



The importance of nutrition in broiler breeder fertility

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All poultry production, be it chickens, ducks or ostriches, begins with the successful union of egg and spermatozoa in order to create a fertile egg. However, before the fertile egg is laid or mating even occurs, a strong nutritional foundation must first be built to ensure both male and female are capable of producing high-quality gametes that will eventually result in viable offspring.

The effect of nutrition on fertility does not begin at laying, but instead at the initial feed intake of the parent stock. Sufficient nutrient intake is vital to ensure optimal reproductive development for parent stock, but can come into conflict with the objectives of their offspring.

The cost of increased efficiency

Developments in the broiler industry over the past few decades are an excellent example of this imbalance: Broiler growth rate and feed conversion ratio (FCR) have increased on an annual basis, the effect be-

ing that the modern broiler needs a diet high in protein and energy to support these improvements. However, the selection for faster growing broilers comes at a cost, with the price for increased growth efficiency being a decrease in reproductive capacity.

This was clearly illustrated with a population of Japanese quail reared on a diet containing 28% protein, from which the biggest birds were selected for mating. The resulting progeny were then fed a diet containing 24% protein during laying and a noticeable delay in egg production occurred, as selecting for growth alone negatively impacted other traits such as reproductive performance. However, in this study the delay in egg production was shown to be ameliorated by feeding the quail a diet containing 30% protein.

Similarly, broiler breeder females need to accumulate a specific amount of nutrients during rearing in order to achieve optimal reproductive development and performance at maturity. Cumulative nutrient intake for broiler breeder females

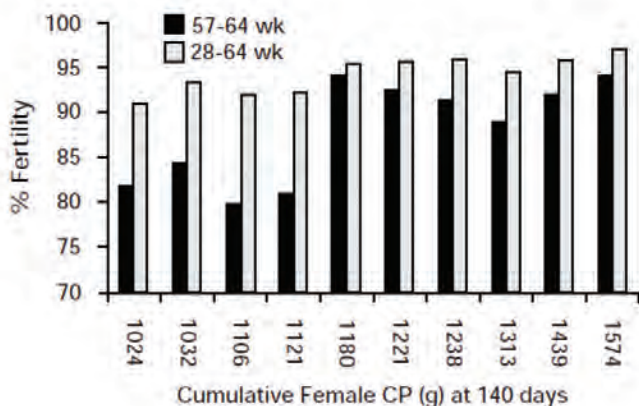
is generally accepted to be approximately 22 000kcal and 1 200g of protein at light stimulation at 20 weeks, and intake below this amount will result in a delay in egg production that will result in a decrease of roughly 15 less eggs over the production period, as well as poor persistence of fertility during the life of the hen.

Effects during later life

Therefore the effect of nutrition and management during rearing of the broiler breeder female, cannot be under-estimated as they will have a lasting effect throughout the production period, with the effects becoming more obvious only in the later production period (see Figure 1).

It is important to note that these values are a guideline and climate can have an impact on cumulative nutrition – out-of-season birds, especially in warm climates where photo stimulation is done in the cooler seasons, need more nutrients when photo-stimulated to compensate for the colder climate, or photo stimulation can

Figure 1: Graphic summation of data demonstrating the effect of cumulative intake of CP prior to photo stimulation on overall fertility, as well as fertility during the last eight weeks of the production cycle.



body weight and feed should increase throughout the productive life of the male broiler breeder, placing great importance on the building of the male frame during the first ten weeks of rearing, as previously mentioned, in order to support this growth.

Increases in feed can also ameliorate fertility problems in flocks where male mating activity has decreased by adding an additional 10-15g of feed per male for a few days. However, nutrient increases must be carefully managed as male broiler breeders do not need the same amount of protein as females, and a clear negative correlation exists between high protein levels and fertility. Female broiler breeders also have a higher requirement for calcium compared to males, and high calcium in the male diet can place stress on the kidneys as the excess calcium is excreted.

Therefore separate feeding of broiler breeder males and females is the best solution, with the male diet containing approximately 12% protein and lower calcium than the female diet. Feeding a separate male diet does, however, have its own challenges as this is normally done by receiving the male feed in bags, which could pose a higher biosecurity risk on the farm.

Storing male feed for long periods can also be an issue, especially if oil is used as an energy source, as this can lead to oxidation and negatively impact sperm production. Therefore management of male feed must be thoroughly investigated before adapting this as a management plan.

be delayed to allow the bird to accumulate more nutrients before photo stimulation. While individual flock conditions may vary, the basis remains the same in that the hen must begin building nutritional reserves during rearing in order to achieve and maintain optimal reproductive performance.

Broiler breeder females reach full maturity after peak production and then begin to experience a decrease in growth rate. Therefore their nutrient requirements decrease as energy expenditure shifts from growth to maintenance and production. Feed withdrawal should be done, taking into account how best to maintain body mass, egg production and egg weight. Increasing nutrients after peak can result in overly fat breeder hens, which tend to have lower fertility and poorer production that will decrease further with age.

and increasing nutrients after this stage will only encourage fat deposition that can lead to lower fertility and higher mortalities. By photo stimulation at 20 weeks of age, broiler breeder males should have consumed at least 1 600g of protein and 32 000kcal via a programme that correctly allocates feed to minimise mortality and maximise fertility.

