Chick quality

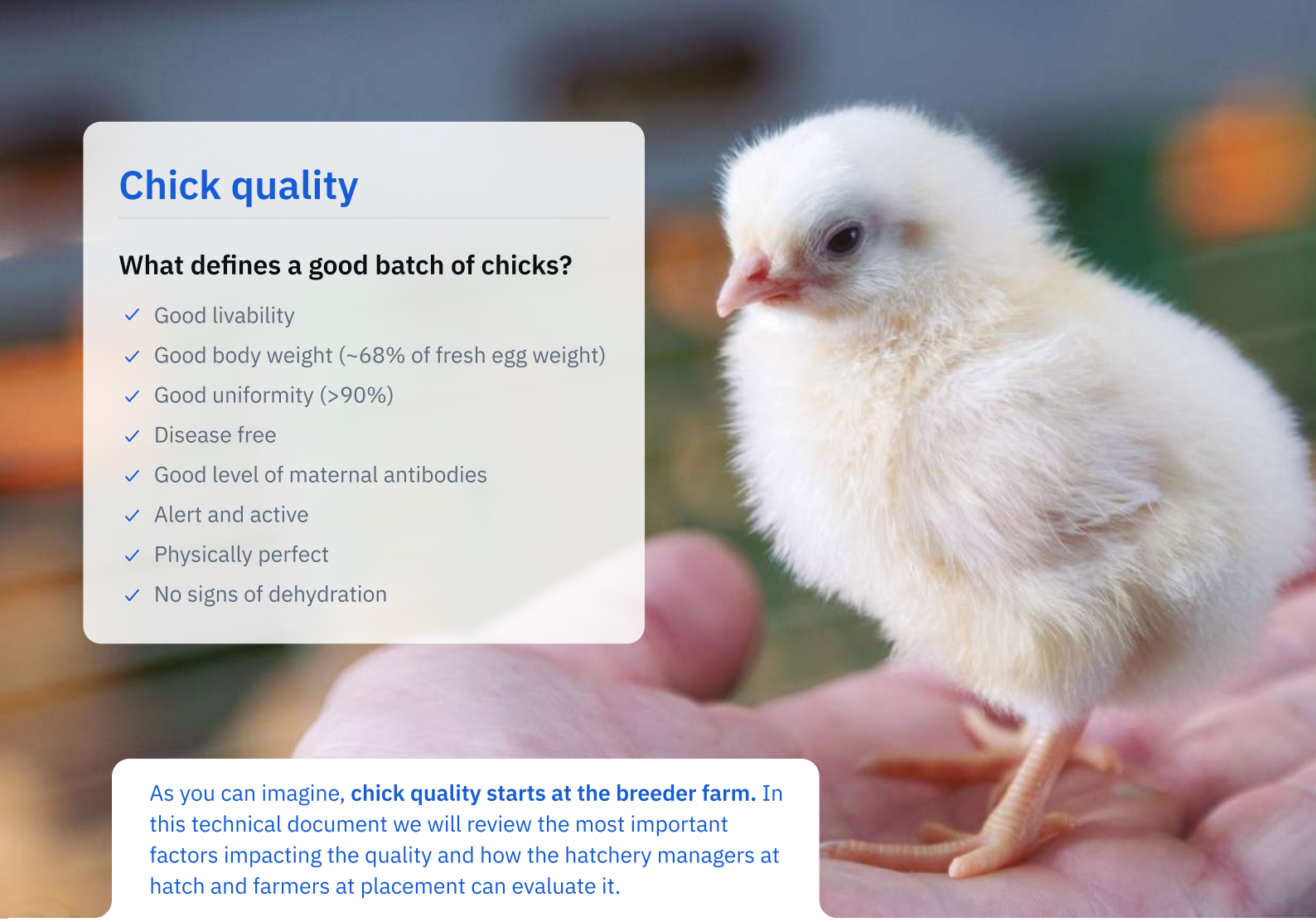
TECHNICAL TIP

It is said that first impressions are critical, and in our industry this is related with chick quality at arrival. Having this in mind, it is very important to have the procedures and tools to help us evaluate chick quality at the hatchery and at arrival on the farm and with that information we can make the corrections to improve it.

At the hatchery, it is critical to understand if the incubation conditions were optimal and when necessary, make corrections and ensure the best quality is sent to our customers.

On the other hand, during placement it is important to not only assess the incubation conditions but also to check if both holding and transport conditions were optimal, and furthermore to be sure we are receiving the best quality.

The purpose of this technical document is to provide guidance to hatchery and farm managers in evaluating chick quality. This document has arranged the factors in three categories: preincubation, incubation, and post incubation.



Chick quality

What defines a good batch of chicks?

- ✓ Good livability
- ✓ Good body weight (~68% of fresh egg weight)
- ✓ Good uniformity (>90%)
- ✓ Disease free
- ✓ Good level of maternal antibodies
- ✓ Alert and active
- ✓ Physically perfect
- ✓ No signs of dehydration

As you can imagine, **chick quality starts at the breeder farm.** In this technical document we will review the most important factors impacting the quality and how the hatchery managers at hatch and farmers at placement can evaluate it.

FACTORS IMPACTING ON CHICK QUALITY

Pre-incubation

Quality of Parent Stock (PS) flock determines the Hatching Eggs (HE) quality

1 Management on the farm

Poor management will negatively affect flock performance and hatching egg quality. For example, poor feeding management can reduce eggshell quality.

2 Age of the PS

As the flock ages the eggshell quality decreases. While hens younger than 30 weeks of age often produce immature chicks that require the best brooding conditions, hens older than 67 weeks produce eggs with poorer internal and eggshell quality.

3 Health status of the PS

Any disease impacting eggshell quality and/or internal quality (infectious bronchitis), and chick quality and livability (salmonella, Escherichia coli, mycoplasma, chicken anemia virus, avian encephalomyelitis, etc.) **is a risk for flock and hatchery performance.**

4 Feed quality

⚠ **Is critical to follow the recommended levels of vitamins and minerals from the management guide.** Not following them could decrease chick quality, fertility, and/or hatchability.

Always check the label of the vitamins/minerals premix and confirm that the levels are within the optimal range. This is even more critical in hot weather conditions and/or in situations of decreased feed intake. **Optimal premix storage is critical to prevent a decline in vitamin levels.**

5 Water quality

Suboptimal water could carry diseases, toxins, or high levels of minerals. A constant water disinfection is critical to prevent bacteria or viruses. **It is extremely important to periodically check the microbiological and mineral quality of the water.**

6 Characteristics and quality of hatching eggs

Egg weight

Incubate eggs of at least 50g and from flocks of at least 22 weeks of age. **Ideally, a batch of eggs to be incubated should have an average egg weight between 58 to 62g** (at least within the range of 50 and 70g) and have good uniformity (>90%). This contributes to having good hatchability, hatch window, and chick quality.

Egg shape

The degree to which hatchability will be impacted depends on the abnormality (see Table 1). **Only incubate normal shape eggs.**

Egg characteristics and the impact on hatchability

Abnormality	Hatchability %
Normal	74
Ridged	65
Round	63
Small	62
Pimpled	19
Wrinkled	13

