A different approach: on-farm hatching and broiler health

Over recent decades the concern about antibiotic use in animal production, and broiler chicken production in particular, has increased. An important reason for this rise in concern originates from the risk of the development of antibiotic resistant bacteria as a result of high antibiotic exposure with possible negative effects for public health.

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Reductions in antibiotic use have been achieved in Europe since 2009, but during recent years, a plateau in this reduction has been reached.

Furthermore, there seems to be a shift from antibiotic use during later life towards use in the first week, or even first days, of the life of broiler chickens.

It has been suggested that an important part of the health issues in broilers originates from early infections with enterobacteriaceae, staphylococci and enterococci with Enterococcus cecorum being the most important. These infections are suggested to take place early in life, for example at the hatchery or shortly after placement on the farm.

Although high quality day old chicks are considered crucial to good broiler health and performance up to slaughter age, it seems that conditions may not be optimal in current incubation systems and hatchery management procedures.

This is due to two important factors. Firstly, chicks hatch over a time window of approximately 24-36 hours and are removed from the hatchers only when the majority of the chicks has hatched. Especially for early hatching chicks, this practice leads to delays in the moment of placement on the farm, and first access to feed and water, which is associated with increased early mortality, and suboptimal growth post-hatch.

Secondly, conditions in the hatcher may not be optimal for modern broiler breeds. In the last phase of incubation, broiler hatching eggs and newly hatched chicks produce considerable amounts of heat.

Field observations have shown that in large capacity setters and hatchers, inadequate heat removal from broiler eggs leads to hyperthermia, depressed hatchability, chick quality and post-hatch performance up to marketing age.

Moreover, high levels of dust and pathogens in present hatching systems, and disinfectant use, seem to have negative effects on the young broiler.

A different approach towards the hatching and brooding phase is the concept of on-farm hatching, currently available in two different systems: a multi-tier housing system, named Patio, and a system which is suitable for floor houses, named X-Treck (Vencomatic Group, the Netherlands).

Using these systems, broiler chickens are hatched inside the broiler house where they have direct access to feed and water and will remain during the rest of their life. The conditions during the hatching and brooding phase in on-farm hatching systems largely differ from conditions in the hatchery (see Table 1), such as air temperature, relative humidity, air velocity, CO_2 level, dust level, disinfectant level, air volume per egg, chick handling, and transportation.

Over the past eight years, results from the field teach us that antibiotics use has almost been banned using these systems, and the flock mortality, dead-on-arrivals, and rejection rates in the slaughterhouse are decreased. Moreover, a significant reduction in feed conversion ratio is observed. These findings clearly indicate higher health status broilers that hatch on-farm.

Environmental conditions during the early post-hatch phase in the hatching system seem to have an effect on the health of the broiler chick and subsequently on technical results and antibiotic use. Effects of the most important different conditions are summarised below.

Table 1. Summary of different conditions during hatching in a hatcher or in the Patio system (adapted from Van de Ven, 2012).

Variable	Hatcher	On-farm hatching
Time of feed and water access	19-53 hours post-hatch	Directly post-hatch
Climate		
Air temperature, average (°C)	38.3	35.2
Relative humidity, average (%)	55.6	32.0
Air velocity, average (m/s)	0.57	0.08
CO_2 level, average (ppm)	3,586	896
Air volume per egg (dm^3)	0.6-0.9	> 34.1
Dust concentration		
Egg position	Horizontal	Vertical
Light	Off	On
Background noise (dB)	85	56
Chick handling, including transport	Yes	No
Second grade chicks	Excluded	Included

First feed and water access

Due to the entire process of hatching, chick collection, and transportation, the time between hatching and moment of first feed intake in common hatchery practice can increase up to 50 hours.

Research has shown that the moment of first feed intake after hatch affects the development of organs, the immune system, and adaptive capacity of chickens throughout their lives.

Also, research showed that effects of post-hatch feed deprivation resulted in impaired performance and increased mortality.

Our own studies showed that supplying chicks with feed directly after hatching has a positive effect on organ development. Early fed chicks showed an increase in organ weight between hatch and moment of chick collection of 4.6g, whereas the feed deprived chicks showed an increase in organ weights of 1.8g, with the major weight gain originat-

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ing from the intestines and the stomach.

