trial registration number: not applicable