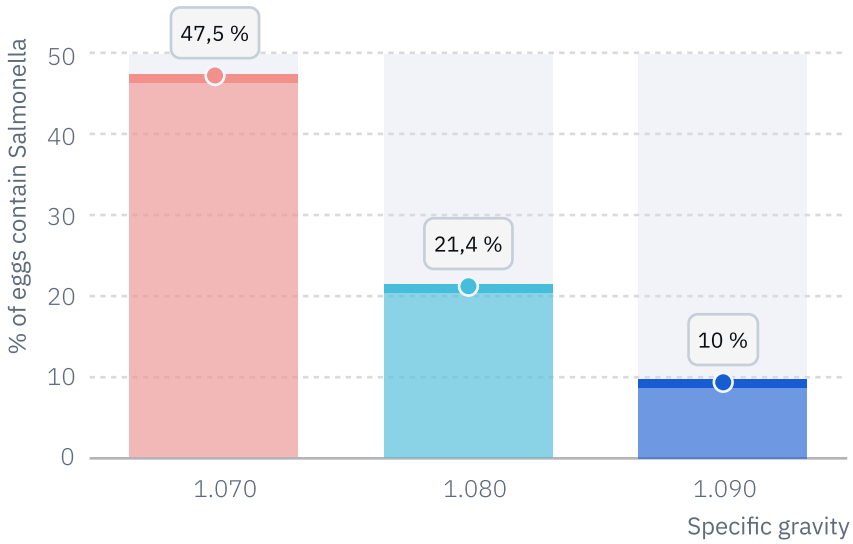
Table 1 (Adapted from Banday and Bakat, 2014)

Eggshell quality

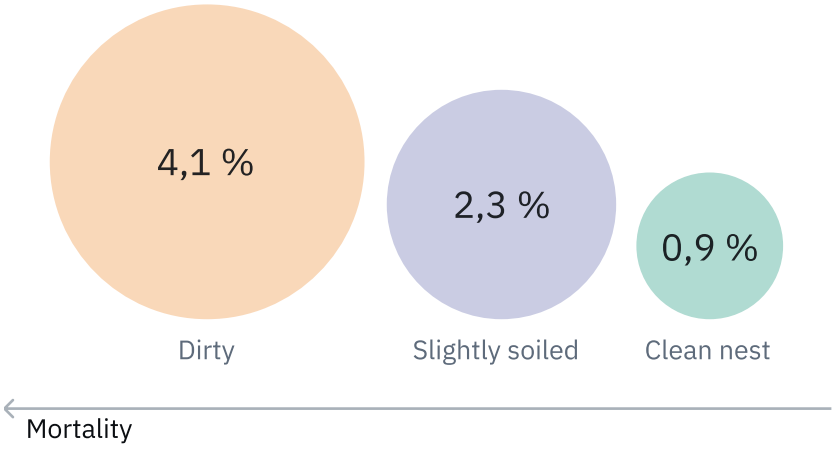
A good eggshell provides protection, a stable calcium source, and homeostasis for optimal embryo development. Flock age, nutrition, season, and management can all impact eggshell quality.

Eggs with poorer eggshell quality are more susceptible to bacterial contamination affecting chick quality (see Graph 1).

Graph 1. The percentage of eggs containing viable Salmonella 24 hours after a challenge and the eggs' specific gravity, an indicator of shell thickness. ***The higher the specific gravity (or shell thickness), the fewer eggs found positive for Salmonella.*** *(Adapted from Sauter and Peterson, 1974)*



Level of eggshell contamination and cumulative 2 week mortality



Graph 2 (Adapted from Mauldin, 2008 (engormix.com))

Clean eggs

Only use clean eggs. Never use floor eggs. To prevent floor eggs and improve nest utilization, it is critical the hens receive good training during rearing. Disease, nutrition, water quality, management, cleanliness of the nest (and egg belts), and characteristics of the equipment play an important role in having clean eggs.

When incubating dirty eggs there is always a risk of hatching chicks that may have high mortality due to bacterial diseases (see Graph 2 and Table 2).

Effect of nest hygiene status in bacteria count and cumulative mortality at second week

Egg source	Total bacteria	Coliform	2 week mortality %
Clean nest	600	123	0,9
Slightly soiled	20.000	94	2,3
Dirty	80.000	1307	4,1

Table 2 (Adapted from Mauldin, 2008 (engormix.com))

Egg storage

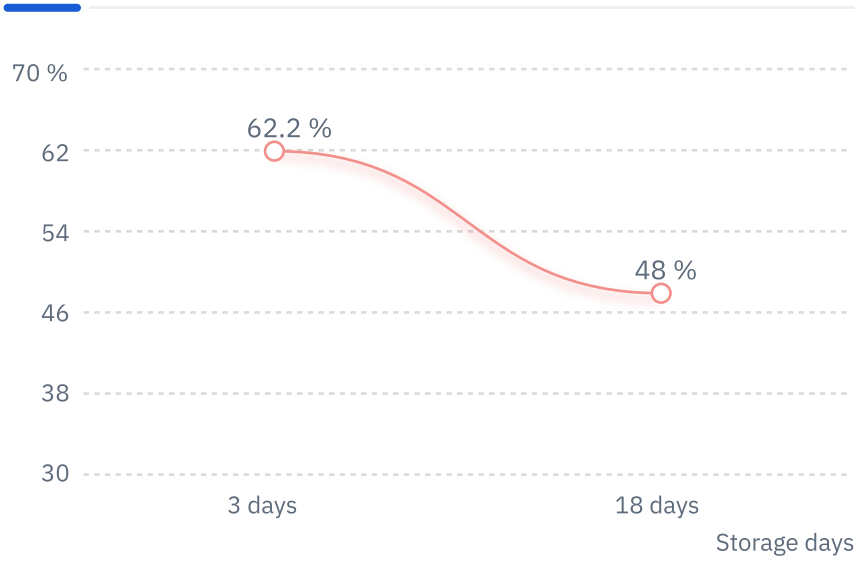
Research done by Tona et al. (2003) showed that **chick quality decreased with increased storage time** (see Graph 3).

In addition, the body weight gain at 7 days after placement is lower in chicks hatched from eggs stored for a long period (> 14 days).

Short Periods of Incubation During Egg Storage (SPIDES) can be used to mitigate the impact of long storage.

Effect of storage days on chick quality

The percentage of good quality chicks decreases as storage duration increases.



Graph 3 (Adapted from Tona et al., 2003)

7 Transportation of hatching eggs

Transport eggs in clean, disinfected vehicles designated only for hatching egg transportation. **Transport temperature should be within the range of 18 to 22°C and relative humidity between 40 to 60%.**

Condensation on the eggshell must be avoided at all costs because moisture on the eggshell impairs the natural microbial defense mechanisms of the egg and provides optimal conditions for microorganism multiplication. The table below can be used to predict if condensation will occur when no additional measures are taken.

In general avoid moving eggs from cold to much warmer temperatures, especially when relative humidity is high.

Prediction whether sweating will occur if no additional measures are taken

Temperature of storage room and eggshell	Temperature outside the storage room			
	15°C	18°C	21°C	24°C
21°C	-	-	-	>85% RH
18°C	-	-	>83% RH	>71% RH
16°C	-	>89% RH	>74% RH	>60% RH
12°C	>74% RH	>64% RH	>53% RH	>44% RH

Table 3 (Adapted from Gerd de Lange, 2011 (poultrysite.com). For a wider range of temperatures and humidities use a psychometric graph.)

FACTORS IMPACTING ON CHICK QUALITY

Incubation

Temperature

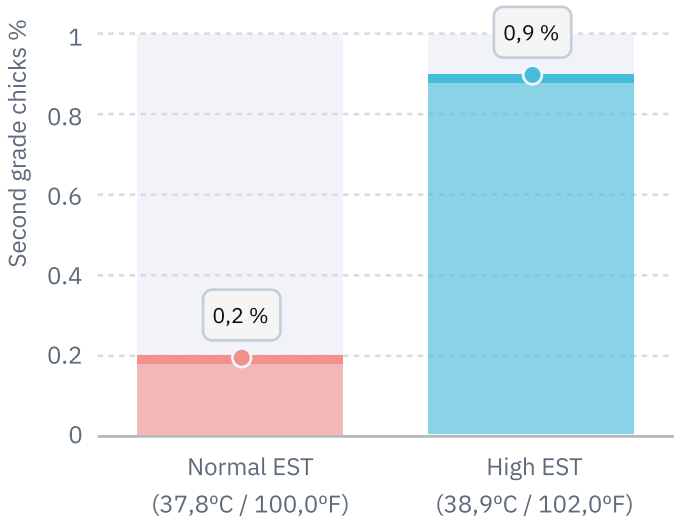
Eggshell temperature (EST) should be between 100-101°F (37.8-38.3°C) until hatch. Temperatures above or below the optimal EST will negatively impact hatchability, incubation time, and chick quality (see Graph 4). This is the most important incubation factor.

The EST must be frequently evaluated, and a written procedure should be followed. Optimal body temperature must be followed post transfer to prevent overheating (dehydration) or chilling chicks in hatchers, which will impact chick livability.

When compared with multistage setters (MS), single stage can produce better chick quality by maintaining the optimal EST during the incubation period. However, MS can still develop good quality chicks when the machine is adequately managed.

Impact of high EST on % of second grade chicks

(first grade = best quality; second grade = poorer quality)



Graph 4 (Adapted from Molenaar et al., 2011)

Effect of relative humidity (RH) on incubation parameters and body weight at hatch (RH of 53% was optimal in this trial)

Variable	Relative Humidity		
	43	53	63
Infertile (%)	7,4	8,3	7,3
Early dead (%)	8,2	7,1	8,5
Late dead (%)	3,0^{b}	2,3^{b}	4,5^{a}
Pipped (%)	0,9	0,5	0,8
Fertile hatchability (%)	86,6^{b}	89,1^{a}	86,3^{b}
BW at hatch (%)	39,4^{c}	40,2^{b}	41,2^{a}

Table 4 (Adapted from Bruzual et al., 2000)

Humidity

Setter humidity must be set to achieve an egg weight loss (EWL) between 11-13% at transfer (18,5 days of incubation). Suboptimal EWL will negatively impact hatchability (increased late embryo mortality), chick quality, and 7-day livability.

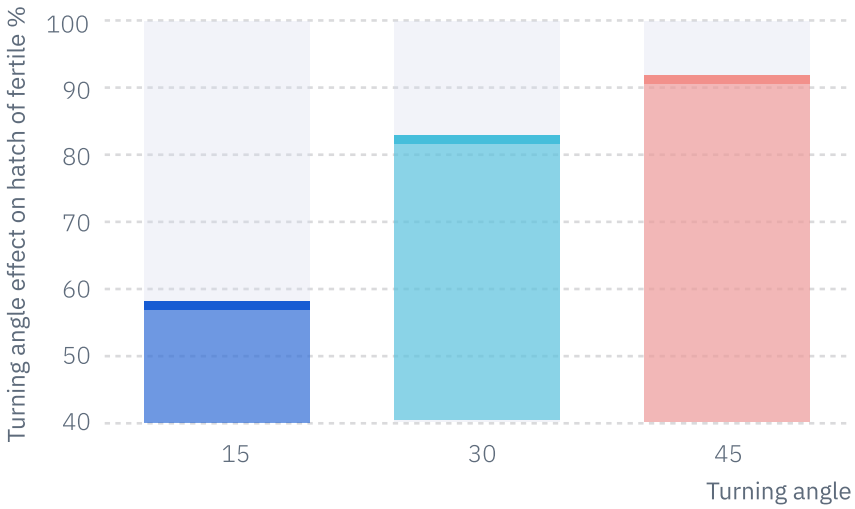
Low EWL can result in chicks with a large yolk sac, which affects hatchability and increases the risk of bacterial contamination.

It is critical to have a standard procedure to check EWL on a regular basis.

