

Feeding The Bird Of Tomorrow, Today

Genetics: Nutrition Interaction

Genetics: Nutrition Interaction was the theme for the second Watt Summit Conference held at the University of Georgia, Athens, USA and attended by more than 150 international scientists and technologists representing 22 countries in North and South America, Europe and Asia.



Dr Roger Crum, Pioneer Hi-Bred Inc; Dr Steven Leeson, University of Guelph.



Paul Cohen, CWT Farms; Dr Fred Hanley, Jamaica Broilers and Vera Scharrer, CIPA SA, Colombia.



A group of delegates from South America including: Dr Mario Penz, Rafael Montoya, Colombia; Dr Norma Avila, Colombia and Dr Nestor Tello, Super Pollo, USA.



Dr Poo Chin Chew and Dr Yuk Kwaun Kwan from Gold Coin, Singapore.

Feeding The Bird Of Tomorrow, Today Genetics: Nutrition Interaction

Setting The Scene

“What do we really know about the nutrient requirements of broilers?”

Dr Park W. Waldroup, University of Arkansas, USA.

“One of the most commonly-uttered statements regarding poultry nutrition is that ‘we know more about the nutrient requirements of chickens than any other



Dr Park Waldroup - “With all the information we have, why are there still gaps in our knowledge?”

animal, including man.’ Certainly those who have been involved in poultry research have every reason to be proud of the accomplishments that have been made in this area. Another similar statement is ‘Chickens are considered to be the best-fed animal in the world.’ I believe that both statements are true, in that we probably do know more about the chicken’s requirements, and we probably do feed them better, but I would also

say without hesitation that we are woefully lacking a considerable amount of information and knowledge that would allow us to formulate diets and feed our poultry more efficiently and effectively.

“It has been my privilege (and penance) to have served on the last two Poultry Nutrition subcommittees of the Committee on Animal Nutrition of the National Research Council. This assignment should probably be made mandatory for all persons involved in poultry nutrition, especially at the onset of their professional careers. Serving on this committee makes one painfully aware of the limited body of information in the scientific literature that specifically relates to the establishment of a nutrient requirement in some form or another. In addition, it points out that much of the information on which present-day recommendations are based upon is extremely old and outdated; vitamin requirements are a classic example. A close observation of any of the nutrient requirement tables in the 9th edition (NRC, 1994) reveals that many of the values are presented in bold italic form, indicating that experimental data to support that particular recommendation are lacking.”

Dr Waldroup recalled that in his professional career, he had come across an article (Hammond, 1967) published in one of the American Feed Manufacturer’s Association (now American Feed Industries Association) semiannual proceedings that made a great impression on him. This article was written by Dr John C. Hammond, an industry nutritionist who served as chairman of the AFMA Nutrition Council in 1952. Dr Hammond gathered suggestions from several eminent poultry nutritionists including H.J. Almquist, H.R. Bird, G.F. Combs, J.C. Fritz, K.H. Maddy, R.F. Miller, T.D. Runnels and E.P. Singesen. Dr Hammond outlined a number of areas in which, in his words, “voids and uncertainties” existed in our knowledge of poultry nutrition. In looking over this list of topics almost 30 years later, he was somewhat dismayed to see that much of what Dr Hammond listed as a gap in our knowledge then probably still exists today.

“With all the information we have, why are there still gaps in our knowledge,” asked Dr Waldroup. “The perception that we know everything about poultry nutrition has impacted badly on research funding with the result that poultry gets short shrift. The low cost of many nutrients and vitamins has minimised the demand for research in some areas. If vitamins cost ten times more, I’m sure it would be different. A great deal of pressure is being directed towards ‘bird-free’ work. The number of research workers is decreasing, hardly anybody is left doing work on turkeys, for example. There has been a strong trend in recent years towards supporting biotechnology. Many other researchers have had to go out and scramble for whatever support they can get,” he concluded.

Broiler Genetics: Genetic x Nutrition Interactions
Dr H.L. Marks, University of Georgia, USA.

