

Protein and eggs

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In recent years it has become more and more clear that the conditions during the incubation process do not only influence the hatchability, but especially also the chick quality and with it the results in the production period. This understanding has driven a strong attention to the incubation process, and the focus has shifted from predominantly looking at lowest cost per egg set to producing the best quality chicks possible with maximum performance in the field.

But over the years we have come to a better understanding of the mechanisms that are involved in that better chick quality, why our incubation conditions are having such an influence on the performance of the chick. And with that better understanding, we are also able to improve the quality of the process and the important factors for that process.

The main energy source in eggs is the yolk. Half of the yolk is made of water, and the other half is 1/3 protein and 2/3 fat. When we look at the different functions of these materials, it seems logical that from the yolk, the fat will be there for providing the energy to the embryo to grow and develop, and the protein is there to build up the body tissue. This is indeed logical, but to allow the embryo to use the fat in the yolk for energy, also oxygen is needed. Oxygen needs to be taken up by the egg to change the fat into a substrate that can be used for energy by the embryo. And when the embryo grows and develops, it uses this substrate, and more oxygen needs to be taken up to convert more fat into usable energy.

Now this is all nice theory, but what does it mean for our everyday practice. Well, actually quite a lot. When we increase the temperature of the eggs, we also increase the developmental rate of the embryo. This means that more substrate is needed to “feed” the faster developing embryo, and more oxygen needs to be taken up to convert fat in a usable form. But the uptake of oxygen is limited by the conductance of the shell. It has to enter to the egg through the pores in the egg shell, and these are limited in capacity. This means that when we increase the temperature in the egg too much, the growth of the embryo goes faster than the system can handle, and it runs out of energy.

But of course, mother nature has worked long and hard to find solutions for these kind of circumstances, to make the system so robust that it can handle less optimal conditions. If the fat from the yolk cannot be used because the egg is lacking sufficient oxygen, it can find an alternative energy source in the form of protein. It can basically burn protein for energy, instead of using the fat for protein. Of course this is not a very desirable situation, as the protein was intended to be used for building up body tissue. But for an embryo it is of course better to use part of the protein for energy, than die because it cannot get energy at all.

The result is that when we overheat the eggs, especially in conditions with limited gas exchange through the egg shell, we force the embryo to burn protein for energy, instead of using it for developmental growth. When there is less protein available for growth and development due to high temperature of the embryo in incubation, we can see the consequences as follows:

There is less protein available for development of the heart, so the heart will be smaller, and as a result growth rate will be lower, and metabolic problems like ascites will occur more frequently

Protein is crucial for bone development, and therefore we see more twisted and bended legs

Protein is crucial for immune response, so the bursa of Fabricius is smaller and the birds have less immune response

Also the development of the intestinal tract is less.

All these effects are well documented in scientific research, but in a practical situation it means that we have to focus on keeping the egg shell temperatures during incubation under control. If the egg shell temperatures are getting above the optimum of 100 to 100,5oF, we see that the development of the embryo is impaired. This lack of development will have a negative influence on later performance of the birds. Incubation is as much about achieving optimal chick quality and broiler performance as it is about achieving maximum hatchability.