Turning

Turning failure, suboptimal frequency (more than 60 minutes per turning), and incorrect angle (< 38 degrees) can reduce hatchabilty and chick quality (see Graph 5). Optimal turning (at least every hour to 45 degrees) ensures correct development of the chorioallantoic membrane, yolk utilization, and eggshell temperature uniformity. **It is important to regularly check the turning frequency (every day) and turning angle (at least every 6 months).**

Effect of turning angle on hatch of fertile %



Graph 5 (Adapted from Cutchin et al., 2009)

Transfer

Transferring hatching eggs from setter to hatcher must be done on the right day (ideally between 18 to 19 days of incubation) to maximize hatchability and chick quality.

Careful handling of the eggs is critical to prevent eggshell cracks and transfer must be done quickly to prevent the eggs remaining at room temperature for too long.

Hatching window

The hatching window is a result of preincubation and incubation factors. The optimal range is between 20 to 28 hours in multistage and less than 18 hours in single stage machines. A long hatch window may result from poor uniformity in incubation conditions (especially EST), extended egg storage, inconsistent egg sizes, mixed PS flock ages, and many other factors.

A long hatch window can impact chick quality as early hatching chicks can become dehydrated while late hatching chicks will be too wet; overall body weight for the chicks will be less uniform. Everything must be done to achieve an optimal hatch window to ensure good chick quality.

Pull-out time

Chicks must be pulled out from the hatcher at the right time to prevent dehydration or immature (green) chicks. Both conditions can have an impact on chick livability.

FACTORS IMPACTING ON CHICK QUALITY

Post-incubation

1 Handling at the hatchery

During chick processing

Evaluate the different areas during processing that can impact on chick quality. For example, sexing, chick counting, beak treatment, vaccine injection, etc. Equipment errors can also impact chick quality and routine maintenance (including calibration) is essential.

Evaluation of chick quality

Areas to assess general chick quality and behavior

- Prior or during pull-out
- On processing belt
- After sexing
- After vaccination and beak treatment
- In chick boxes prior to delivery

Holding room and transportation of day-old chicks

- **Optimal temperature is 20 to 25°C with a relative humidity between 50 to 60%.** Constant monitoring of these two parameters is essential and a data logger is the best option for an optimal evaluation.
- Optimal ventilation allowing uniform temperature distribution, preventing chilling and overheating.
- Always check vent temperature and behavior. **The vent temperature should be 104-106°F (40-41°C).** Monitor this temperature in each step of processing (pull-out, sexing, vaccination, beak treatment, inside chick boxes, etc).
- Transportation must be smooth and as short as possible. Supplementation is recommended for long transport to limit dehydration and help maintain chick quality and livability.
- Clean and disinfected designated trucks (only for day old chicks transport) to prevent infectious diseases.

Brooding conditions

Temperature, feed, water, and ventilation are critical to achieve good 7-day livability.

Incorrect temperature, wrong feed presentation or quality, and lack of access to water will negatively impact chick quality and livability.

There are qualitative, quantitative, semiquantitative, and microbiology methods to precisely evaluate chick quality.

Regardless of the method, **it is important to have a good representative sample** and evaluation must be done after processing and selection.

2 Qualitative methods

Chick grading

Behavior
Not moving, lazy, appear asleep, etc.

Navel quality
Black button, string, etc.

Beak quality
Beak treatment, red dot on beak, etc.

Hocks and leg quality
Red lesions, dehydration lesions, etc.

Abdomen characteristics
Too large, feels mushy (unabsorbed yolk), too small and hard (dehydration), etc.

Navel quality

Navel quality is affected mostly by egg storage, breeder age, and incubation conditions.

Red hocks

Red hocks are in general associated with high temperature and/or high humidity during incubation.

Big belly

Big belly is associated with suboptimal incubation temperature and high humidity during incubation. It often appears with together with red hocks.

Chick behavior

AT HATCHERY

- Able to stand and move easily, but may rest when relaxed
- Active and alert
- Chicks should not be noisy. If chicks are very loud, it can mean they are under stress (for example, low or high temperature)

3 Quantitative methods

Hatch analysis and residual breakout

- Breakout of unhatched eggs to determine embryo stage at death.
- The % of chicks dead on hatcher tray must be 0%.
- Cull rate %: less than 0,5%.