Furthermore, early feeding affects the development of the immune system. Early fed chicks were shown to have a larger bursa and greater lymphocyte proliferation compared with their non-fed counterparts. It was demonstrated that early feeding affects the intestinal macrobiotic composition, influencing the immunological maturation of the chick, and adaptive response to a bacterial infection in layer chicks.

The intestine of a chicken is usually sterile at hatch. Bacterial colonisation of the gut begins the moment the chick hatches and is dependent on the microbiota composition ingested by the chick from its environment. It was stated that colonisation of early fed chicks is different from feed deprived chicks since microbiota present in the feed will differ from the microbiota present in the environment.

In summary, the moment of first feed clearly affects the health and development of the young chicks with consequences in later life.

Dust

During the hatching process high levels of dust are released. It has been shown that dust is an important transport mechanism for potential pathogens.

The combination of high dust levels inside the hatcher combined with high air speeds is suggested to create a high potential risk for cross contamination within a hatcher. It was demonstrated that a reduction in dust levels by the use of an electrostatic space charge system could effectively reduce total aerobic bacteria, enterobacteriaceae, and salmonella infections in commercial hatching systems.

Furthermore, it is known that the immune system of a broiler chick during the early post-hatch period is immature. A combination of high pathogenic load with an immature immune system may result in high infection risks for the broiler chicks in early life with implications for their health in later life and resulting in the necessity for antibiotic treatment.

Use of disinfectants during hatching

In order to reduce the airborne pathogenic load during hatching, hatcheries commonly use vaporisation of formaldehyde or hydrogen peroxide. It is well known that these substances have a negative effect on the airway epithelium. It was shown that formaldehyde exposure negatively affects the mobility of the trachea resulting in blunted cilia. In addition, formaldehyde exposure was found to result in increased lesion scores of the tracheal epithelium directly after exposure creating possible entry routes for airborne pathogens.

Also, elevated feed conversion ratios were found in chicks exposed to formaldehyde compared to non-exposed chicks during the first week, while body weights were similar between the two groups.

This difference in FCR lasted throughout the life of the chickens. A higher FCR with similar body weights indicates an increase in energy use in the formaldehyde exposed group. The exposure to formaldehyde seems to induce a stress response, increasing energy use and diversion of the energy resources. It could also be hypothesised that the increased amount of epithelial lesions resulting from the formaldehyde exposure resulted in a higher susceptibility of the chicks to pathogenic infections, consequentially resulting in higher energy use by the immune system.

Transport

Transport of day old chicks is a multifactorial stressor, amongst others consisting of changes in environmental temperatures, movement, noise, and vibrations. Thermal conditions during transport were identified as one of the main concerns regarding health, welfare, and physiological stress in day old chicks.

In older broilers, other factors such as handling, feed and water deprivation, noise and vibrations were indicated as stress inducing conditions during transport to the slaughterhouse. In addition, research showed that heat stress affects the intestinal health of broilers between 35 and 41 days of age.

Effects of stress as a result from day old chick transportation on the health of the chicken are not well documented. In piglets, it was shown that the combination of stressors during weaning had a negative effect on the morphology of the intestinal wall. Villus height and intestinal barrier function decreased after weaning in 20-day-old piglets. The abrupt changes in environment associated with weaning resemble the changes a broiler chick encounters during handling and transportation, where it is taken from the hatcher, transported, and subjected to a set of new environments.

Research however indicates that the day old chick lacks a certain level of stress responsiveness and that this responsiveness of the chick returns within 24-36 hours after hatch.

Due to the entire hatching and handling process a majority of the chicks will be at least 24 hours old before being subjected to transport. Therefore, it could be suggested that the chicks are responsive to stress by the time they are being transported.

Although effects of transport stress on the health of day old chicks and of broiler chicks in later life are still unknown, the combination of high pathogenic load during hatch combined with a stress response resulting from transport is likely to affect the adaptive capacity of the chicks resulting in possible health issues in later life.

Summary

In summary, in common hatchers broiler chicks are subjected to high levels of dust, pathogens, disinfectants, and an extended period of feed and water deprivation.

Environmental conditions during hatching and in the early post-hatch period in on-farm hatching systems differ greatly from the conditions in the hatcher. Results from the field show that mortality of chicks in on-farm hatching systems is decreased, the feed conversion ratio is strongly improved, and that antibiotic use is greatly reduced.

The different environmental conditions and early feed access seem to be the basis for a strongly improved health status of young broilers in on-farm hatching systems that lasts throughout the broilers' lives. ■