Improvements in duck performance

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Although duck meat currently represents less than 10% of total poultry meat production and is largely concentrated in China and southern Asia, this market has grown significantly in recent years. Duck meat production has increased by more than 50% over the last decade from 5.6 to 8.3 million tonnes according to FAO statistics. The majority of this growth has been seen in East Asia particularly China (from 2.6 to 4.3 million tonnes), where production processes are becoming increasingly more sophisticated with the need for lower cost and better quality products for both domestic and export markets.

This growth is likely to continue with genetic and husbandry advances making duck increasingly competitive to other poultry and meat products. The growth of these markets has also led to more commercial style production with the movement of birds into intensive or semi intensive systems, often within larger integrated operations.

Current breeding strategies

Current breeding strategies in Pekin ducks are similar to those in broilers. Selection effort has primarily been driven by the demand for lower cost, higher quality food products typified by traits such as growth rate, breast meat yield and feed conversion ratio (FCR). This selection has been very successful and has vastly improved the efficiency of growth and meat production of Cherry Valley ducks whilst maintaining chick cost.

Selection over the last several years has resulted in an improvement in the efficiency of growth in excess of

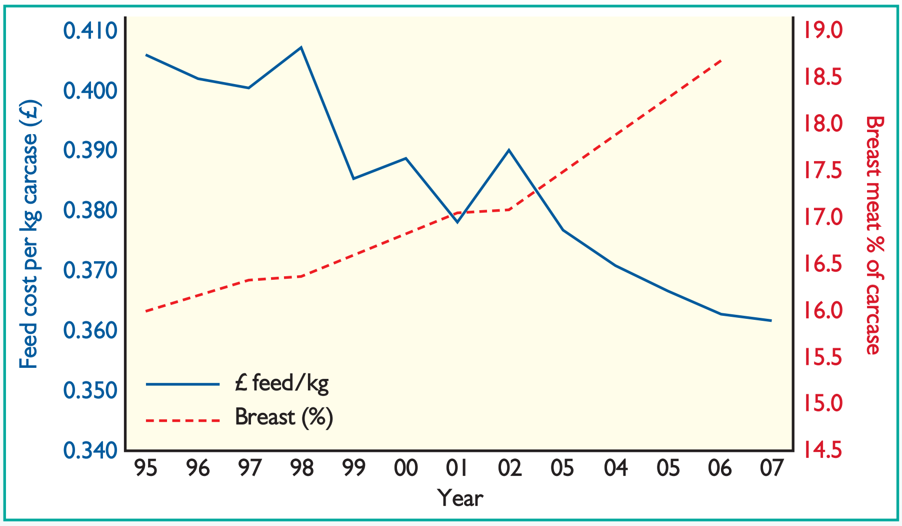

Fig. 1. Relative feed cost of producing 1kg of carcase and percentage of breast meat in the carcase. Assumes an average feed cost of £160/tonne.

2% per year resulting in a significant reduction in annual feed cost. During the same period improvements in growth rate have resulted in the time taken to reach a slaughter weight reduced by approximately nine days. Selection emphasis has also been used to improve carcase quality, in particular the breast meat yield, which has increased on average by 1.5% annually.

The genetic improvement programme at Cherry valley is based on selecting a number of 'elite' pure strains. These are split into male and female strains and are used to produce crossbred parents and finally mated as a four way cross to produce a commercial bird.

Elite birds are selected for the next generation on the basis of BLUP breeding values, which takes account of records from the individual's relatives as well as the individual's own performance so increasing the accuracy of selection to ensure the most effective genetic improvement.

Breeding policy and individual strain selection objectives at Cherry Valley have long embraced a pragmatic balance of profitable genetic change in both cost and quality production traits, without compromising reproduction, liveability, mobility, or identifiable metabolic adequacies, such as the pulmonary system.

Ensuring 'robustness' of the birds is an integral part of the breeding programme with the recording and analyses of fitness traits, the incidence of various disorders (maladies) and the monitoring of breeders throughout their lifetime.

Male strains tend to have more selection emphasis on feed conversion ratio, breast meat yield and growth rate, whilst the female strains are primarily selected for their improved reproduction and carcase quality.

Selection programme

The aims of the programme are to increase the profitability of duck production by improving the growth and carcase characteristics of the commercial duck, whilst maintaining the liveability and reproductive capacity of the breeding bird. Recent analyses of genetic trends show that current selection is moving the commercial bird in the right direction (Figs. 1 and 2).

However, there is some evidence that intensive, long term selection for such traits in other poultry species can make these populations more susceptible to various pathogens.

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Although some studies have found positive correlations between muscle growth rate and that of vital organs such as heart, spleen, liver and gastrointestinal tract there is some evidence that intensive selection for efficient growth in poultry can result in physiological changes that can increase the incidence of metabolic disorders such as ascites.

