

**A Brief History of Broiler Selection:
How Chicken Became a Global Food Phenomenon in 50 Years**

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A \$44 Billion Industry Emerges

Around the world, the broiler industry consumes approximately 417 million parent stock (PS) per year, the equivalent of some 58 billion broilers. The US industry alone now generates over US\$44 billion in annual retail sales, according to the USDA.

Although US-based commercial broiler production started the 1920s, the effort to genetically improve commercial stocks didn't begin in earnest until the 1940s. And it would be another 20 years before independent sales of these birds was common.

Over the years, quality and efficiency efforts have paid off. The inflation-adjusted cost of producing a pound of live chicken dropped from US\$2.32 in 1934 to US\$1.08 in 1960. In 2004, the per-pound cost had dropped to 45 cents, according to the USDA Poultry Yearbook (2006).

Within flocks themselves, genetic selection has largely driven broiler performance, with improvements in nutrition, veterinary science and environmental control also contributing to improved bottom line performance.

Beyond Weight and Growth Rates: Selection Criteria Evolve

In 1945, the American grocer A&P (Atlantic & Pacific Tea Company) organized the first of its "Chicken of Tomorrow" contests. Qualifying trials were conducted in 1946 and 1947 with the national finals held in 1948. For the finals, breeders submitted a case of 30 dozen hatching eggs to an Eastern Shore hatchery, where the eggs were hatched and the offspring fed until they reached market weight and were then slaughtered. Broilers were judged on several factors, including growth rate, feed conversion efficiency, and the amount of meat on breasts and drumsticks. Though held only three times, the contests

enabled breeders such as Peterson, Vantress, Cobb, Hubbard, Pilch and Arbor Acres to become established market brands.

The initial breeders relied only on “mass selection” – or selecting an individual based purely on its own characteristics. And because the original purpose of most birds was to grow large quickly, breeders used weight – by choosing the heaviest males and females— as the primary selection criterion. They also found that weight was moderately heritable, where 20 to 40 percent of the trait was genetically controlled. Though simple, this selection process helped improve broiler breeder performance across the generations.

Market forces have changed selection criteria over the years. A more integrated and consolidated industry learned that weight and growth rates alone could not be the only selection criteria considered. This was particularly true as feed costs rose: Today, feed accounts for between 65 and 70 percent of the input cost for a broiler. As a result, selection for feed efficiency became a must.

As breeders better understood negative correlations between growth and reproductive traits, breeders looking to produce chicks cost effectively, began evaluating such criteria as egg production and hatchability also became increasingly important. With these negative correlations at play in most breeding companies’ selection objectives, mass selection was no longer an effective selection tool and the use of Selection Index theory, where information on family members was taken into account, became the norm.

Changes and Consolidation in the ‘80s and ‘90s

The United States and Europe – the major markets for chicken meat – matured in the ’80s and early ’90s, leading retailers to shift from selling eviscerated carcasses to tray pack, a trend that made components of yield more important than purely whole bird yield. As markets mature further, there is also a shift from tray-pack fresh meat to more further-processed products, with a greater emphasis on breast meat yield in the most developed markets.

Also during this time, the major westernized markets for chicken became increasingly focused on bird welfare and food safety. With the increasingly complex selection objectives required of the breeders, selection programs began incorporating BLUP (Best Linear Unbiased Prediction) selection tools, which weigh individual and family performance while evaluating how traits relate to one another. Some breeders were better than others at incorporating BLUP selection tools. Those variations, the need for high levels of R&D spending and the capital intensive nature of the business prompted consolidation within the primary breeder industry. By the late 2000s only three sizable breeding groups remained: Cobb-Vantress (with the Cobb, Avian, Sasso and Hybro brands), Aviagen (with the Ross, Arbor Acres, Lohmann Indian River and Peterson brands), and Groupe Grimaud (with the Hubbard and Grimaud Frere brands).

Today the history of the industry continues to influence selection criteria, with growth still important throughout most of the world and feed efficiency a high priority. The ability to produce broiler breeders with an economically viable number of eggs and chicks remains important, and becomes increasingly so as companies become more integrated. Meat yield of cuts and the fitness of modern broiler breeder are also crucial to the industry's continued success.

Sustainability Becomes a Priority

Sustainability has become the watchword of the early 21st Century. Increasingly, breeders ask, "Can the breeding program continue to produce purpose-fit birds in the face of increasingly scarce and costly resources?" Accumulations of leg health issues, poor immune responses, high feed intake or high outputs of waste product are today not considered acceptable for a long-term sustainable breeding program, let alone for the birds being bred.

For breeding programs, sustainability and welfare surround four basic issues:

- 1) Does it safeguard human health?
- 2) Does it ensure that the animal is bred with due regard to its health and welfare?
- 3) Does it further the financial success of the customer?

4) Does it improve the long-term sustainability of the industry?