Selection for increased bodyweights and/or rate of gain dramatically changes the pattern of growth in domestic animal species. Intense selection for increased bodyweight in both chickens and Japanese quail results in changes in relative growth rate patterns of selected lines when compared to non-selected controls. When gain is expressed as percentage change in bodyweight (relative growth rate), the greatest differences in gain between selected and non-selected lines occurs during the first week post hatch. Both changes in growth rate and pattern must be

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Speakers in the opening session (left to right) Dr Peter Hunton, Dr Henry Marks, Dr Jerry Weigel and Dr Park Waldroup.

accompanied by nutritional alterations. The question, "Does genetic selection for growth result in a change in nutritional requirement?" is of concern in view of major genetic changes accompanying selection in domestic animal species (i.e. broilers, swine). The study of genetic variability in nutrient requirement is often initiated by comparing breeds, and also by comparing selected lines fed two or more diets varying in one or a whole group of nutrients.

Although there is clear evidence that genetic variation exists for nutritional requirements in domestic animal species, the questions of their importance remain elusive. If genetic selection for increased rate of growth or bodyweight has changed nutrient requirements, it appears that any changes have been minor. However, because the majority of studies designed to investigate genetic differences in nutrient requirements have been conducted with stocks selected for bodyweight, it is risky to make generalised statements that nutrient requirements of broilers have not been changed by selection. For example, if selection is conducted for changes in yield or breast size instead of bodyweight, nutrient requirements may be altered because demands may differ between selection traits. Selection for different traits may redirect "resource allocations" in a manner that could result in genetic differences in nutrient requirements between "yield", and "bodyweight" broiler stocks.

There is good evidence of "adaptive" selection behaviour following long-term selection, in that populations selected under a given environment have superior bodyweight to other populations when reared under their respective selection environment. In general, populations selected long-term under optimum

nutritional conditions have little ability to tolerate less than optimum environments, whereas populations selected under lower nutritional levels show little response when provided higher nutritional levels.

Because selection for increased bodyweight is closely related to feed intake, it appears that increases in feed intake and the favourable relationship between bodyweight and feed efficiency allow more rapid growth in populations selected for bodyweight without necessitating a change in the nutrient composition of the diet.

Nature vs Nurture in the Egg Industry: Genetics and Nutrition

Dr Peter Hunton, Ontario Egg Producers Marketing Board, Canada.

How do we define "genotype - environment interaction"? Sheridan (1990) states that it is "used to describe situations where different genotypes respond differently to different environments." Falconer (1960 in the "bible" for population geneticists of my generation, defined it as "a change in the order of merit of a series of genotypes when measured under different environments."

In our particular context, we are especially interested in those interactions involving genetics and nutrition. However many other aspects of environment may impact on environment in the broadest sense.

Selective breeding and development work undertaken by layer type breeders is most often undertaken in an environment quite distinct from that to which commercial layers are exposed. Pedigree breeding, measurements and selection, are often done in single-bird cages, under minimal disease conditions, with optimum nutrition aimed at maximum expression of economic traits. There are good reasons for this: breeders need to know which individuals, families and lines have the best potential performance under these conditions. Furthermore, subsequent generations may have to meet rigid specifications of disease-freedom in some countries, or risk being denied access to important markets.

But commercial conditions are often anything but "disease-free" and involve high density management, and nutrition based on least-cost formulations or even least-cost per unit output, which may be far from those conditions present at the breeder-farm level. Of course, breeders test commercial generation stock in commercial environments, but there is always the chance that some marginal nutritional or other

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circumstances may not be tested, and that some birds in the population may respond adversely to it.

In the past three decades, considerable progress has been made in improving feed conversion efficiency in layers. Initially, this was accomplished mainly by selecting for lower bodyweight, thus reducing the maintenance requirement for energy and other nutrients. Some progress may also have resulted from earlier sexual maturity. The influence of this on feed efficiency per se may not be too important, but on a lifetime basis, earlier maturity would improve it. (Table 1)

Table 1: Changes in output efficiency of commercial layers over three decades

	1963-1995		
	Egg	Mass/Ave body	Weight
	1963(1)	1978(2)	1995(3)
Babcock	6.4	7.2	10.8
Dekalb	7.0	8.2	11.3
H & N	6.7	8.2	10.2
Hy-Line	6.9	n/a	10.9
Shaver	6.4	8.5	10.1

Sources:

1. 1963 USDA Two Year RST Combined Summary
2. 1978 USDA Two Year RAT Combined Summary
3. 1995 Breeder Specifications

More recently, selection has been directed at specific traits affecting feed efficiency, once the practical obstacle of measuring individual feed intake was addressed. I suspect that not all breeders use the same selection criteria however, even though all may be assessing feed intake for individual birds. The choices would be at least between selecting directly for feed efficiency itself, and the so-called "residual feed intake", calculated as the feed consumed in excess of that calculated to be required for known egg output and bodyweight gain. While both strategies will result in improved feed efficiency, they may also result in small differences in the birds' responses to marginal deficiencies in nutrients.