Body weight and uniformity

- 100 chicks per flock (individual weight) after processing and selection.
- Uniformity (> 90%) and CV (< 8%) are the most important factors to focus on.
- Influenced by residual yolk weight, flock age, hatching window and pull-out time.

The bigger the yolk, the heavier the chick. This is not always good because a big yolk can indicate poor utilization during incubation. Efficient yolk utilization is essential for optimal embryo development, strong immunity, and healthy gut formation.

Uniformity **> 90%**

CV **< 8%**

Chick yield

- BW of chicks at hatch as a % of egg weight prior to setting (less than 7 days of storage).
- 3 setter trays per flock per machine.
- It is not necessary to weigh individual chicks but all chicks that hatched from those 3 trays.
- Optimal result is between 67 to 68%
- < 67% dehydrated (too much time in hatchers? high 7d mortality? High EWL?)
- > 68% too “green” (lethargic, low EWL? prone to bacterial infection).

This method helps to evaluate chick quality, and at the same time setter and hatcher conditions.

Optimal result

between 67 to 68%

Yolk free body mass (YFBM) and residual yolk (RS)

- Weight each individual chick and the residual yolk.
- YFBM = Need to divide by BW and x100 to fit with optimal guidelines below
- Optimal YFBM > 90% and goal is to achieve less than 10% residual yolk sac from BW at hatch.
- Higher the EST, lower the YFBM and quality.

Good predictor but time consuming and destructive method.

YFBM

= BW (body weight) – RS

Chick length

- Measure length of chick along a ruler from tip of beak to end of middle toe.
- Low sample number (25 should be enough).
- Variability between people, but consistency can improve with experience.
- Good method, not destructive.

Good relationship with yolk utilization and less time consuming and destructive method than YFBM method.

It requires to develop your own standard.
The optimal length depends on flock age.

Chick check

MICROBIOLOGICAL METHOD

Ask technical team for detailed information

- Sample 10 healthy chicks per flock (right after pulling out)
- Yolk swabs for bacterial cultures
- **Assess bacteria growth on:**
  - Blood agar
  - McConkey agar: for gram negative
  - PEA agar: for gram positive.
- Lung tissues for mold (Aspergillus spp) on SabDex agar.
- Pool samples of viscera and intestines for Salmonella culture.
- Always evaluate leg, navel, and yolk quality.
- Presence of gizzard erosions.
- This method helps to evaluate farm and hatchery sanitary conditions.
- A good option is to leave chicks for 48 hours under optimal conditions at the hatchery and after that period take the samples.

4 Semi-quantitative methods

Tona, Pasgar, and Cervantes scores

- Results could vary among evaluators.
- Score chick based on morphological characteristics.
- Cervantes method includes bacterial contamination.
- All three evaluate: activity, posture, belly, navel, legs, beak, and eyes.
- Pasgar score is more simple and more practical to use.

Meconium excess

When too much meconium is found **on eggshells and hatcher trays** it means chicks have been in the hatcher for too long.

Corrective measures must be taken: adjust incubation hours, pull-out earlier, evaluate eggshell temperature (maybe is too high), and check incubation humidity (maybe too low).

5 Placement and brooding

AT FARM

- Chicks at placement must be very active.
- They must start eating and drinking almost immediately.
- **Dead on arrival:** less than 0.2%.
- Measuring the **chick's vent temperature** remains important during the first 24 hours after placement. Check 15 – 20 chicks at various areas in the house to ensure that body temperature remains between 104-106°F. Corrective action should be taken if temperatures are outside of this range and temperatures rechecked afterwards to confirm changes have improved chick comfort.
- **7-day mortality:** less than 1%.
- **Crop fill score:** evaluate around 50-60 chicks per sample time. The goal is to have full crops for ~75% 6 hours after placement, 85% 12 hours after placement, and 100% 24 hours after placement.

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