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Topic of Discussion

"To understand incubator preferences in IVF labs"

CHAT DISCUSSIONS COMPILED BY

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SUMMARY OF SURVEY RESULTS

Discussion on to understand incubator preferences in IVF labs.

By Dr Shilpa Doultani

Introduction

The incubation environment plays a crucial role in the success of in vitro fertilization (IVF). Proper regulation of gas composition, temperature, and humidity within an incubator ensures optimal conditions for embryo development (1,2). Over the years, advancements in reproductive technology have introduced new approaches, such as Tri Gas incubators, which aim to mimic physiological conditions more effectively than traditional CO_2 incubators (3,4). Research suggests that maintaining a low-oxygen environment (5% O_2) can enhance embryo viability by reducing oxidative stress and improving implantation success rates (5,6).

In addition to gas composition, humidity control within incubators is another crucial factor. Humidified incubators help maintain media osmolarity by preventing evaporation but require stringent maintenance to avoid microbial contamination (7). Conversely, dry incubators eliminate the need for humidity control but necessitate careful oil overlay techniques to prevent media dehydration. This report presents insights from a professional discussion on embryologists' preferences regarding CO_2 vs. Tri Gas incubators, media equilibration strategies, and the impact of different incubation conditions on embryo viability.

Understanding Incubator Types, Gas Composition, and Certification

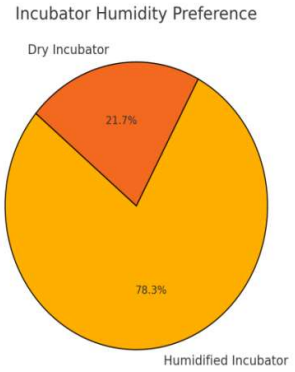
Incubators in IVF laboratories provide a controlled environment to support embryo development. The primary types include CO_2 incubators and Tri Gas incubators, both of which differ in their gas composition and intended application (2). CO_2 incubators operate with 5-6% CO_2 to regulate the pH of bicarbonate-buffered culture media, making them a standard choice in many IVF settings (1). Tri Gas incubators, on the other hand, incorporate a mixture of CO_2, O_2, and N_2, creating a low-oxygen environment (5% O_2) that closely resembles in vivo conditions within the female reproductive tract (4). Several studies indicate that low oxygen tension improves embryo viability and blastocyst formation rates (5,6).

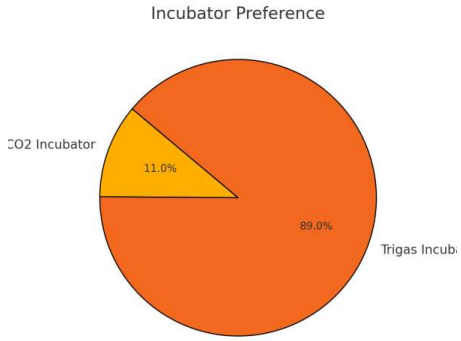
Gas quality and certification play a critical role in maintaining an optimal embryonic environment. Medical-grade gases, while costly, ensure consistency in culture conditions (8). However, many IVF centers face challenges in verifying the authenticity of gas purity certifications. Some centers receive 99.99% purity certification, but embryologists acknowledge that verifying the authenticity of these certificates is difficult. Many rely on supplier documentation without independent validation. Experts suggest conducting third-party gas analysis periodically and using inline filters to remove contaminants. Additionally, concerns have been raised regarding gas pressure regulation and pipeline quality, as improper setup may introduce fluctuations in culture conditions. The material of the charging line is also a factor, as some tubing materials, particularly copper, can react with CO_2. Switching to bio-compatible alternatives and ensuring the proper diameter of gas pipelines helps maintain stable pressure levels (9).

