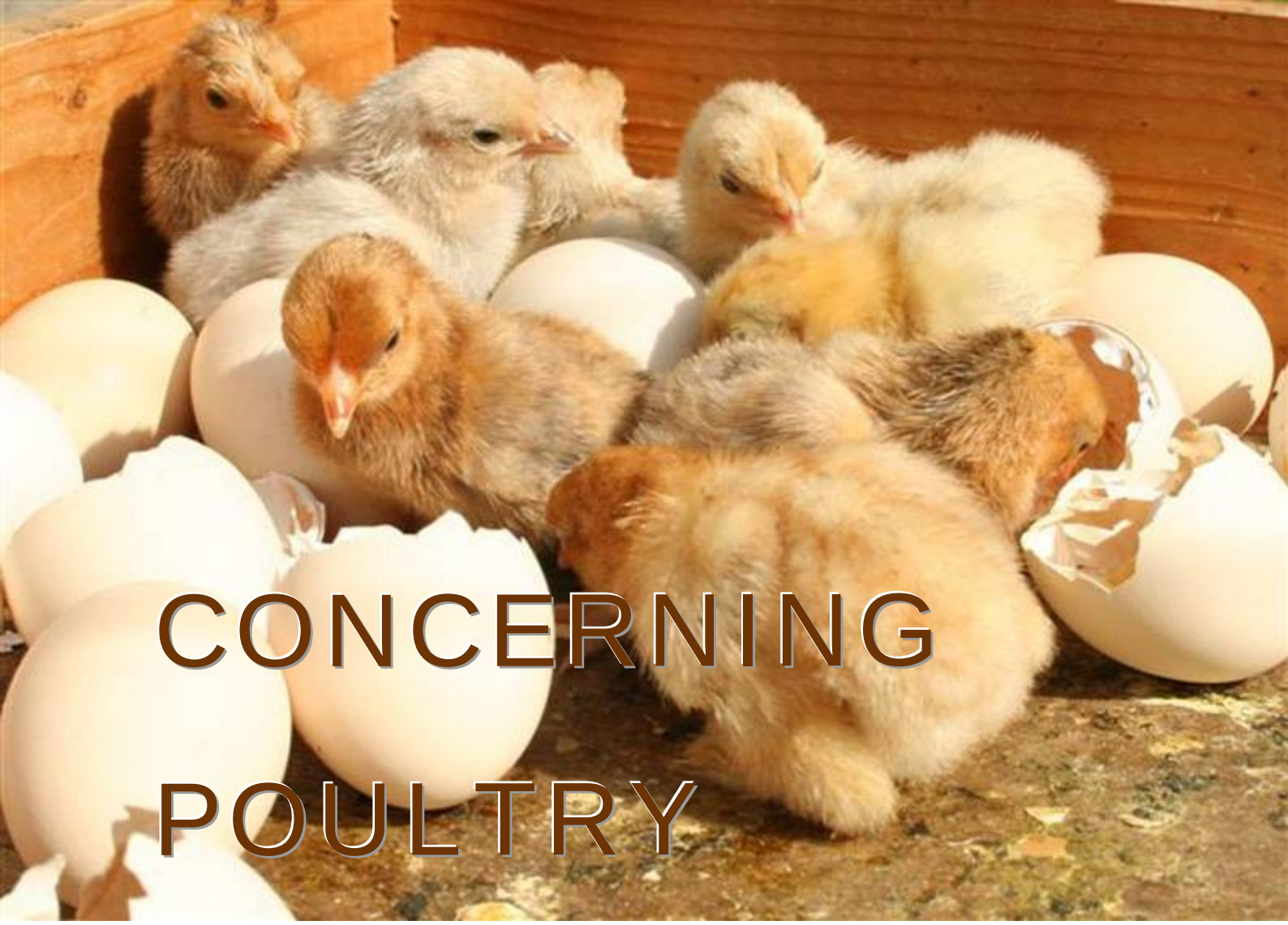


CONCERNING POULTRY

One can be puzzled by noticing that, from the same batch, in the same incubator, some of the chicks hatch normally, while others die before breaking the shell. Reading the following article, based on the experience of industrial poultry breeders, could be a real eye-opener for breeders of exhibition poultry as well.

DIFFERENT BREEDS DEMAND DIFFERENT INCUBATION MEASURES

By Dr. Ron Meijerhof , Poultry Performance Plus, Voorst, the Netherlands.
With our thanks to World Poultry

Commercial broiler strains usually show different performance characteristics. This is not just a matter of growth performance however, but starts at incubation already.

Although it is generally accepted that genetic differences between strains and breeds exist, we often assume that incubation and incubation conditions are more or less equal for all breeds, especially if we look within a specific group like broilers or layers.

There are a lot of similarities among breeds and strains within a breed, but there are some differences as well. Although sound scientific information is limited, practical experiences can give some indications. But to better understand these differences, we will first take a look at the incubation process itself.