The words "small differences" are significant. Only highly competitive genotypes have survived the past few decades of erosion of primary breeder numbers. If genotype x nutrition interactions are present, they are most likely overshadowed by other variations in temperatures as well as major changes in feed ingredient prices.

The perspective of the genetics - environment story changes depending on your place in the industry hierarchy. We can rest assured that while differences may exist between strains in their responses to variations in nutritional treatments, these differences are

not large. The variation in production parameters resulting from other environmental factors will far outweigh them.

The Protein and Energy Market

Dr Jerry Weigel, ADM Bioproducts.

Considering first the situation as it stood in early May, Dr Weigel said there was a strong demand and low stockpiles of corn, "in a word, a 'hurt' on stockpiles," was how he put it. Export demand from the USA had grown by about 60% over the last 20 years. New markets had opened up, for example in Canada, Mexico, Japan and now China.

"While China has historically been a net exporter of corn, it was now an importer. The demand from a growing Chinese market could have a huge potential impact on world trade."

In the US, 1996 plantings of corn were up by 12%. Soybeans were down in acreage but the wheat crop was in a devastating situation because of the poor weather in several key areas. Already, by the end of April, more than one million acres had been ploughed in because of crop failure.

Dr Weigel looked at the impact of the new Farm Bill (FAIR Act of 1996) in the USA. There is no more set-aside, just about all the acreage released has already been put down to corn. "The new Bill has finally taken the government out of production agriculture," he commented. But most of the content of this Act was to do with environmental impact rather than directly with agricultural production. "And in any case," he continued, "a lot of the former set-aside land was of low production potential. Farmers were not going to put their best land into set-aside so we cannot expect normal crop yields from this land now it has been brought back into cultivation."

Turning to the factors affecting demand for protein and energy sources, Dr Weigel said that rising consumer income in developing areas was resulting in better eating habits and increased per capita food consumption. Government aid programmes to developing countries was providing the necessary finance for import purchasing through various loan schemes. The prevailing attitude in this respect seemed to be, "if they want to pay us back, that's fine, if they can't, well, that's fine, too."

The world's population is growing rapidly, currently by plus 2.4 babies per second. In India alone, he said, population growth is around one million a month: their growth rate now outpacing China.

We may expect to see some change in the make-up of exports to developing countries from food raw materials like corn and soya more into the form of

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value-added pig- and poultrymeat products.

As far as production this year was concerned, the weather was critical. Serious delays in planting due to persistent rain will affect the corn 1996 corn and wheat harvest. Other factors including "stress" and "emotion" will also have an effect. In general, the outlook looks favourable for oilseeds but not so good for cereals.

Dr Weigel then reviewed the situation with regard to possible alternative feed raw material sources to corn. Wheat, as he had already stated, was a poor prospect because of the weather problems and crop failures. Grain sorghums were generally of poor nutritional quality and there was little prospect for supplies of feeding barley. Poultry feed grade, low gossypol content, cottonseed meals were now becoming available and were in great demand but the situation for rapeseed or canola meal was generally "unfriendly". Sunflower seed meal was not really suitable for broiler rations because of its high fibre content. If wheat availability and quality were going to be poor then wheat co-products will suffer the same problem. As for corn co-products, only two came into consideration and of

these, interest was mainly in corn gluten meal from ethanol production. More of this product would become available within the US instead of being exported. Demand for fats and oils would continue to remain strong. Synthetic amino acids were also expensive.