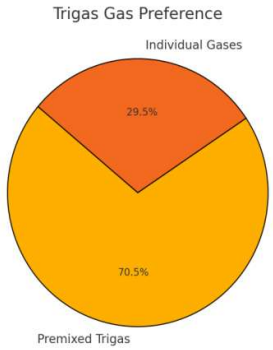
Survey Results

A total of 283 embryologists participated in a survey exploring their preferences for incubator types, gas selection, and humidity control strategies. The findings revealed that 89% of respondents preferred Tri Gas incubators, while only 11% favored CO_2 incubators. The most cited reasons for selecting Tri Gas included better oxygen control, enhanced embryo viability, and improved blastocyst formation rates.

In terms of gas composition, 70.5% of respondents preferred premixed Tri Gas due to its ease of use and consistency, whereas 29.5% opted for individually mixed gases to allow greater customization. The choice of incubator humidity was another key consideration, with 78.3% of embryologists favoring humidified incubators, while 21.7% preferred dry incubators to minimize contamination risks .







Discussion and Expert Insights

As most respondents preferred **Trigas incubators and premixed gases**, the discussion focused on the **availability, certification, and quality control** of gas supplies. While metropolitan IVF centers have easier access to **medical-grade premixed gas**, smaller centers often struggle with inconsistent supply chains and higher costs. **Certification reliability** remains a concern, as some centers report receiving certificates but cannot independently verify purity levels. This highlights the need for **regular third-party gas testing** and the use of **inline filters** to reduce potential contamination.

Another key aspect discussed was the **timing of gas cylinder changes**. Industry best practices recommend replacing cylinders when **10-20% of gas remains** rather than waiting until they are nearly empty. This prevents fluctuations in gas pressure that could compromise incubator stability and, consequently, embryo viability. A sudden drop in gas pressure can lead to inconsistent pH regulation in culture media, potentially impacting blastocyst development. Additionally, frequent incubator door openings in high-volume labs can accelerate gas depletion, making timely cylinder replacement even more critical. rather than waiting until they are nearly empty. This prevents **fluctuations in pressure** that may affect incubator conditions, especially in labs with high patient loads where frequent door openings lead to rapid gas loss. Additionally, experts suggest using **separate gas cylinders for each incubator** instead of a single source, as a failure in one cylinder or connector could compromise multiple incubators.

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When comparing **humidified vs. dry incubators**, embryologists had mixed experiences. Some reported similar blastocyst formation rates in both systems, while others noted that **dry benchtop incubators produced more blastocysts** but not necessarily of higher quality. The consensus was that **changing media on Day 3** in dry incubators led to better-quality blastocysts, whereas humidified incubators maintained stable conditions throughout the culture period. Sensor damage was another concern, with **oxygen sensors in dry incubators requiring replacement every 9-12 months**. Monitoring sensor performance is critical, and early signs of failure include inconsistent gas readings, prolonged equilibration times, and unexpected fluctuations in pH levels within the incubator. Regular calibration and periodic cross-checking with external gas analyzers can help detect potential issues before complete sensor failure. Humidified incubators generally exhibit lower sensor degradation rates due to reduced exposure to dry gas conditions, but they require routine water bottle changes to maintain optimal function., while humidified incubators had fewer sensor issues but required **regular humidification bottle changes** as per manufacturer guidelines.

A frequently overlooked factor was the **impact of altitude and atmospheric pressure** on gas mixing and incubation. Centers operating **at higher altitudes** may need to adjust their premixed gas composition to accommodate differences in pressure. Additionally, the **number of incubator door openings** plays a role in **gas loss rates**, requiring more frequent adjustments in high-traffic labs.