What happens in incubation?

Embryos need energy for growing, and that energy is supplied by oxidising the content of the egg. In the first part of the incubation process, the embryo grows on carbohydrates, but in the second part it has to switch to the yolk. This yolk consists mainly of fat, which is a very effective energy source. Utilising this fat

for energy is a relatively slow process which requires a lot of oxygen. This means that the ability of the embryo to produce energy is influenced by the availability of oxygen through the shell.
The rate at which the embryo uses energy depends on the temperature in the egg. If this temperature goes up, the embryo will metabolise faster, and therefore will use its energy faster. Of course it is important that the production of energy and the use of energy is in balance. If the embryo uses more energy than it can produce, it will run out of energy at the end of the process, and we can imagine that things will then go wrong.

Left: Eggs from all sorts of breeds, in all sorts of colours and all sorts of size. Photo: Evert van Dijk.

The running embryo
To try to imagine what happens in incubation, we can compare it with endurance sports like running a marathon. Of course the development of an embryo and running a marathon are not the same, but there are some similarities. Although running a marathon is a very stressful process, walking a marathon at a speed of 5 km/hr is in reach of everybody with a good physical condition and sufficient motivation.
However, if we want to run a marathon at 12 km/hr, we need to do a lot of training, and only a few people can run a marathon at 20 km/hr. So it's not the distance that makes the difference, it's the speed. In fact, almost everybody has enough energy stored in their body to run a marathon, as running 42 km requires the energy that is delivered by burning approximately 400 g of body fat. But we need to metabolise this fat into nutrients that can be used by the muscles, which requires oxygen and takes time.
That is why training programmes focus on the ability of the body to uptake oxygen. If we do not run but walk, the body has enough time and oxygen to convert that fat in time, and we have no problem.
However, if we run at high speed, the use of energy is much higher, and the body cannot keep up with the demand. If we try to run in an environment short of oxygen, for instance at high altitude, this will even be worse.

Differences among breeds
Not all breeds and lines are equal. If we incubate for example Ross 308 and Cobb 500 eggs of the same weight in the same machine, we can observe some differences. We will find for instance that the Ross 308 will approximately lose 0.5 to 1% more weight (moisture) in 18 days.

If we take egg shell temperatures (embryo temperatures) at 18 days of incubation, we will see that Cobb eggs will be 0,7 to 1,0ºF warmer than Ross eggs. If we look at the hatch time, we normally see that Cobb eggs will hatch 8 to 12 hours earlier than Ross eggs of the same weight.

Above: Leghorn bantam chicks – one breed, one colour variety, hatching at the same time. Photo: Arie van Bijsterveldt.

What are the consequences?

If we try to compare this with our running chicks, how can we explain this? Cobb embryos seem to have a higher internal temperature than Ross. The likely reason for this is that Cobb embryos produce slightly more heat during incubation than Ross, and as the eggs are in the same machine at the same air temperature, their resulting embryo temperature will be higher. It is as if the embryo is running at a higher speed, which also explains why it hatches earlier.
At the same time, the Cobb eggs lose less moisture. This will be partly the result of the higher temperature of the eggs, but it indicates that also the conductance of the eggs is less. A lower conductance does not only mean that moisture passes more slowly, also gas exchange and therefore oxygen uptake and carbon dioxide release will be more difficult.

Left: Marans egg with chick dead in shell; the embryo was fully developed but didn't pip the air sac.
Photo: Dirk de Jong.

Two options possible

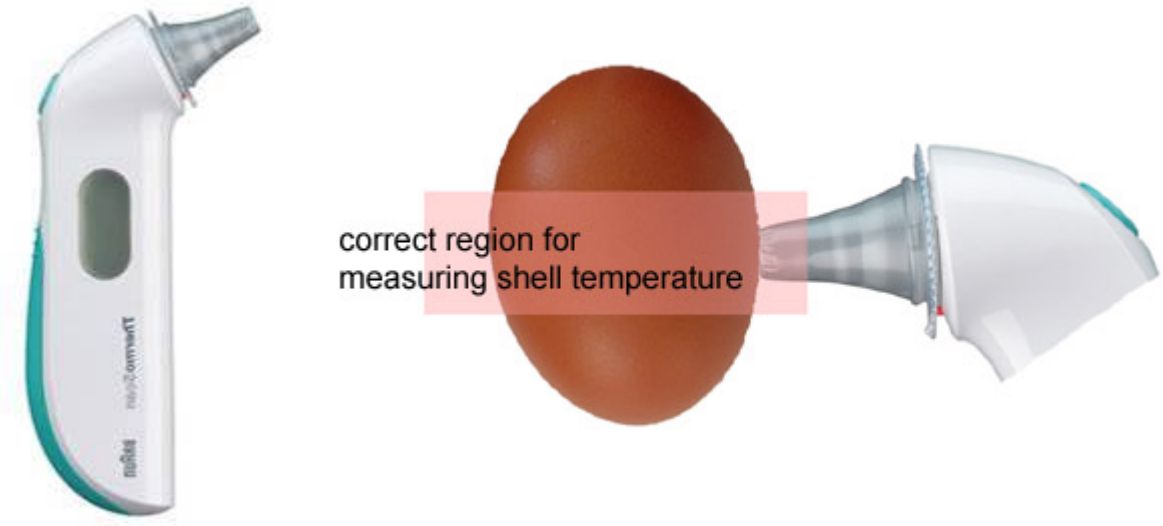
If we put this all together, it means that the Cobb embryo is able to run faster, but at the same time has less oxygen available. As a result it will hatch earlier, but it will run out of energy more quickly. As the embryo needs energy to survive and has no opportunity to burn more fat, two things will happen:
1) The embryo will start to burn protein. This means that it will take energy from its muscles, resulting in lower muscle weight and development at hatch. Especially the heart muscle seems to be affected, creating problems later in life.