Approaching sustainability in this way is making an impact. According to a UK report, (AC0208, DEFRA, 2008) commercially raised broilers have the lowest green house gas (GHG) emissions per kg of meat produced of all the meat-producing livestock species. Genetic selection of broilers over the last 20 years has led to this success, and has resulted in about a 25 percent reduction of GHG emissions. The authors of the UK report predict these reductions will continue for approximately the next two decades. Commercial geneticists would consider this a very conservative estimate given the pace of technological development. Selection targets for efficiency, especially in feed conversion ratio and meat yield, have driven this reduction. At the same time there has been a reduction in the wholesale price of high-quality, healthy animal protein to the customer.

Sustainability efforts have also led to significant improvements in animal welfare. Though discussion persists about physical ailments and about the physiological health impact of commercial selection processes on broilers, the truth is that problems like these were far more prevalent in the 1980s. Twenty years of continued focus on animal welfare, using advances in genetic technologies, and medical tools to improve selection techniques, has reduced the incidence of these issues to very low levels within effectively managed commercial production facilities.

While effective measurement of the reduction of these concerns is difficult, large datasets results, like those available from the Canadian Meat Inspection Service, indicate dramatic improvements in the underlying genetic strength of modern broilers to these issues. However, the rate of improvements seen cannot be attributed to genetic selection alone, but also to the improvements in effective poultry management practices that directly contribute to the overall performance of the individual birds.

Around the world, primary breeders continue to pursue research and development initiatives designed to address additional welfare and sustainability concerns. Breeders

respond to emerging trends as swiftly as they can. However, due to the multiplication structure of the industry, there is a genetic lag of approximately five years from when an issue is first addressed to the first effects of these selections can be observed in the field. At first, improvements are often incremental, but they act like compound interest to create dramatic change over time.

For example, foot pad condition is currently perceived as one of the primary metrics of welfare in the newly released European Broiler Directive. Selection methods to both improve foot pad quality and to reduce the incidence of contributors to this condition have been underway for some years. However, due to genetic lag, producers still must make special efforts to manage birds effectively to improve paw condition while the genetic improvements progress through the generational pyramid.

Global Awareness and Future Trends

In New Zealand and Australia, much like Europe and other developed markets, primary breeders are working to improve absolute bird performance by leveraging the latest insights into environmental control, veterinary medicine and nutrition. The most successful are able to select pedigree individuals under close to ideal conditions. Indeed, the New Zealand poultry industry leads the world in many areas of broiler production with the highest growth rates and best feed efficiency. This is partly due to the lack of endemic poultry diseases in the country, but also to those producers' persistent attention to detail in all areas of poultry management.

Industry experts have long discussed the possibility of hitting biological barriers to improved performance. But due to the high levels of variation in the chicken genome, these have yet to materialize. Some theorize that Feed Conversion Ratios of less than 1:1 are possible, and New Zealand is making strong headway to determine if this can be achieved on a commercial scale. Since many body components of the chicken have yet to benefit from direct selection, further tailoring of selection lines to suit novel markets for the future remains a real possibility.

While per capita consumption of chicken is generally highest in the developed West, absolute volumes of chicken production are shifting to more emerging markets, with Asia seeing the fastest growth rates. As energy and feed costs remain high and as the cost of land and other resources increase, it is likely that many commercially produced chickens will continue to be grown under less than ideal conditions for the foreseeable future. In fact, even in developed markets, rising costs have recently squeezed margins so much that some end users have opted to loosen previously strict nutritional and management practices, simply to stay in business. This makes it even more crucial for emerging genetic technologies, and the study of populations under sub-optimal conditions, to lead to the development of selection strategies that result in healthy, high-performance individuals – particularly for poultry raised under widely varying production strategies in force throughout the world.

The Role of Genomics

With the publication of the full chicken genome (Nature, Dec. 2004), the industry is a step closer to incorporating genomic technologies into commercial poultry breeding programs. Today, all the current primary breeding groups are investing heavily in genomics research. For the foreseeable future, these research efforts will most likely focus on understanding the function and effect of genes already present in the breeding population. Research into such areas as transgenics—removing genes or artificially moving genes from one individual or species to another—have fewer prospects in gaining favor among consumers.

Whatever breeders learn from their genomic studies, they will surely be used to more efficiently and effectively select for traits of economic importance. The traits that will benefit the most from these technologies are likely to be the ones for sustainability, as these are traits often difficult to measure in a traditional breeding structure.

After 50 Years, A Global Impact

In developed nations like the United States, the percentage of household income spent on food can be as low as 7.4 percent. But in less developed countries like India and the Philippines, more than half of household income is devoted to food.

The improvement of chicken production efficiency over the last 50 years, coupled with many other agricultural advances, has helped bring high quality, low fat animal protein within reach of all but the very poorest of individuals worldwide. The next few years will see the kind of advances in genetics and in optimization of broiler production that will finally bring chicken within every budget.