Nutrient increases

Although male body weight is correlated with testes size and sperm production, body weight should be considered relative to the frame of the bird. A 5kg broiler breeder male with a small body frame will not have the same reproductive capacity as a 5kg bird with a large body frame. Male

Nutrition of breeding males

Of equal importance is nutrition during the rearing of broiler breeder males. Feed allocation during rearing has been demonstrated to determine the fertility and mortality pattern of the male broiler breeder throughout production, and therefore must be meticulously managed. The focus of early male nutrition must be on building the correct body frame and supporting organ development, as beyond the first ten weeks these attributes are largely fixed.

Around 15 weeks of age, male nutrition should begin to plateau as the foundation for reproductive success has already been determined by the early feeding programme,

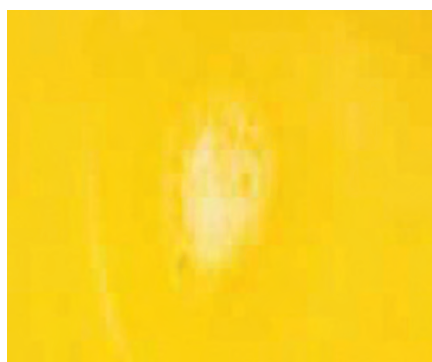


Figure 2: Visual evaluation of fresh, unincubated eggs.

A: Infertile blastodisc



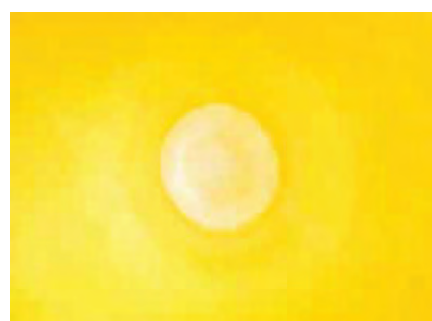
B: Blastodisc magnified



C: Fertile blastoderm



D: Magnified blastoderm⁽⁹⁾



Determining fertility

Once a strong nutritional foundation is built and mating begins, fertility can be properly evaluated. However, accurately determining fertility can be difficult. Poor hatchability is often blamed on poor fertility, when in many cases there is confusion between very early deaths of fertile eggs and true infertile eggs. Fertility can only be truly determined by the number of spermatozoa arriving in the outer perivitelline membrane of an oviposited egg.

Both the male and female play a role in the sperm deposited in the outer perivitelline membrane – the male by producing viable sperm with good motility and the female through the storage of the sperm in the uterovaginal and infundibular glands in sperm storage tubes (SST). The amount of sperm stored in the SST is directly correlated to the number of spermatozoa laid down in the outer perivitelline membrane.

However, the techniques required to determine sperm storage or outer perivitelline penetration are not realistic for a commercial breeder operation, and hatchery breakouts by trained staff serve as a much more practical measurement of fertility on a regular basis.

Fresh egg breakouts are also a useful tool in determining true fertility, with the difference between a fertile blastoderm and blastodisc being apparent in fresh, unincubated eggs (see Figure 2). However, this method does incur an economic loss of potential hatching eggs – to some it may be preferable to first examine the reproductive quality of the broiler breeder and address any potential nutritional issues.

Semen quality is vital in the production of hatching eggs and can be heavily influenced by nutrition. Broiler breeder males with body weights not proportional to their frame have been shown to produce sperm with lower mobility, leading to lower fertility. Increasing protein in the male diet has also been demonstrated to decrease sperm production and a strong negative correlation exists between spermatozoa concentration and dietary protein levels.

Sperm quality

Male nutrition has been shown to influence the quality of sperm as well. Broiler breeder spermatozoa contain an extremely high proportion of long chain polyunsaturated fatty acids (PUFA) that are needed to maintain membrane integrity, fluidity and flex-

ibility. However, PUFAs are susceptible to peroxidation by free radicals that can occur during stress, and the high concentration of PUFAs in chicken spermatozoa must be protected in order to preserve sperm integrity.

Adding an antioxidant such as vitamin E at levels of 100mg/kg to the diet can help to preserve PUFA concentrations in sperm and maintain fertility. Other

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antioxidants such as carotenes, water soluble antioxidants like ascorbic acid and certain minerals (selenium, manganese, copper, zinc and iron) can also have similar beneficial effects. Complexed organic zinc has also been shown to improve gonadal maturation in broiler breeder males when included in the diet during the rearing period.

Overall, the role of nutrition in broiler breeder fertility cannot be underestimated. Allocating the correct amount of nutrients at the correct stage in rearing is of paramount importance in ensuring reproductive success and persistence. Monitoring nutrient levels during the laying period is also critical to ensure that fertility is maintained and adjustments must be made as the nutrient requirements of the bird change with age.

Antioxidants should also not be overlooked in the diet as they play a vital role in promoting and protecting sperm quality and production. Above all, dietary requirements for fertility must be measured on an individual flock basis with consideration given to flock rearing history, production status, body weight and egg weight.

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References available on request. ❖