2) The embryo will switch more or less to anaerobic oxidation of carbohydrates, resulting in the production of lactic acid, the same product that makes our muscles hurt the day after we did excessive exercise without proper training. These birds will have a problem to move on the belt and tray in the hatchery, and also in the farm, resulting in a poor start.

Left: Another Marans egg with chick dead in shell; this embryo did pip the air sac, but obviously had no energy left to pip the egg shell.
Photo: Dirk de Jong.

But not only protein sources like the heart muscle are sacrificed in this process, also the immune system is affected, and will not function as well as it is able to.

How to manage this situation?
What we have to realise is that there is a difference between breeds. In this case of Cobb and Ross, there is a difference in shell conductance and heat production. Issues like differences in hatch time, more exhausted, poor starting birds with damaged hearts and immune systems are in most cases not genetic, but are the result of the fact that we didn't force the embryos to walk the marathon instead of running it. How do we let the embryos walk the marathon? Just by controlling its temperature to the right level of approximately 100ºF (egg shell temperature).



Above: For measuring eggshell temperature, all you need is a medical infrared ear thermometer. Measure shell temperature at the equator of the egg, not at the top or bottom. Make sure the tip of the thermometer is flat against the eggshell surface.

This means that the temperature of the machine needs to be adjusted to the breed which we are incubating, but also for instance to the egg sizes in the machine, as bigger eggs will give higher heat production and lower air velocity, resulting in higher embryo temperatures.

Above: Just hatched Dorking chicks. Photo: AE

Adjusting to breed

If we do not adjust our temperatures to the right level, we will see differences between breeds. The higher heat producing breeds like Cobb compared to Ross, but also Cobb 700 compared to Cobb 500 and Ross 708 compared to Ross 308 will suffer more from overheating in the same temperature environment.

It will result in a too quick hatch (with all the problems of dehydration, etc. associated), more exhausted chicks and therefore a poor start, more leg problems due to the breakdown of the protein, more metabolic problems like ascites (waterbelly) because of the damage on the muscles, and possibly more disease problems due to a less developed immune system.

Not all of these problems will be very severe, depending on the level of temperature and oxygen supply we can implement, but a too high temperature will have these negative effects.

Right: Day old Cochin chick. Photo Pauline van Schaik.

If we are not able to control the temperature based on the demands of breed and strain, we will especially hurt the embryos that tend to produce more heat during incubation. Taking tailor made incubation measures in time, will lead to a better start.

All breeds are equal, but some are more equal than others…

Some additional notes by Aviculture Europe:

Optimum shell temperature for maximum hatch and chick quality is 100 - 101 ºF (37.8 -38.3 ºC) throughout the whole setting period.
Eggshell surface temperature is closely related to internal egg temperature, thus what is experienced by the embryo inside the egg. It is not necessary the same as the air temperature in the incubator!

High incubation temperature is more damaging to the embryo than low incubation temperature.

Apart from incubation temperature, also incubator humidity is very important. Check the size of the air space in the eggs while candling; it will give you a good indication if the humidity level is all right.
Thick, 'full' chicks that are lazy and not eager to feed and drink, are due to low incubation temperature and/or high incubator humidity, or only just finished hatching and fluffing-up when they were removed from the incubator.
Smaller, compact, very active and noisy chicks are due to incubating at a high temperature or a low humidity, or hatched a long time before they were removed from the incubator; they are often dehydrated and have little yolk reserve.

The negative effects of not optimal incubation will probably have not only short-term but also long-term effects on survival and development of the chick.

Using a still-air incubator (without automatic turner)? While turning the eggs, make them move to another part of the incubator (from the centre to the outer edges and vice-versa), as the temperature is not the same everywhere.

Good luck in the coming breeding season!

Houdan chicks.
Photo Dirk de Jong.