Hatchery Expertise Online
CEVA ANIMAL HEALTH ASIA PACIFIC
ceva.aslapacific@ceva.com

Issue No.1 / July 2005

DAY-OLD CHICK QUALITY

By Christophe CAZABAN, D.V.M., International Technical Manager for Poultry Biologicals,
CEVA Sante Animale, La Ballastiere, BP 126, 33501 Libourne Cedex, France.

What does "**day-old chick quality**" mean ? Traditionally, it has been defined as the combination of **hatchability** and **three-day mortality**. There is actually no single definition: this concept is more or less subjective.

To try to define it properly, let's split the wording in two parts: one can state that:

- The "day-old chick" (DOC) is the newly-hatched chick (*Gallus gallus*). It can be considered in the hatchery, and until the farm where it will be housed and fed to provide a broiler chicken, a laying hen, or a breeding cock or hen. According to the country, "one-day old chick" can actually last longer than 24 hours, *e.g.,* until 72 hours of life in the French law;

- Quality can be defined as "a set of product's characteristics that confer to it the ability to address needs, should they be expressed or implicit".

One must ensure the best chick to target the best final chicken. Chick quality covers all the parameters which directly relate with the ability of the chick to generate a profit.

But what about the hatching success: what kind of role does it play in the whole chick quality? Is a maximum hatchability rate the best and unique indicator for viability, growth, and best return on investment? What about other possible criteria?... For instance, it is well recognised that there is a great correlation between the bodyweight at 7 days of age and at slaughter. Let's have a look backwards at all steps by starting in the breeding farm, focussing on possible means to check the quality of the chicks and ways to improve it.

BREEDER FLOCK

There are numerous husbandry and pathological conditions that may impact egg production and/or quality and consequently affect the day-old chick quality:

- Unsuitable lighting programme;
- Unbalanced diet: it has direct impact on hatchability and chick quality;
- Physical and microbial quality of the diet;
- Pathogens with direct effect on egg production: infectious bronchitis, egg drop syndrome, avian encephalomyelitis, Newcastle disease, Marek's disease, etc
- Pathogens with indirect effect, by debilitating the general state of health: infectious laryngotracheitis, swollen head syndrome, mycoplasma, infectious coryza, *E.coli*, etc

In addition to preventing diseases occurrence in the breeders themselves, an integrated vaccination regime is also aiming at transferring a **passive immunity** to the progeny through the egg yolk, to protect them for their first two to four weeks of age: infectious bursal disease, chicken anaemia, reovirus, encephalomyelitis. Such passive immunity is crucial in protecting the chick, while the young bird is completing the maturation of its own immune mechanisms. We should keep in mind that the amount of maternally-derived antibodies transferred to the progeny is directly proportional to that of the hen. The transfer rate is approximately 50%. The higher the antibody titre in the hen, the higher the quantity of antibodies transmitted to the chicks and the longer this passive immunity lasts.

The **hygiene** of eggs laid is crucial. When the egg is laid down, its inside temperature decreases from the hen's body temperature (41°C or 106°F) to the temperature prevailing in the nest box: by cooling down, its content will retract, and this process can draw into the egg any outside contamination. To avoid this, first minimise the rate of floor eggs, because they are heavily contaminated, hatch badly and produce the most rots in the incubators; should the farm reduce floor eggs by 1%, the hatchery contamination will drop by 10%; secondly, ensure that the nests are always clean; lastly, collect the eggs as frequently as possible (*e.g.,* every hour, and starting as early as possible in the morning) to get them onto a tray as quickly as possible. In addition, the shell cuticle has to dry, as it will tighten and limit bacterial penetration.

HANDLING THE HATCHING EGGS

An egg is quite robust. But as it contains a developing germinal disc, and later a developing embryo, it is very sensitive to "adversities", such as:

- Temperature: too low, too high temperatures must be avoided, as variations in temperatures as well. During egg storage in the breeding farm, the environment must be set at around 16°C and 75% humidity. Eggs are put in storage for up to 14 days (depending on the strain and the age of the breeder hens) before being transported to the hatchery for incubation. This storage procedure has been recently questioned, as it may decrease hatchability rate from 89% after a 4-day to 72% after a 14-day storage, for instance; incubating the eggs for 6 hours at 37.5°C before starting the cooler 14-day storage can boost this rate back to 82%, in this example. Other workers have shown that a short storage time (3 days *versus* 18 days) results in a better relative growth at 7 days of age;

- Bacteria and fungi: they can induce rots (and a decreased hatchability rate), or a poor chick quality through yolk sac infection or "brooder pneumonia" (aspergillosis). It is linked to the hatchery hygiene, but also to the cleanliness of the egg at collection;

- Poor quality egg can be due to microcracks in the shell, inducing dehydration and embryonic death;

- Incorrect storage position;

- Exposure to chemicals: some of them can penetrate the egg, and be toxic to the embryo, whereas others, such as disinfectants can block the pores of the egg shell;

- Excessive handling: it can induce microcracks in the shell.

