

Figure S1. Effect of PQQ added to the freezing extender on post-thaw boar sperm viability and acrosome integrity.

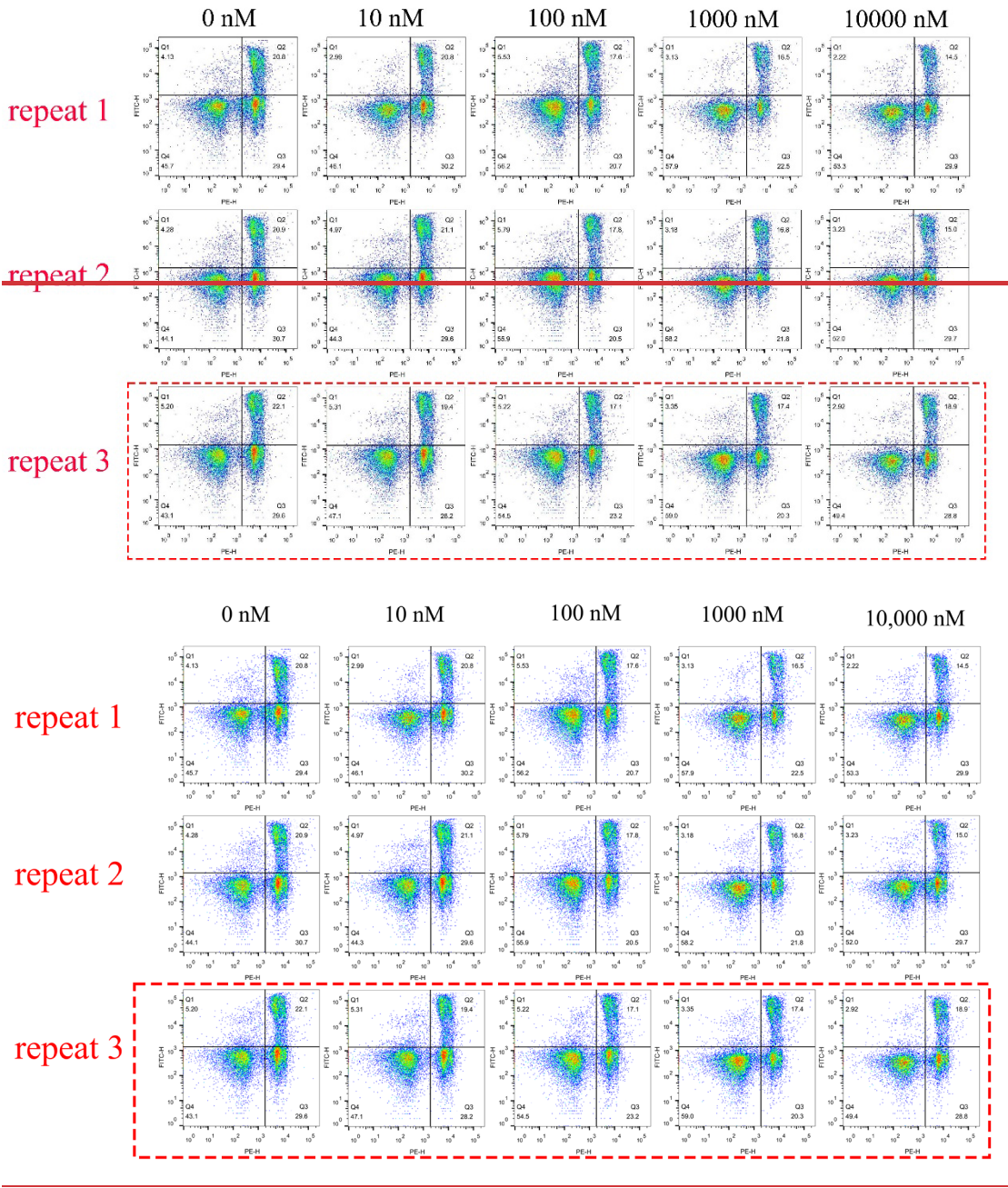


Figure S2. Effect of supplementation different concentrations of PQQ to the freezing extender on sperm mitochondrial membrane potential in boar sperm post-thaw.

