Technical Insights: Bovine IVF

VetMotl, Inc.

VetMotl® Sperm Separation Devices: Raising the Bar for Bovine IVF Outcomes

Across multiple bovine IVF studies, the VetMotl Sperm Separation Device (also referred to in the literature as the ZyMōt® device, or microfluidic device) consistently delivers higher cleavage, blastocyst, and hatched blastocyst rates than conventional density-gradient centrifugation (Percoll/BoviPure) in appropriately run bovine IVF programs.[1–3] These results position the VetMotl device as a compelling new standard for sperm sample preparation in bovine *in vitro* embryo production, particularly for sires with historically poor IVF outcomes.[2]

The Need: Limits of Conventional Sperm Sample Preparation

Most bovine IVF laboratories still prepare semen using centrifugation through colloid density gradients such as Percoll or BoviPure.[1-2] While familiar and inexpensive, these methods expose spermatozoa to mechanical stress and other insults that can compromise functional competence.[1]

These limitations are especially problematic for sires with acceptable field fertility but consistently low blastocyst yields in IVF, where incremental improvements in embryo output translate directly to more pregnancies per unit of semen and higher economic return per bull.[2]

The VetMotl Solution

The VetMotl device applies biomimetic, microfluidic technology originally developed for the human ZyMōt Sperm Separation Device platform to veterinary IVF, selecting motile, progressively moving sperm that successfully navigate through a micro-pore membrane, leaving less motile and morphologically compromised cells behind.[1-2] Because sperm separation occurs without high-g centrifugation, sperm are processed under gentler, more physiological conditions that better preserve competence for fertilization and embryo development.[1]

In practice, frozen-thawed bovine semen is diluted and injected into the VetMotl device, incubated for approximately 30 minutes at 37-38 °C, and then the enriched sperm fraction is aspirated directly from the outlet for IVF use—offering a simple, standardized workflow that fits easily into existing bovine IVF lab routines.[1-2]

Key Evidence: Improved Embryo Development

Controlled Bovine IVF Study (VetMotl vs. BoviPure)

In a controlled embryo-production project, "Effect of bovine spermatozoa preparation on embryonic development *in vitro*," two parallel IVF groups were run where the only difference was sperm sample preparation: density-gradient centrifugation using BoviPure versus a bovine VetMotl device with a brief post-harvest spin.[1]

Under optimized oocyte-collection conditions (study day 2), VetMotl preparation produced similar or better cleavage rates (89% VetMotl vs. 82% density gradient; not statistically different), significantly higher blastocyst rates on day 7 (49% vs. 34%, $p < 0.01$), and significantly higher hatched blastocyst rates on day 9 (35% vs. 22%, $p < 0.05$).[1] Developmental kinetics scores were comparable between groups, meaning embryos from VetMotl-prepared sperm progressed through developmental stages at least as efficiently as those from gradient-prepared sperm, with more of them reaching the blastocyst and hatched stages.[1]

Even when oocyte quality was compromised by suboptimal slaughterhouse conditions (study day 1), VetMotl microfluidic preparation performed at least as well as density gradient, with no significant differences in blastocyst or hatched blastocyst rates.[1] Together, these findings suggest that VetMotl devices can match conventional performance under challenging conditions and exceed it when standard laboratory practices are followed.[1]

Rescue of Low-Performing Sires

A separate study, "Use of a sperm separation device as an alternative for sires with low outcomes using gradient selection for in vitro embryo production," evaluated the VetMotl Sperm Separation Device in Nelore sires with known sub-optimal embryo yields when processed by Percoll gradients.[2]

When semen from the same bulls was processed either by Percoll or by VetMotl microfluidic separation, sperm sample preparation with the VetMotl device produced markedly higher embryo yields.[2] In the fresh-transfer protocol, cleavage rates were 81.8% vs. 41.2% and blastocyst rates 44.2% versus 16.0% for VetMotl vs. Percoll, respectively ($p < 0.05$ for cleavage; $p < 0.001$ for blastocysts).[2] In the direct-transfer freezing protocol, cleavage rates were 51.4% vs. 42.3% and blastocyst rates 17.2% vs. 7.5% for VetMotl vs. Percoll, respectively ($p < 0.05$ for cleavage; $p < 0.001$ for blastocysts).[2]

Across all sires, use of the VetMotl device increased embryo rates from 2.4% up to 48.1%, with a mean absolute improvement of 26.5 ± 7.1 percentage points compared with historical Percoll-based IVEP results.[2] These gains demonstrate that VetMotl device use can transform "problem bulls" into commercially viable IVF sires, unlocking previously unrealized genetic value.[2]

Percoll vs. VetMotl device: Performance Snapshot

Outcome / Setting	Conventional gradient (Percoll/BoviPure)	VetMotl Sperm Separation Device
Cleavage, fresh protocol, low-performing sires	41.2%[2]	81.8%[2]
Blastocyst, fresh protocol, low-performing sires	16.0%[2]	44.2%[2]
Cleavage, direct-transfer protocol	42.3%[2]	51.4%[2]
Blastocyst, direct-transfer protocol	7.5%[2]	17.2%[2]
Blastocyst day 7, optimized IVF (study day 2)	34%[1]	49%[1]
Hatched blastocyst day 9, optimized IVF	22%[1]	35%[1]

These data highlight a consistent pattern: VetMotl device sample preparation maintains or improves fertilization (cleavage) while substantially increasing the proportion of embryos reaching transferable blastocyst and hatched blastocyst stages.[1-2]

Frozen-Thawed Semen

An SBTE poster, "The use of a microfluidic sperm sorting on bovine frozen-thawed semen for in vitro fertilization," reports that, in Nelore cattle, microfluidic VetMotl preparation of frozen-thawed semen increased blastocyst and development rates compared with Percoll preparation while maintaining comparable cleavage rates.[3] In that work, VetMotl-processed semen achieved blastocyst and development rates of approximately 26.7% and 42.0% vs. 21.0% and 31.5% for Percoll, respectively, in day-7 embryo assessments.[3]

Practical Advantages for IVF Laboratories

Beyond numerical improvements in embryo yield, the VetMotl microfluidic device approach offers operational benefits that matter to busy IVF programs.[1-2] Reduced centrifugation steps and fewer tube manipulations simplify workflow and may help lower contamination risk, while the single-use, device-based format supports consistent, standardized processing that is less dependent on operator technique than layering and spinning density gradients.[1]

Because sperm cell separation occurs in a low-stress, microfluidic environment, VetMotl devices may be particularly advantageous for fragile semen samples, including sex-sorted or previously frozen-thawed doses.[2-3] Together, these features support the adoption of VetMotl technology not only as a performance upgrade, but also as a process-improvement tool for laboratories seeking reproducibility and scalability in bovine IVF services.[1-2]

Strategic Implications: Shifting from AI to IVF with VetMotl

As embryo outcomes improve and become more predictable, bovine IVF moves from a niche tool toward a mainstream alternative or complement to artificial insemination (AI) for disseminating elite genetics.[1-2] Higher blastocyst yields per collection enable more embryos per donor, more pregnancies per straw, and faster dissemination of high-value sires, making IVF economically attractive even beyond traditional donor cows.[2]

The microfluidic VetMotl platform represents a critical enabling technology for this shift by turning previously marginal bulls into viable IVF sires through improved embryo production and by increasing the efficiency of programs already using IVF, especially when high-value frozen-thawed semen is involved.[1–3] For veterinary reproduction practitioners and IVF laboratories, adopting VetMotl Sperm Separation Devices is therefore not just a technical change in sample preparation; it is a strategic move toward a more efficient, IVF-driven model of cattle reproduction.[1-2]

References:

1. VetEmbryo. Effect of bovine spermatozoa preparation on embryonic development *in vitro*. 2022. Internal report.

2. Xavier MC, Peixer MAS, Oliveira LGA, *et al*. Use of a sperm separation device as an alternative for sires with low outcomes using gradient selection for *in vitro* embryo production: preliminary results. Anim Reprod. 2024;21(3):213.

3. Cardoso BL, Borges MFA, Pazianotto LFF, *et al*. The use of a microfluidic sperm sorting on bovine frozen-thawed semen for *in vitro* fertilization. Poster presented at: 37th Annual Meeting of the Brazilian Embryo Technology Society (SBTE); 2024.