INCUBATING THE EMBRYONATED EGGS

During the 1st week of incubation, the organs and basic membrane systems (amnion, allantois and yolk) are formed. Rotation of the eggs is the most critical factor during this period, as it stimulates gas exchanges through the chorioallantois.

The climate control of incubators must be flexible. Depending on the strain of breeders, week of lay (inducing a given egg size), duration of storage and shell thickness (inducing higher or lower moisture losses), the incubation programme must be adjusted by changes in temperature, ventilation and relative humidity.

Optimal parameters are usually provided by the breeding company. Incubation temperature is the most critical environmental factor, not only for hatchability but also for post hatch growth. Embryo temperature is deducted from the eggshell temperature by using an infrared fever thermometer for instance. It can be stated that the average eggshell temperature must be set at around **38°C** (100.4°F) during the first 2/3 of incubation, and it should not exceed 38.5°C (101.3°F).

A too cold temperature during incubation will induce small sized chicks, because they will use their nutrients resources first to survive, instead of growing and developing.

A too high temperature during incubation will induce small sized chicks as well, because of dehydration, and a too fast yolk utilisation. The DOCs will also show bloody navels.

An adequate humidity (**55%**) will not only remove the metabolic water, but it also plays an important part in the heat supply in the first nine days of incubation, and in the heat removal from the egg afterwards. The larger the egg, the larger the chick body mass, the higher the amount of heat produced.

Key factors:
- During the first two thirds of incubation: water loss from incubator;
- During the last week of incubation: ventilation to remove carbon dioxide and heat produced in excess by the embryo. A common rule is 6.8 m^3 per hour. The target is to ensure 21% oxygen and 0.3% carbon dioxide in the outside air.

There is a huge variability in practices concerning the time between hatching and placement of the DOCs. In general, an early placement, and consequently an early feeding is the rule to increase the yolk absorption.

Heterogeneity in the incubating eggs (*i.e.,* derived from different parent stocks) must be taken into account, as:
- Eggs from old breeders hatch earlier than those from young breeders;
- Within a single flock age, chicks from smaller eggs hatch earlier than those from larger eggs;
- Chicks from older hens seem to tolerate longer periods between hatch and placement than chicks from younger flocks. Small chicks have a proportionally smaller residual yolk.

A common rule is to pull the hatch when 5-10% of the chicks are still wet behind their neck. The chicks are held in a room where a temperature of 24°C or more, and a relative humidity of 50%, have to be ensured. Dehydration has to be prevented.

Sample dead-in-shell embryos, hatcher fluff, and chick tray liners for salmonella monitoring on every hatch. Hatchery environment may be sampled twice weekly.

At hatch, or more and more frequently by *in ovo* route at 18 days of incubation, numerous **vaccinations** can be carried out, given the easiness to mechanically handle DOCs in boxes, or eggs, respectively. In addition, there are far less risks of failures in vaccine administration at the hatchery than at the farm level.

RECEIVING THE CHICKS IN THE FARM

At arrival in the farm, several "tricks" are available to assess the quality of the purchased chicks.

Purchase conditions
Check the accompanying documents to know the number of the originating breeder flocks. The best situation is one unique breeder flock, but it is actually quite rarely the case. Avoid, if possible, multiple origins, and especially breeding flocks of different ages (leading to a heterogeneity in the chicks).

Check the transportation conditions themselves from the hatchery to the farm:

- Transportation period: ensure that the chicks are being transported during the coolest parts of the day,
- Transportation length and time: the time spent in transportation can be a significant factor leading to dehydration and yolk depletion,
- Cleanliness of the transportation truck,
- Environment in the transportation truck: ventilation system; the internal truck's temperature must be set at around 21-24°C (70-75°F).

These immediate information have to be sent back to the hatchery for improvement request, if necessary. On the opposite, do not forget to congratulate the hatchery for sending good quality chicks!

Immediate physical examination

Weigh a representative number of chicks (*e.g.,* two chick boxes): the average bodyweight should be at around **40 grams** (to be compared to the breed's standards), with the lowest possible weight heterogeneity. A good and uniform size is obtained when chicks did hatch from eggs weighing at least 48 to 50 g, on average.

By direct inspection, the chicks must be:
- dry and clean, with clear and bright eyes;
- as homogeneous as possible according to: size, quiet, alertness and exploratory behaviour;
- without deformities: toes, feet and legs must be straight, without lesions or swelling.

A "dark" coloration on the neck is the evidence that the chick recently hatched.

Check the navel of some chicks: it must be sealed and clean, *i.e.* free from adhering dried yolk, shell and membranes.

Record the number of dead DOCs upon arrival (to be compared to standards).

Delayed sanitary assessment of the DOC batch

Cull twenty DOCs upon arrival for serology, especially for IBD. These chicks must be selected at random, from all parts of the building. In addition to helping to determine the optimal date of vaccination, this will provide another evidence of the DOCs' homogeneity rate. The coefficient of variation (ratio mean : standard deviation) of the antibody titres will provide a picture of the flock's range of titres, and hence, of its homogeneity or heterogeneity. A homogeneous flock has greater chances to resist to a field challenge. Sample in the delivery lorry, and in the bottom of at least five boxes for salmonella.

Ensuring the best start

Check that farm **ventilation** is set properly. The minimum ventilation requirements can be deducted from the average body weight of the birds, of from the feed intake, *e.g.,* the current British recommended ventilation rates in broiler chickens houses are set at 1.9×10^{-4} m^3/s per kg 0.75, or more easily to work with, 2 m^3/s per tonne of feed consumed in a day.

Provide them **water** first (at 27°C, or 80°F); it can be sweetened to bring immediate energy. Then add **feed**. There is no doubt regarding the need for carbohydrates, but there is a requirement for amino acids as well. The residual yolk is used up slightly faster in DOCs that have immediate access to feed than those which are temporarily deprived.

Set the inside **temperature** at the right level. There is a direct influence of temperature upon feed intake and growth. The DOC body temperature is at about 40°C (104°F). The chicks' thermoregulation system has not yet fully developed: chicks are homeothermics, *i.e.* they must have a constant body temperature. In addition, they cannot adapt to extreme ambient temperatures. They are consequently highly susceptible to chilling, or to wind. Conversely, from two weeks of age onwards, the chickens are becoming poikilothermics, *i.e.* the body temperature is able to adapt to varying temperatures. To know whether the temperature conditions inside the farm are accurate, look at the DOC spreading in the brooder area: are they uniformly spread? To ensure optimal ambient temperature in the farm, the brooders have to be switched on 24 hours prior to chicks arrival.

Standard brooding temperature during the first week is about **29-32°C** (85-90°F); DOCs born to young breeders (less than 30 weeks of age) are usually smaller in size: this may be compensated by a warmer brooding temperature at start (32 to 33°C, or 90-91.4°F); it should be gradually reduced to 24-27°C (75-80°F) by the time they have fully feathered (around 21 days of age). The recommended final temperature until slaughter age should be set at 18-21°C (65-70°F).

See also experiment results summarised in the Table.

Table: Effect of various brooding temperatures [during the first two weeks of life] on broiler (male and female) performance at slaughter age (42 days) (from A.H. Nilipour)

Treatment	Bodyweight (kg)	Feed Conversion Ratio	Mortality (%)	Performance index	Extra cost per kg of meat (in US cents)
Controls 29-32°C	2,267	1.71	2.08	309	0
Moderate 24-27°C	2,219	1.77	4.17	285	2.16
Cold 21-24°C	2,149	1.82	7.08	261	4.37

And after the critical first 72 hours:
- Regularly monitor the birds' health status, including by serology;
- Daily monitor the birds' performances, at least during the first three weeks of life.

To summarise

Obtaining a quality day-old chick is characterised by a chain of successive, and related events:

- The laying of embryonated eggs,
- The collection of the embryonated eggs,
- The incubation of the laid eggs,
- The transfer of the eggs from the incubation trays to the hatcher,
- The hatching of the chicks,
- The handling of the hatched chicks, including placing them into boxes, possibly vaccinating them (*e.g.,* by spray), and putting them in a truck,
- The transport until the farm,
- The handling of the chicks in the farm at receipt (environment, density, water and feed availability, etc...).

In every step, failures can affect the final quality of the chick obtained: technical failures (temperatures or ventilation breakdowns), insufficient hygiene at any step of the chain, low quality of the originating eggs (due to the breeder chickens or the breeder farm).
Everyone involved in one step should keep in mind this long succession of events, and integrate the fact that his/her work is part of this chain.

References are available upon request.