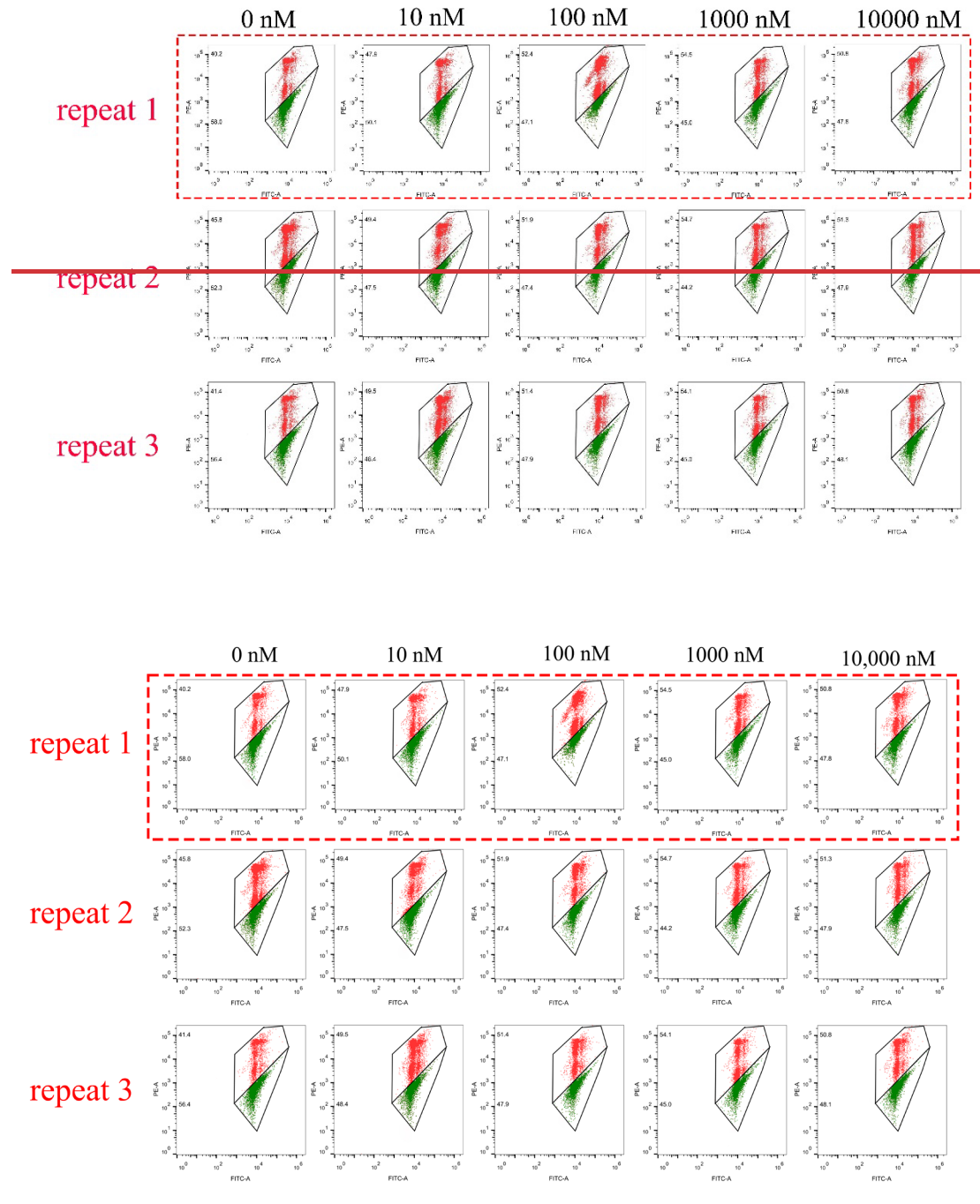


Figure S3. Effects of PQQ added to the freezing extender on post-thaw boar sperm mitochondrial ROS levels.

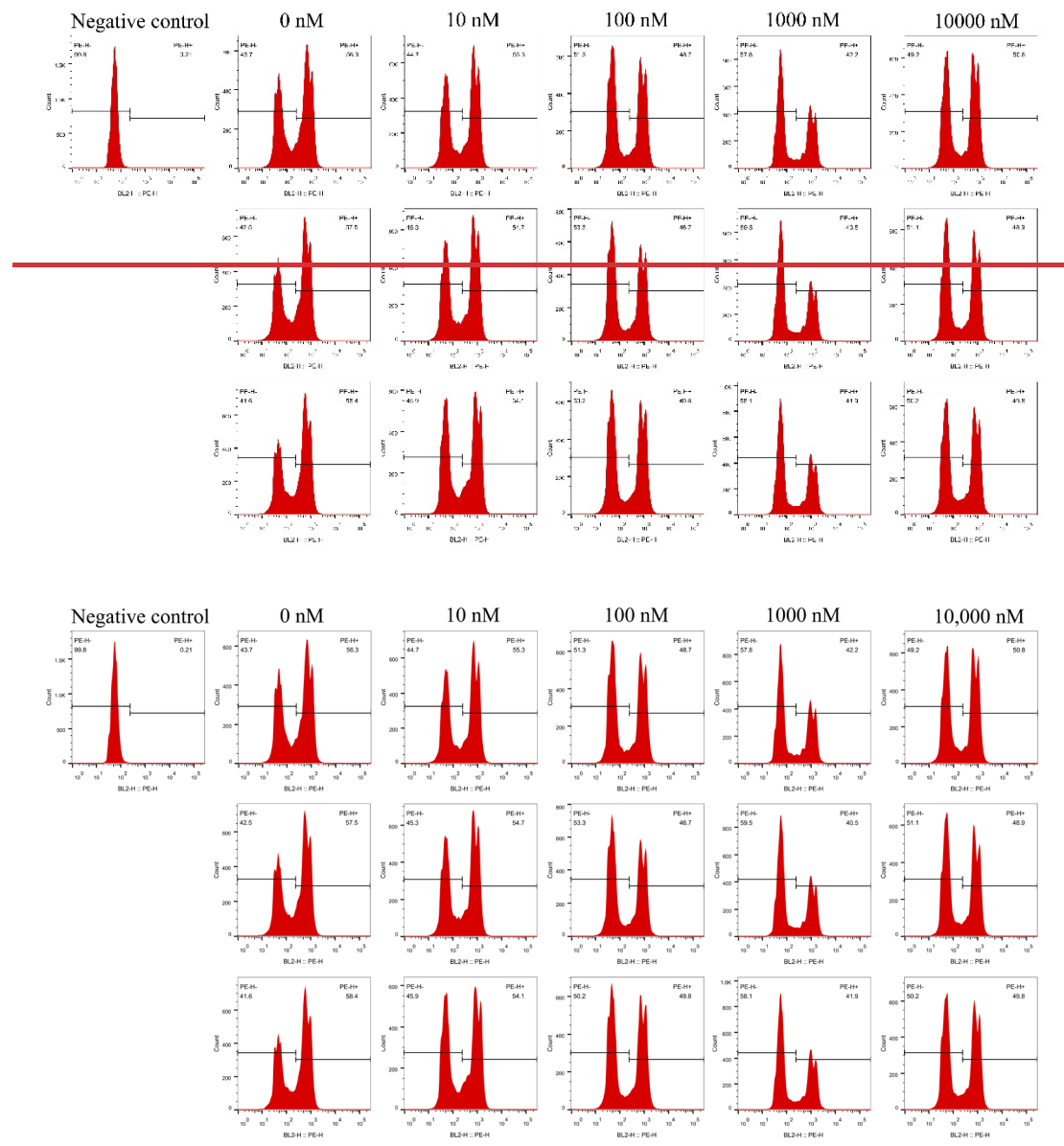
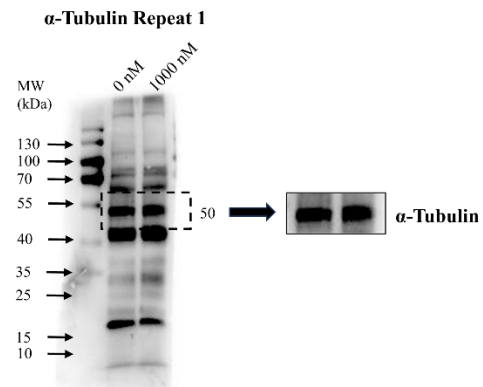
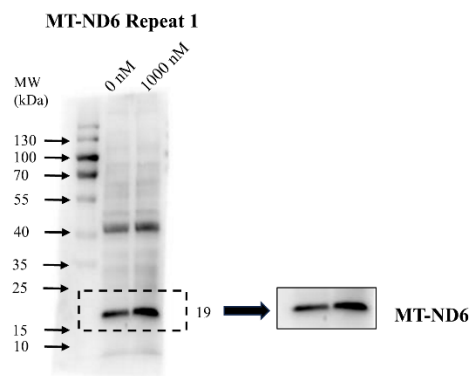
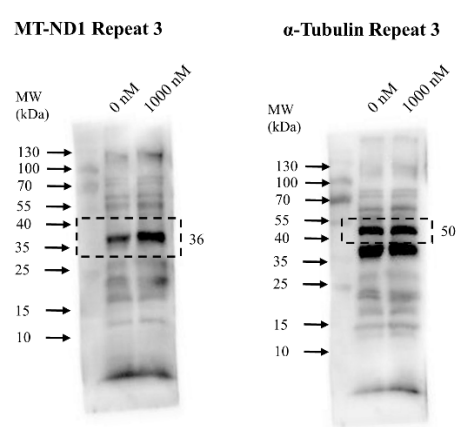
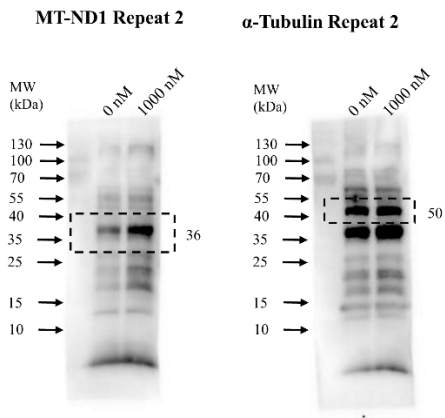
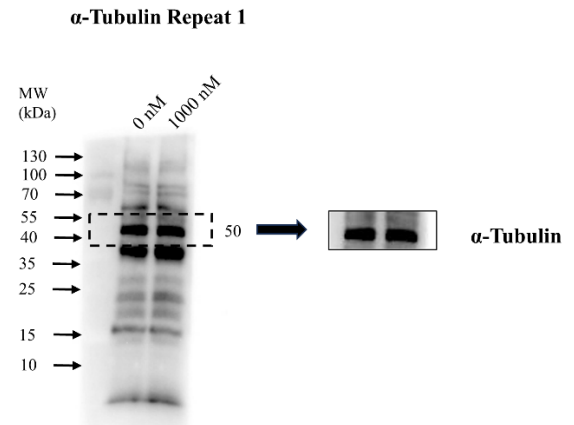
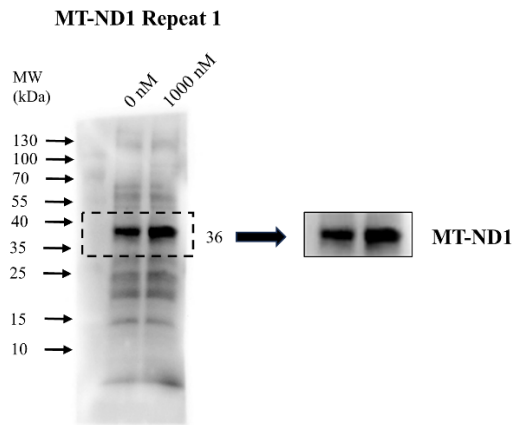


