

# **Knowledge Transfer and Innovation to reduce Mortality and improve Welfare of the birds as well as improve Feed Efficiency and Profit of the chicken meat industry – A Case Study**

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## Background

Population growth forecasts predict a world population of 9 Billion by 2050. Expanding middle classes in China, India, Africa and elsewhere are demanding more meat in their diet from animals which have to be fed from limited land areas, many of which will be threatened by climate change. So the challenge to the meat industry is to produce more meat from fewer resources, which means that big improvements in Feed Conversion Efficiencies from all livestock species will be required. Chicken meat production is currently one of the most efficient with farm FCRs of 1.585 having already been achieved on a 5-house site in the UK. But there is wide variation from farm to farm. A system is required to reduce this variation nearer to the best as well as to set new standards for the best, most efficient producers.

## The Knowledge

- 1) Farm wisdom. Father's poultry farm and Kent Farm Institute (1948-49)  
Simple truths were learnt such as a) Time spent watching animals is never wasted. b) Animals in your care rely on you. c) Look after your animals and they will look after you. d) Avoid sudden movements – make all changes gradual e) No breakfast 'til your animals have been fed. f) Most important: Keep an edge on your animals' appetites.
- 2) London and Cambridge Universities (1950-54)  
Professor MM Cooper - Scientific method: (i) Observation – classification – theory. (ii) Experiment to verify, modify or abandon theory. (iii) Observation and analysis of results. (iv) New or modified theory - Go to (ii)  
Sir John Hammond – Phases of growth (i) Brain and nervous system (ii) Bone (iii) Lean (iv) Fat. He showed how body composition could be altered by plane of nutrition. Over feeding leads to fatness. Fat needs more energy to produce. Lean meat needs less energy so lean growth produces better FCR.  
Sir RA Fisher – Father of Agriculture Statistics (i) Population statistics - Normal Distribution – Standard Deviation (ii) Least significant difference – P values (iii) Optimal farm trial designs. (iv) Advanced mathematical techniques.
- 3) Royal Engineers and Army Emergency Reserve (1954-77)  
Battle Planning. Situation Appraisal (i) Clear definition of Objectives (ii) Strengths and weaknesses (iii) Enemy and friendly forces (iv) Evaluation of alternative options (v) There is ALWAYS a way!!
- 4) Unilever Animal Nutritionist and Senior Manager (1961-88)  
Daily nutrient intake determines performance. Two routes to manipulate this (i) diet composition (ii) feed intake. Growth modelling e.g. EFG model (Emmans, Fisher and Gous). Population nutrition. The Robert Curnow equation. Advanced computer programs: minimise costs, maximise output and optimise cost/benefit and Return on Investment. Lighting programs to enhance immune systems, better health and lower mortality. Poultry food marketing activity.
- 5) FLOCKMAN company (1988 to date)
  - (i) MAFF Link project (LK0612 1998) Integrated Management Systems for Poultry Production. Showed how feedback from bird data can be used to grow birds along a realistic pre-determined growth curve.
  - (ii) Fowl Digestive Physiology (KJ Hill 1968) showed the importance of active crops and gizzards in avian digestion.
  - (iii) History of chicken meat production shows how feeding systems changed on intensification of production from meal-time and whole grain feeding to ad-lib with "complete" feeds, with the loss of crop and gizzard activity.
  - (iv) (Forbes (2003) review paper on wet feeding of poultry showed that feeding of standard broiler feed that had been soaked for 2 hours at a porridge like consistency, but at the same dry matter intake of control birds, led to substantial improvements in feed efficiency. He compared the similarity to force feeding of ducks to produce *pâté de foie gras*, where the optimal liquid feed fed was of a creamy consistency. However, the mix ratio of broiler feed to water to produce the optimal consistency varied dependent on the water holding capacity of the dry feed.
  - (v) Observations of the crop contents of birds fed meals and not ad-lib, showed they contained feed of optimal consistency. A theory was deduced that mealtime feeding might also produce substantial improvements in FCR.

