Decades of Welfare and Sustainability Selection at Aviagen

Chickens and Turkeys

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Aviagen has a history of breeding for animal welfare and sustainability spanning 45 years. Since the first systematic inclusion of leg strength evaluation for every animal, a range of other welfare and sustainability traits have been successfully introduced into the broiler breeding programme. Following the acquisition of Nicholas Turkeys and British United Turkeys by Aviagen, the methods developed in broilers have also been implemented to improve the effectiveness of selection for welfare and sustainability traits in turkeys.

In the breeding programmes, the source of the genetic progress comes from a wide range of pedigree lines (Diagram 1) (more than 30 in broilers, over 40 in turkeys; Defra, 2010) where a high selection pressure is applied for a broad range of traits. The individual lines, each with clearly defined selection objectives, are then combined to give parents and finally commercial birds. Aviagen’s diverse product range consists of cross-bred birds, typically made up of four different types of pedigree lines. To go from the very top of the breeding programme, pedigree birds, to the commercial birds, takes approximately four years.

A large amount of data is gathered on a variety of traits for each animal, including information on welfare, health, fitness, reproduction and production efficiency. These data are combined into family indices to assess the genetic merit of each individual. The breeding goals are defined after careful consideration of market requirements and the feedback coming from customers and society in the wide sense. The genetic improvements made in the pedigree lines are disseminated to the rest of the industry through a series of multiplying generations as shown in Diagram 2, where pure lines are combined into a variety of cross-bred products at parent and broiler / commercial turkey level to meet the needs of different markets.

Bird performance is the result of a combination of genetics, stockmanship, housing, nutrition and health. It is only the genetic component, explaining typically 10% to 30% of the variation, that can be utilised to permanently improve a breed. The majority of the variation is explained by the stockmanship, housing, nutrition and health factors. Aviagen provides an extensive range of continually-updated technical and management recommendations to farmers in order to enhance welfare and optimise performance further.

This paper describes the development of welfare and sustainability traits in the Aviagen broiler and turkey breeding programmes. Typical for the Aviagen breeding programmes is that the animals have been raised and selected under group circumstances. In this way group behaviour is integrated into the Aviagen lines in a natural way.
Aviagen’s broiler breeding programme is designed to enhance both efficiency and sustainability of poultry meat production, having a long history of selection for welfare traits (see Diagram 3). Since the early 1970’s, as part of the selection process, any bird with leg problems has been removed, leading to a tremendous improvement of leg health over the last 25 years as shown in Figure 1 for the Ross 308 cross-breed.

Since then, a variety of methods for the selection of new traits have been developed, implemented and continually refined in the breeding programme. The major historical developments are shown in Diagram 3 and are described in more detail in the following section.

In 1989 Aviagen introduced an X-ray device (Lixiscope) as a selection tool. This has allowed the identification of Tibial Dyschondroplasia (or TD) at clinical and sub-clinical level on selection candidates. Birds showing any evidence of TD have been rejected for breeding. Animals that are not used for breeding are processed for meat consumption.

Figure 2 shows the historical reduction in incidence of TD in the Ross 308 cross-breed based on Lixiscope measurement. This shows that the major reduction in the incidence of TD was achieved 10 years ago. In 2008 Aviagen replaced the first generation device (in blue) with an improved version (in green) which gave an even more accurate picture and allowed improved identification of sub-clinical TD, leading to more effective selection pressure against TD. This device is still in use today.

In 1991 Aviagen implemented pulse oximetry, measuring the oxygen saturation level of the blood, which has a direct relationship with heart and lung function. Oxygen saturation level, measured using an oximeter, is an important indicator of susceptibility to develop ascites and sudden death syndromes. Since that time Aviagen has been measuring oximeter values and has selected only those individuals with a family index above the average, thereby reducing the incidence of ascites and sudden death at field level. Figure 3 shows the improvement in oxygen blood levels in the Ross 308 cross-breed and Figure 4 shows the resulting reduction in levels of ascites as measured by the Canadian Food Inspection Agency.

Since 1979 Aviagen has worked with fully pedigreed populations, identifying both male and female parents and all other relatives creating a family tree spanning for over 40 generations. This approach has allowed the identification and rejection of birds expressing particular leg defects. In addition, the exclusion of defect-free individuals originating from families with higher incidences of leg defects has led to enhanced selection for increased leg health. The same principle applies to liveability where individuals are selected from families with above average liveability. This has resulted in significant continuous improvements in liveability through the years.
Aviagen grows pedigree selection candidates in an optimal, biosecure environment that has been free of prophylactic antibiotics use since 1999. This environment allows for the effective selection against heart and lung issues and leg defects.

In 2000 Aviagen introduced a “commercial sibling test” to improve the robustness of the birds by selecting in contrasting environments. The brothers and sisters of selection candidates are grown in a non-biosecure commercial environment assessing gut health, digestive and immune function along with liveability, growth and uniformity (Kapell et al, 2012). The individuals selected using extra sibling testing data to produce the next generations have shown improved family performance in both environments. This multi-environment strategy has made current generations of birds better able to adapt to the wider range of management circumstances they may encounter in the field. This testing of siblings has led to more robust animal populations with higher liveability and better uniformity and continues today. A schematic overview of the multi-environment selection components are displayed in Diagram 4.