The discussion surrounding incubator preferences highlighted several key factors influencing embryologists' choices. One critical aspect that emerged was the impact of altitude and atmospheric pressure on gas mixing and incubator performance. Centers operating at higher altitudes may require specific adjustments to their premixed gas composition due to variations in atmospheric pressure that can affect oxygen and carbon dioxide concentration stability. It is recommended that IVF centers in such regions consult with gas suppliers to tailor their gas mixtures accordingly and conduct routine gas quality checks. Additionally, the frequency of incubator door openings plays a role in gas loss, particularly in high-traffic labs. Frequent exposure to external air can lead to increased fluctuations in oxygen and CO_2 levels, necessitating more frequent monitoring and adjustments to maintain optimal embryo culture conditions. influencing embryologists' choices. Trigas incubators were largely favored due to their ability to maintain stable oxygen levels, reducing fluctuations that may compromise embryo development. Oxygen-sensitive embryos, particularly those cultured for blastocyst formation, demonstrated improved viability in low-oxygen conditions. While CO_2 incubators remain widely used, their inability to regulate oxygen tension effectively was cited as a limitation by many professionals.

The debate over **premixed vs. individually mixed Trigas** reflected the balance between convenience and precision. Premixed Trigas eliminates the need for manual gas adjustments, reducing the risk of errors, but concerns regarding gas purity and potential contamination were

raised. On the other hand, individually mixed gases offer greater control over composition but require continuous monitoring and calibration, making them more resource-intensive.

The choice between **humidified and dry incubators** depends largely on laboratory conditions and maintenance protocols. Humidified incubators help maintain the stability of culture media by preventing evaporation, making them ideal for prolonged embryo culture. However, they require stringent cleaning and monitoring to prevent microbial growth. Dry incubators, though easier to maintain, necessitate the use of oil overlays to prevent media dehydration, and some embryologists reported challenges in maintaining consistent culture conditions under these settings.

Another key issue discussed was **gas cylinder handling and contamination risks**. Several embryologists shared concerns regarding the quality of gas supplies, particularly when sourcing from non-certified vendors. Inline gas filters were recommended to reduce contamination risks, and regular monitoring of gas pipelines was advised to ensure consistent pressure stability. Additionally, the discussion highlighted increased reports of **sensor damage in dry incubators**, likely due to improper cleaning procedures and excessive exposure to air fluctuations.

Key Takeaways

1. **Gas quality verification is crucial.** Many centers rely on supplier certificates, but **third-party analysis** and **inline filtration** should be considered for added safety.
2. **Timely gas cylinder changes prevent fluctuations.** Best practices suggest replacing cylinders when **10-20% remains** to maintain stable incubator conditions.
3. **Use separate gas cylinders for different incubators** to prevent widespread system failure in case of gas supply issues.
4. **Dry incubators may require media changes on Day 3** for better-quality blastocysts, while humidified incubators maintain stable culture conditions over longer periods.
5. **Oxygen sensors in dry incubators have a shorter lifespan (9-12 months),** while humidified incubators require periodic water bottle replacement.
6. **Altitude and atmospheric pressure** impact gas regulation, requiring careful adjustments in high-altitude centers.
7. **Pipeline material and gas pressure regulation** play a critical role in maintaining a stable embryonic environment; copper tubing should be replaced with bio-friendly materials.
8. **Trigas incubators are preferred over CO_2 incubators** due to their ability to regulate oxygen levels and create a more physiologically relevant environment for embryo culture.
9. **Premixed Trigas gases offer convenience**, but concerns regarding gas purity and contamination must be addressed through strict quality control measures.
10. **Humidified incubators help stabilize media conditions**, but they require rigorous maintenance to prevent contamination.
11. **Gas cylinder handling and pipeline quality play a crucial role** in maintaining stable incubator conditions, reducing the risk of pressure fluctuations.
12. **Improper handling of dry incubators has been linked to sensor damage**, underscoring the need for proper training and laboratory protocols.

Conclusion

The findings from this discussion emphasize the growing preference for Trigas incubators, particularly in settings where stable oxygen levels and long-term embryo culture are critical. While CO_2 incubators remain widely used, their limitations in oxygen regulation make them less suitable for advanced embryo culture techniques. The choice between humidified and dry incubators depends on laboratory capabilities, with each approach carrying specific advantages and challenges. Ultimately, the successful operation of an IVF incubator relies on strict quality control, proper maintenance, and adherence to best practices to optimize embryo development and improve clinical outcomes.

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