The Transfer A simple system was conceptualised to feed broilers in large commercial houses several meals a day dependent on the numbers of birds involved, their age, strain and sex. Also their stocking density based on the number of birds per feed pan. As one has to use whatever feed is normal, a mechanism was needed to manipulate nutrient intake by feed intake control, using feedback from the birds themselves. It was decided to have the same number of dark periods per day as feeding periods and to deliver the feed during those dark periods so as to ensure that each pan had adequate feed in it before the feeding period started. Over a time period, the lights would be gradually taken from completely out to fully on in order to simulate dawn so as to avoid birds all trying to eat at the same time. Observation inside the chicken house showed that, provided they had been trained from an early age, the birds realise that if they wait their turn, they will all get a full crop of feed. The natural dominance hierarchy or peck order ensures orderly feeding. Firstly the dominant birds feed and rapidly fill their crops in 5 to 10 minutes, then leave to rest, so allowing the

next most dominant birds to feed. The result was that even the smallest birds at the bottom of the peck order get a full crop. On ad-lib feeding, recessive birds often encountered more dominant birds, which chase them away from the feed pan. So these smaller birds now grow faster. Once the required feed has been fed, the equipment disables the feed lane augers so that no more feed is delivered before the next feed period. The pans then soon run out of feed and remain empty for an hour or two before the lights start to dim down to simulate dusk. This means that the larger birds, which often become too fat and suffer from clogged arteries resulting in heart attacks, flip-over and Sudden Death Syndrome in ad-lib conditions, can not now do so. So their leg problems and mortality decrease. FCR is also improved because the birds are leaner. All birds' FCR is also better because the porridge like nature of their crop contents enhances digestibility (Forbes 2003). There are lighting programmes that fully comply with ACP recommended standards.

**Field trials** Over a dozen farmers and integrators have co-operated in product development involving millions of birds. All trials have used the paired comparison technique to enhance statistical precision. Each pair of houses was on the same farm, of the same size and with the same climate control system, the same type of pan feeders and drinkers and the same farm manager. They were stocked on the same day with equal numbers of the same breed and as far as possible the same parent stock. At random, one house had the new equipment installed. The following trial in 2008 involved 9 pairs of houses each of minimum 25,000 birds totalling 0.5 million birds. In all cases, whole wheat was used ensuring active gizzards. Liveweight, feed consumed, mortality parameters and factory weight and weight of feed used (together with their costs), were recorded. Statistical analysis of the performance difference between the new system and the control house within a pair was carried out using the t-test. Financial parameters were analysed in the same way.

**Results** Birds on the new system had significantly less mortality, faster growth and better feed efficiency as measured by both Feed Conversion Ratio and European Performance Efficiency Factor (Table 1). Birds on the new system were visually cleaner and more active but no statistics are available. Financial parameters were also examined statistically. Participating growers were unwilling for the margin of bird value minus feed cost on the controls or the new system to be revealed. However they agreed to the difference between bird value and feed cost between controls and the new system to be published. The average benefit over all nine comparisons was 3.79 pence per bird and £1,083 per house. The p value was 0.002 and the 95% confidence limits were 2.59 to 4.98 pence per bird and £798 to £1,368 per house.

Table 1 Effects of the new system on performance

Parameter	New System	Control	Benefit	p value	95% confidence limits	
					Lower	Higher
Mortality	3.27%	4.28%	1.01%	0.0053	0.50%	1.52%
Liveweight	2057 g	2003 g	55 g	0.0010	30 g	80 g
FCR	1.642	1.696	0.053	0.00028	0.033	0.73
EPEF	331.9	311.4	20.5	0.00006	14.3	26.6

**Note.** There were no farm interactions as all of the paired comparison differences lay within the normal distribution.

**Conclusions** Results show that the new system significantly improved bird performance and profitability. Confidence limits show a 97.5% probability that the new system improved mortality by a minimum of 0.5% and FCR by a minimum of 0.033. Extra margin over feed cost increased by a minimum of £798 per house of 25,000 birds per crop. With 6-7 crops of broilers per year, this represents a satisfactory return on capital. Less feed intake also lowers scarce water and energy use and the carbon footprint of the meat produced. Subsequent to the above trial, feedback from farmers and the chicken was needed to improve and fine-tune the system to cater for different stocking densities and methods of production involving several enhancements to the software. This involved more observations of bird behaviour in the chicken house when subject to various imposed feed control strategies.

#### Practical application

A major UK broiler integrator has done its own separate verification trials and has produced results similar to those reported. In addition, an integrator in Thailand has also reported similar results although they used curtained open sided houses and the feed contained no whole cereal. In January of this year an agreement was reached with another company to handle the marketing and sales of the new equipment in the UK and world-wide. This has resulted in equipment being installed in South Africa. There is also interest from Brazil and China. To date, 175 systems have been manufactured in the UK.

#### References

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