New technology in the hatchery for incubation efficiency

For many years, the hatchery sector has been at the forefront in the use of new technology as the poultry industry has developed. Traditionally, most focus has been on the use of technology to maximise hatchability and chick quality. The incubation process is a key part of the whole system of broiler production so it cannot be viewed in isolation.

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It is not surprising therefore that new technology is being used in hatcheries not only for incubation efficiency but as part of the focus on some industry-wide concerns including:

- Animal welfare.
- Environment and sustainability.
- Antibiotic-free production systems.

Incubation efficiency

Maximising hatchability requires a basic understanding of both the incubation requirements of eggs from each breed and how these requirements vary for example by breeder hen age, egg size and prolonged storage before incubation.

The basic parameters required include eggshell temperature at different stages of incubation, what is the acceptable weight/water loss during incubation, turning requirements and the ventilation requirements especially before transfer and during hatching.

Traditional research has focused on determining these basic requirements of the average egg and in most cases these are well defined. For example, embryo development and chick quality are optimal when the embryo temperature is maintained between 99.5-100.5°F throughout incubation.

More recent technological developments that have led to hatchability improvements have focused on two aspects:

- Monitoring incubation parameters in real time, so the optimal requirements are provided at the level of the egg.
- Reducing the risk of variation in the environment in an incubator, so all eggs are kept as close to their optimum requirements as possible in a uniform environment.

Incubator manufacturers continue to make improvements through more advanced sensor and control technology particularly to monitor embryo or eggshell temperature in real time and monitor ventilation linked to CO_2 concentration within the incubator and the hatcher.

Optimal control of air velocity around all eggs remains a key requirement as is optimising the size of water droplets in the air that impacts how humidity affects heat loss. Zoning within incubators is now possible in some machine designs which allows adaptation to be applied for small eggs or big eggs that have different heat production profiles during incubation and can be 'micromanaged' to prevent excessive variation in eggshell temperature.

Each manufacturer has their own design ideas to achieve these objectives. The ideal situation may be to adapt the incubation conditions to the physiological development of embryos and not just to embryo temperature. This is an area of research attracting more attention for the future. Also interesting is applying short term changes in incubation temperature that changes physiological development but has yet to be applied commercially.

Data handling

Increased sophistication with more sensors creates more data that needs to be monitored. So more advanced computer programming and incubation algorithms are required together with new information technology applied in hatchery management systems. There are two concerns here: This takes hatchery management away from the hatchery managers to computers, but this also places emphasis on training of hatchery staff.

Technology is helpful but we must be able to effectively monitor the incubation process and ensure chick welfare is monitored. Some human assessments are still essential and one of the most critical roles is assessing chick quality in relation to the hatch window or time from the first to last chick hatching.

The target hatch window is less than 28 hours in single stage or 30 hours in multi-stage incubators. A hatch window more than 32-35 hours indicates too much variation in eggshell temperature caused by poor egg uniformity, by the incubator design and management such as temperature profile, pre-heating profile and setting pattern.

Assessing chick physiological development and dehydration status is also very important in relation to the hatch window and new technology does not easily replace experienced personnel.

Any discussion of new technology must also include the application of 'big data' analysis technology to quickly identify variation in performance throughout the chain. Incubation is a key part in the broiler chain so data analysis must include the impact of many factors including flock of origin and farm effects, individual incubator variation and hatchery to hatchery variation.

These analyses must not only be related to hatchability and chick quality but also to the impact of incubation on broiler performance including welfare, disease and economic assessments. Few companies apply these methods today across all of the broiler production chain, but these services are more widely available and are being applied by some progressive broiler companies.

Biosecurity and reduced use of antibiotics

Many countries now have national plans to reduce antibiotic use or companies have antibiotic-free programmes. Precision hatchery management must be a key part of any overall antibiotic reduction strategy. The

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impact of chick quality on subsequent broiler performance has been studied in trials such as the risks of high eggshell temperature or low O_2 concentration during incubation on subsequent broiler growth or risk of ascites.

Contaminated yolk sacs, weak chicks and chicks with exposed navels will increase the risk that antibiotics are required after placement or at a later stage of growth. This places more emphasis on biosecurity in the hatchery such as incubators that can be easily cleaned and materials that limit microbial growth. New systems to rapidly monitor the effectiveness of disinfection protocols in hatcheries are also critical to making hatchery biosecurity more effective.

Other new technologies have recently been developed including automated candling, ultrasound and imaging technologies for accurate automated removal of clear eggs and unviable dead embryos at transfer or even at earlier ages.

These can significantly reduce bacterial contamination to chicks. High-accuracy and high-speed vaccination technology including in ovo vaccination technology is now integrated with egg and chick handling equipment.

Egg quality, egg storage management and pre incubation egg sanitation remain important factors with new technology applied to controls such as modern fumigation chambers using effective alternatives to formaldehyde. Pathogen control by UV lighting may become another viable option for egg sanitation during incubation.

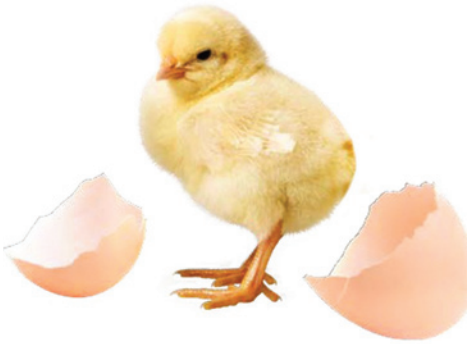
Welfare

Some of the most exciting new technologies in hatching are related to improving chick welfare. New technology is being introduced to identify male and female embryos during incubation and is likely to be mandatory in some countries for table egg layers to avoid culling male chicks.

These technologies are being applied commercially but at present they have very limited application to broiler production. However, they should not be ignored as once the costs and speed of operation improve they may have a role in some broiler production systems.

In some countries, the impact of hatching on subsequent performance and chick welfare is under more scrutiny and has led to the development of new approaches to reduce hatching and transport stress.

These include feeding in the hatchery before transport, specialised combined hatching and brooding machines or on-farm hatching systems.



Each system requires specific new technology, for example, to distribute eggs in broiler houses before hatching and new monitoring systems. The advantages claimed for these systems are mainly linked to the improvement of seven-day weight and chick uniformity and reduced hatching stress.

With more focus on animal welfare these systems may become more popular in some countries depending on the broiler housing and farming systems.

Conclusion

The hatchery sector has been highly innovative and successful not only in incubating chicks but also incubating new ideas. This spirit of innovation looks set to continue into the future. ■