In 2004 Aviagen introduced the recording of individual meals during the growing phase for birds housed in large groups (Picture 1). This strategy has provided large amounts of individual feed-intake and behavioural data, a unique source of information which helps to study feeding behaviour and to improve the efficiency of poultry meat production further in a responsible way. The data have shown that there is a significant genetic component in feeding behaviour (Howie et al, 2011). In addition, common patterns of feeding behaviour are conserved across chicken lines with widely varying rates of selection for growth (Howie et al, 2009) and even across chickens, turkeys and ducks (Howie et al, 2010).

During the last ten years the attention in welfare research on contact dermatitis has shifted gradually from hock burn, which was measured and selected against since the 1970’s, to foot pad dermatitis (FPD). Aviagen has been measuring FPD of individual birds since 2006 and started selecting for reduced incidence in 2008 (Kapell et al., 2012).

The most recent investment milestone in further enhancing selection for welfare is the new science of genomics. Genomics offers the possibility of combining information at the DNA level of individual birds with the existing records on the clinical and sub-clinical incidence of all traits related to welfare, hence increasing the accuracy of selection in pedigree populations. Aviagen has started the first inclusion of genomics into its breeding programme using genomic selections in 2012.
Since Aviagen acquired Nicholas Turkeys in 1999 and British United Turkeys Ltd (BUT) in 2005, significant investment has been made in the turkey breeding programme. The technology platform and the pedigree operations have been strengthened to a great extent by taking advantage of the access to shared resources and techniques initially developed for chickens. Selection objectives have been further defined to include a wider range of traits and more sophisticated selection techniques were applied in particular with regards to welfare and sustainability traits.

The turkey breeding programme has a long history of phenotypic selection for leg health, with walking assessment of individual turkeys, and culling for leg defects and poor walking ability since the 1970’s. This had allowed continuous but moderate progress in leg health, in line with the low heritability of leg health traits (10-15% of observed variation explained by genetics).

In 2006, Aviagen Turkeys implemented a multi-trait family genetic selection for a wider range of leg health traits, which includes individual gait scoring (Picture 2) and leg strength assessment. The incidence of leg defects in the BUT 6 at pedigree programme level shows a marked improvement in leg health owing to the increased selection intensity in this important area (Figure 5).

During 2006-2007 Aviagen Turkeys developed feed station technology, recording individual feed intake of the birds using transponder identification. This enables the high throughput capture of quantitative measures of feeding behaviour as well as feed efficiency.

The development of the new generation Lixiscope allowed for the assessment of more dense bone structure, such as that found in juvenile turkey males. Aviagen Turkeys has applied this tool in the breeding programme since 2007. In the breeding programme each pedigree selection candidate is assessed for incidence of TD.

When Aviagen Turkeys selects for leg health both individual as well as family information are taken into account. Any individual showing TD lesions, or with high incidence of TD lesions recorded in the family, are refused for any breeding. This ‘zero-tolerance’ approach has led to a highly significant reduction in TD incidence, going from 30-40% incidence to currently 5-10% incidence, and with further reductions expected (Figure 6).
Aviagen Turkeys have now expanded this technology further and developed ‘water stations’. This enables recording not only feeding but also drinking behaviour of the individual birds on a large scale. The studies indicate a link between higher water to feed ratio and incidence of wet litter. The aim of this combined individual water and feed recording is to be able to target individual birds generating wet litter and to exclude them from breeding populations in the future. This methodology was implemented in selections during 2011.

Wet litter is a primary cause of FPD (FAWC, 2011). Aviagen Turkeys started recording FPD on every pedigree individual in 2008, and included this trait in selections to reduce its incidence. Individual foot pad scoring, in combination with targeted exclusion of individuals creating wet litter is likely to be the most effective genetic means of improving the birds foot pad health for the future.

At Aviagen Turkeys elite pedigree turkeys are reared under good management conditions, which are highly biosecure with no antibiotic growth promoters or the prophylactic use of antibiotics since 1993.

Aviagen Turkeys has implemented a commercial sibling test which follows the same principles of the chicken sibling test explained above, to put further emphasis on health and robustness selection. In chickens, this strategy has led to more robust gut functionality and performance and flock uniformity across a range of management regimes, and is expected to be just as effective in turkeys.

Conclusion
The improvement of welfare and sustainability has been a major focus within Aviagen breeding programmes over the last decades. Balanced breeding goals accompanied with large investments in research and technology have resulted in improvements in liveability, skeletal health, metabolic health and robustness at the same time as improving production performance of Aviagen pedigree chicken and turkey populations. These improvements in the pedigree stock will continue to benefit current and future generations of commercial birds in production environments globally.

Investments in research and development in both chicken and turkey programmes will be maintained, focusing on the implementation of selection tools to achieve the greatest accuracy of selection. Maintaining a broad gene pool and keeping the diversity within and between pedigree populations is also a priority upon which depends the current and future portfolio of relevant poultry cross-breeds. A high-level research and development team comprising personnel with over four decades of bird care and handling and solid scientific foundations is at the core of Aviagen’s long-term strategy.

Aviagen is highly committed to deliver continuous progress on balanced breeding, enhancing welfare, robustness and efficiency of its birds. In line with Aviagen’s long-term tradition, breeding goals will continue to be refined after careful consideration of market requirements and the feedback coming from customers and society in the wide sense. This will ensure that future needs of any market segment can be met in a responsible and holistic way.

References: