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Biological activity of an aqueous solution of fullerene C_{60} molecules

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A hydrated fullerene is a cluster formed by a fullerene molecule (usually C_{60}) surrounded by a stable shell consisting of ordered water molecules bound to the fullerene surface by hydrogen bonds and van der Waals forces. This structure gives the fullerene biocompatibility and water solubility, which distinguish it from its water-insoluble parent form. Hydrated fullerenes find applications in biophysics and biology, cryobiology due to their unique physicochemical properties.

The main areas of application of hydrated fullerenes include:

— antioxidant activity — protection of cells from oxidative stress and free radicals,

— neuroprotection — use in the therapy of neurodegenerative diseases,

— antibacterial and antiviral properties — potential in the fight against infections,

— targeted drug delivery — use as nanocontainers for targeted transport of bioactive substances,

— study of biomolecular interactions — use as probes and sensors in biophysical studies.

We present a new method for obtaining hydrated fullerene by co-condensation in vacuum of fullerene vapors and water onto a surface cooled by liquid nitrogen. The solution of C_{60} molecules obtained during the melting of the condensate demonstrated high stability for a long time (one year).

Comprehensive analysis of this solution using various physical methods: optical spectroscopy, mass spectrometry, electron microscopy, *etc.* showed that the solution mainly contains single molecules and small clusters of unmodified C_{60} (from 1 to 10 nm), which are surrounded by a water shell (Cherednychenko *et al.*, 2024). Studies have shown that even very low concentrations of fullerene in water (up to 1 μg/l) significantly accelerate the development of plant sprouts from seeds.

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Effect of different yolk treatments on cold resistance of boar semen

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One of the most important ways to intensify pig production is to utilize the genetic resources of the breeding stock fully. Long-term storage of boar semen in a frozen state opens up great prospects for breeding work, allowing us to realize significant genetic reserves of breeding pigs and increase the efficiency of testing boars for the quality of their offspring.

Many scientists from different countries are working to improve the method of long-term storage of boar semen, but there is still no reliable method of freezing and thawing of boar semen.

The research on improving the cryoprotective environment for storing boar semen in liquid nitrogen was carried out in the production conditions of the Testing Center of the Livestock Farming Institute of the National Academy of Agrarian Sciences of Ukraine, accredited by the National Accreditation Agency of Ukraine, under the requirements of DSTU ISO/IEC 17025:2006 as a basic organization of the metrological service of the Ministry of Agrarian Policy and Food of Ukraine.

The objective of this research stage was to determine the effect on the improvement of the cold resistance of boar semen, under low temperature shock, when diluted with media containing chicken egg yolk after various treatments.

Freshly collected boar semen was diluted in glucose-chelate medium with the addition of 8.0% egg yolk of different treatments: 1) native; 2) native inactivated at 56 °C; 3) infused with distilled water, centrifuged and inactivated; 4) diluted with distilled water, shock frozen, thawed, centrifuged and inactivated. The media were incubated for 2 hours at room temperature (24 °C), then 1 cm^3 of semen from all samples was transferred to a water bath at 35 °C for 10 minutes and then abruptly transferred to a water bath at 5 °C for 10 minutes. Sperm viability was then determined by a heat stress test at 38 °C for 3 hours. The control was semen diluted with medium without yolk. Sperm motility was determined before and after shock using a microscope on a 10-point scale. The experiment was performed on the semen of 9 sire boars.

According to the results of the study, it was found that the first 3 media containing the yolk of the following treatments were characterized by the most pronounced protective properties: 1) native; 2) native inactivated at a temperature of 56 °C; 3) infused with distilled water, centrifuged, and inactivated. In terms of survival, these treatments ranged from 51.0—54.2%. The worst survival rate of 33.7% was obtained using egg yolk diluted with distilled water, shock frozen, thawed, centrifuged, and inactivated.

Therefore, adding egg yolk from these treatments to the cryoprotective environment may also have a positive effect on the survival of boar sperm after thawing.