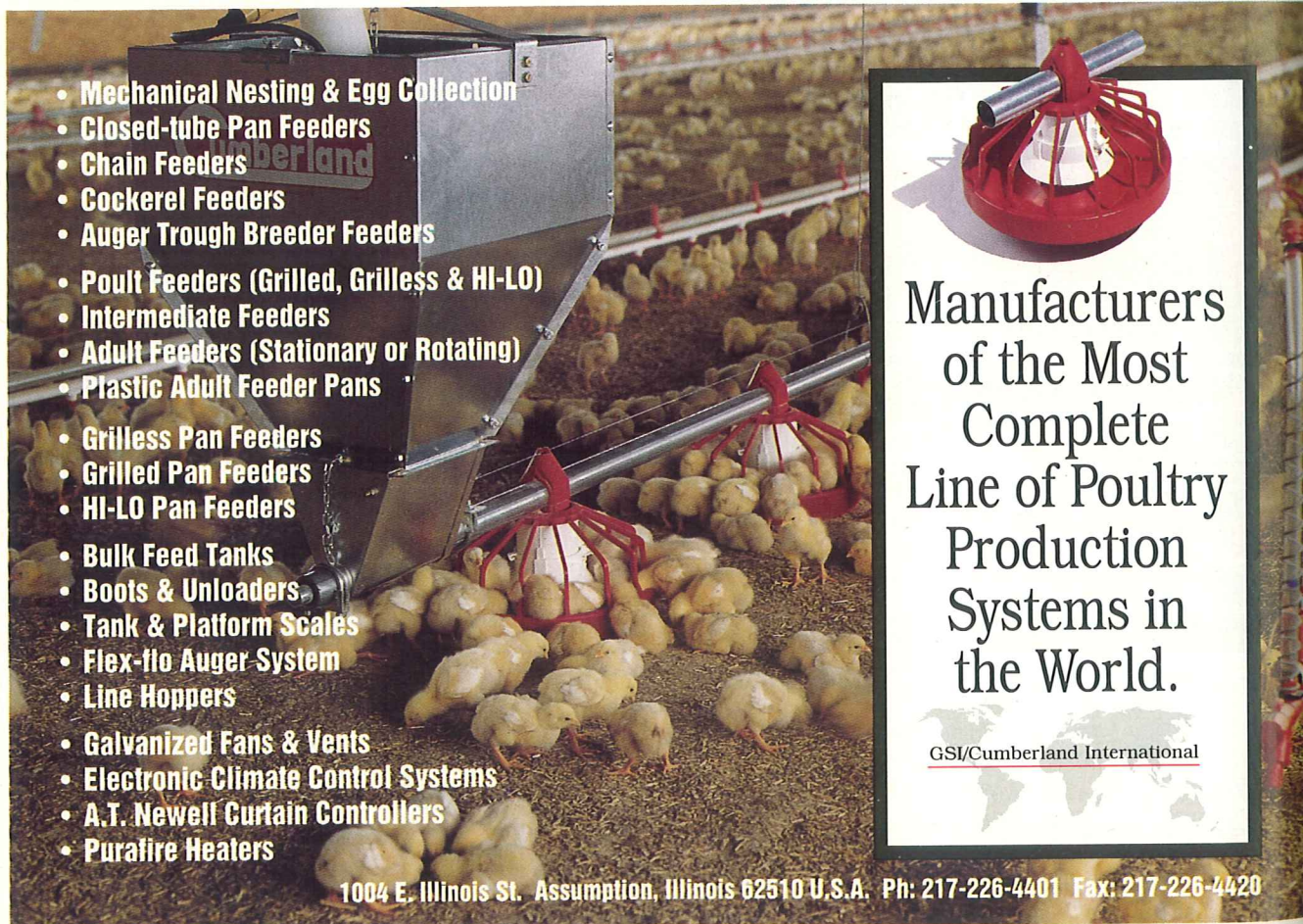
Looking into his crystal ball for 1996, Dr Weigel said, "Watch the weather. If we plant 83 million acres and if we get 125 bushels/acre then the new seasons crop could be priced in the range \$2.80-2.85/bushel. But if not, then we could be facing prices of \$5.80-6.00 for corn.

"This is a real possibility. Watch the weather and watch out for the strong impact of what happens with the wheat crop.

"For soybeans, the prospects look good, but what happens to prices depends a lot on world trade developments. Soybean meal prices could be around \$240/ton but could go as high as \$270-280. And there are other factors to be taken into account, too. Not least, the cost of transportation."

In conclusion, Dr Weigel urged "you better go out and breed chickens in a hurry - but ones you can raise without corn."

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