Previous studies have estimated the heritability of these disorders and related traits in broilers at approximately 0.15-0.3.

The incidence of these conditions in commercial broiler populations is in the region of 2%, whereas in Cherry Valley's commercial duck flocks the observed incidence was much lower at approximately 0.5% and has declined over recent years (Fig. 2).

It appears that adverse metabolic effects, such as, ascites, are not as severe in ducks compared to other poultry species at present, but in order to meet the demands of an ever expanding global marketplace duck breeders continue to provide breeding stock which are profitable and robust in a wide variety of environments.

Such traits have been shown to be heritable with published estimates for ascites in broilers ranging from 0.15-0.30 and related traits such as physiological and pulmonary fitness measurements have also shown significant heritability of 0.3-0.5.

This suggests that direct quantitative genetic selection against such traits and for robustness is possible.

Parameter estimates from our data suggest that the heritability of heart failure and ascites in Pekin duck is lower than that in broiler chickens and is approximately 0.08-0.10.

Such traits can be incorporated into a selection strategy, along with existing and new quantitative measures of robustness, such as oximetry or haematocrit values and selection in different environments to further improve the performance and quality of Pekin ducks. These demands are often conflicting and include such issues as robustness, disease resistance, animal welfare and food safety alongside more traditional cost of production concerns.

Although many of these objectives could be achieved by improved management and husbandry practices there is still considerable potential to provide genetic solutions.

There are a number of potential genetic technologies being developed, for both biomedical and in some cases agricultural research purposes.

These technologies include relatively simple genome mapping and sequencing aimed at providing a greater understanding of the genome and hence biology of a species along with more controversial technologies such as transgenics and cloning, which may offer some unique opportunities.

However, we must also bear in mind that although some technology may exist it is not just a question of what is possible, but what is appropriate.

The duck genome

The chicken genome has received a great deal of attention from poultry scientists around the world and the complete sequence is now available. By contrast, the duck genome is poorly studied. The most compelling reason for using molecular genetics is to develop selection tools for traits, which are difficult, expensive or impossible to measure in one or either sex.

Examples of such traits include disease resistance, meat quality and some reproductive traits.

Quantitative genetic approaches to such selection would require sib or progeny testing which would reduce the accuracy and increase the generation interval.

Molecular markers would enable direct selection within the elite populations. A number of potentially useful QTL (quantitative trait loci) have been identified, but despite the theoretical benefits and high investment in research the uptake of useful markers into commercial breeding programmes has been limited.

The commercialisation of molecular breeding tools poses a number of challenges not least of which are the high costs of genotyping relative to the low economic value of individual birds. QTL are usually based on markers and not causative genetic polymorphisms.

These markers are assumed to be close to the gene of interest, but are not a direct test for the DNA change associated with phenotypic differences. The further the marker is from the causative polymorphism the greater the risk of recombination and hence a reversal of the marker-phenotype association.

To adequately compensate for this weakness it is often necessary to repeatedly determine the 'phase' of the association in each family under selection. For traits, which are not routinely measured, such as meat quality or disease resistance, this becomes prohibitively expensive.

Conversely, where the marker is for a routinely measured and heritable trait (such as growth rate and FCR) the marker effects must be very large and consistent to offer significant financial benefit above that of conventional genetic selection (BLUP).

If we can identify the actual gene(s) affecting the trait of interest then this is no longer necessary and the accuracy of selection can be vastly improved, however, most traits of interest appear to be controlled by a large number of genes which interact with each other and the environment to produce the phenotype, so it seems unlikely that the use of such technology will be simple.

It is unlikely that the latter technologies of cloning and transgenics will be applied to any agricultural livestock systems in the foreseeable future for obvious reasons of both cost and public concerns, which may or may not have a scientific basis, about the welfare of stock and safety of food produced in this way.

Pedigree hatching; a single full sibling group.

Significant improvements

Cherry Valley's duck breeding programmes have yielded significant improvements in economically important traits and will continue to do so. There is certainly a great deal we can learn from academic research into other poultry species, in particular the chicken.

However, we must also appreciate that there are some significant differences not only in the genetic makeup and physiology of ducks compared to broilers, but also in the market requirements.