Figure S4. Effects of PQQ added to the freezing extender on post-thaw boar sperm mitochondria-encoded proteins (MT-ND1, MT-ND6).



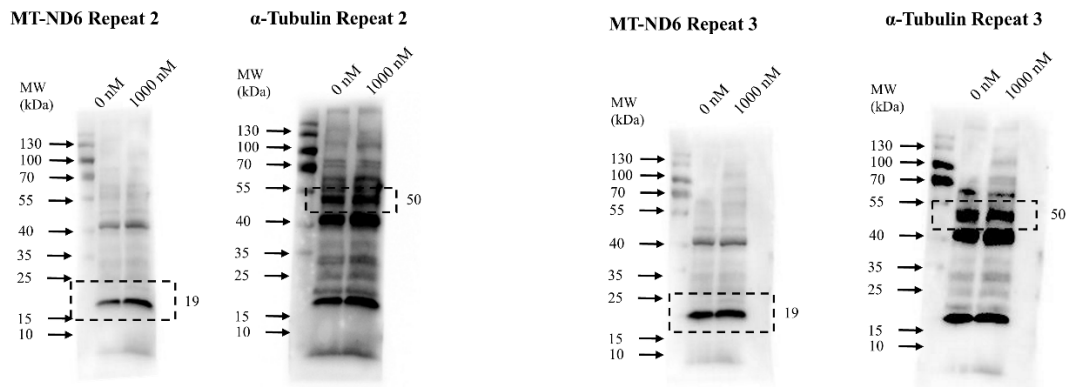


Figure S5. Effects of PQQ added to the freezing extender on post-thaw boar sperm-zona pellucida (ZP) binding capacity. (A) zona pellucida. (B) Control group sperm-zona pellucida complex, (C) 1000 nM PQQ group sperm-zona pellucida complexes. Bars=50  $\mu$ m.