The development of breeding programmes for ducks will need to be continually reviewed and in order to satisfy the markets in the 21st century we must con-

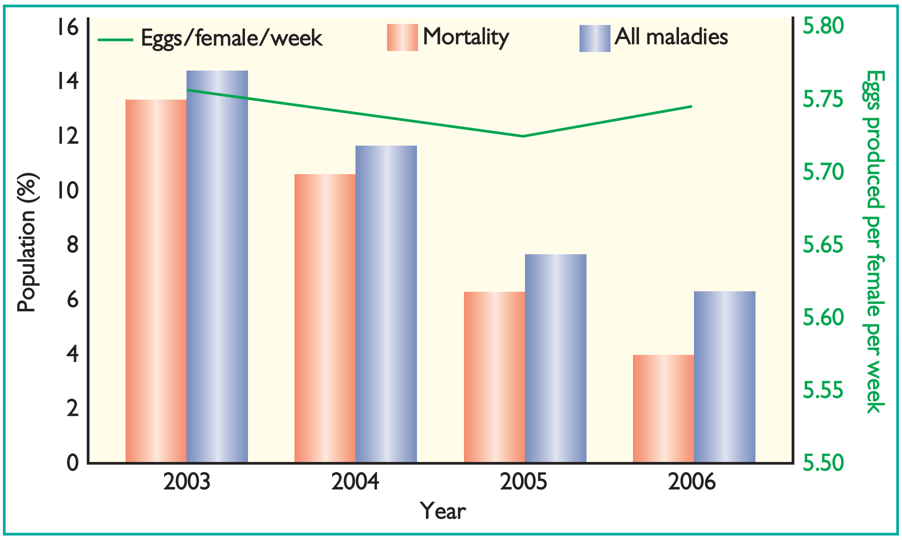

Fig. 2. Percentage incidence of mortality and all recorded abnormalities and maladies within Elite selected flocks at Cherry Valley and commercial reproductive performance.

sider all aspects and ensure an appropriate use of technology to improve the performance, health and welfare of stock.

Genetic improvement is a gradual process and accumulates year on year. In order to ensure the full genetic potential of stock is achieved it is important to ensure that husbandry and management improvements go hand in hand with genetic gains.

Optimal bird performance will only be achieved by an understanding of all aspects of the production chain not just genetics.

Whilst it may seem obvious it is important to note that in order for a duckling to achieve its genetic potential for lean growth it must be supplied with an adequate quantity and quality of essential nutrients.

Ducks are grown around the world in hot, temperate or cold conditions, and in a wide range of agricultural systems, to produce a variety of duck products.

It is, therefore, important that the ducks are fed an appropriate diet correctly balanced for energy, protein, essential amino acids, minerals, vitamins and trace minerals if the bird's genetic potential is to be achieved and its welfare not compromised.

Recent research has provided information on energy and nutrient utilisation in a variety of feed ingredients for ducks.

For ducks it is particularly important that feed is formed into pellets. These should be no more than 3mm in diameter and 10mm in length for ducks up to two to three weeks of age, but can be 4mm in diameter and 15mm long for older birds.

The quality of the final ration offered to the stock depends on the quality of the ingredients and then on the quality of the manufacturing process and the subsequent storage of the feed before and during use.

Heat and humidity will both increase the rate of decline in vitamin levels and other aspects of quality and will encourage mould growth and possible toxin production.

The addition of a mould inhibitor and an antioxidant to the feed will help to prolong its life but in general feed should be used within four weeks of manufacture in temperate climates and within seven days in less favourable conditions where temperature and humidity are high.

Often the forgotten nutrient, the provision of clean drinking water must be non-limiting in order for either broiler or breeder ducks to achieve their genetic potential.

Ducks consume water in much greater quantities than chickens and the result is a highly liquid excreta. Litter condition and effluent disposal should be managed in such a way as to not constrain water intake

The provision of sufficient water to swim or bathe is a more debatable issue as it may improve bird welfare, but in certain cases may be detrimental to overall health and biosecurity.

Another vitally important aspect of achieving optimal duck performance is to ensure the highest possible health status.

Despite the relative robustness of ducks compared to some other poultry species the depression in performance following a disease outbreak can result in severe financial implications for large producers who have invested significant time and money in building a successful business.

For certain notifiable diseases this can be catastrophic with the loss of entire flocks and restriction of bird and even fresh meat movements.

Some of the risk of such disease challenges can be mitigated by improved biosecurity.

The move to indoor production and even SPF shower in 'clean' sites can reduce the risk of disease being spread by wild birds and rodents or being carried onto sites on boots or equipment and such precautions seem sensible in the present disease climate.

Security of supply

The direct affect on the bird is not, however, the only concern. Many East Asian duck producers source their genetic stock from European suppliers, however, in the light of the recent H5N1 avian influenza outbreaks in these countries and the potential threat of this and other diseases limiting the movement of stock around the world, there is understandable concern about the security of supply of breeding birds.

At Cherry Valley we have long been aware of such dangers and in order to ensure security of supply for vital East Asian markets have maintained pure line, GP and parent stock production in the Asia Pacific region for several years.

In addition to these measures, we have also placed GP stock into another European country to ensure availability of high quality stock throughout the world.

These birds are genetically linked to the Elite UK flocks and benefit from genetic gain achieved in the UK. ■

Mitigate the risk of disease challenges with improved biosecurity.