Adjusting Nutrient Density when Faced with Volatile Markets

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Introduction

The profitability of broiler production, expressed in its simplest form, is the value of the end product minus the input costs to produce that product. The end product can be live birds, eviscerated whole carcasses, portioned meat products, or value added chicken products.

The value of the end product will be directly affected by supply and demand in the meat industries. Generally, the return from portioned products is greater than from whole birds, but this is greatly dependant upon local market requirements.

Feed is the major component of input cost, normally accounting for up to 70% of the total production cost. For this reason, any review of input costs and profitability will include a review of feed costs as a primary component of the exercise. With feed representing the largest proportion of cost of poultry production, choosing nutrient levels can have a huge impact on cost, but more importantly on profitability. It is the responsibility of the nutritionist to decide on nutrient levels that will not only optimize biological performance but also that will maximize profitability.

When faced with increases in feed ingredient prices and rising feed costs, it is often a first instinct to look at ways of off-setting the financial impact upon the business by reducing the nutrient specification of the feed to reduce feed cost per ton. However, before such action is taken, it is important to evaluate the full impact of such a decision upon margin over feeding cost. The desire to minimize feed cost per ton needs to be balanced against maintaining or maximizing margin.

USA Industry Trends

Over the last decade, the average annual improvement in broiler growth rate to 42 days made by primary breeding companies has been about 50-60g or one day of growth per year. During this same period, white meat yield has increased 3.0%-3.5% on average. In addition, the amount of feed required to grow to market weight with extra meat yield has decreased. Simply put, the genetic potential of today's broilers means that they grow faster with more muscle development, but consume less feed per unit of gain. Because amino acids are required to grow muscle protein, it is reasonable to infer that there would be a change in the dietary requirements for these modern broilers.

A look at USA industry trends since 2001 shows how dietary nutrient density has been adjusted to account for changes in genetic potential and other market factors. Figure 1 shows the trends since 2001 in energy and protein density of the diet of birds grown to weights less than 2.35 kg (source: Agristats). Figure 2 shows the same information for birds grown to weights above 3.40 kg. The data represents weighted averages of the nutrient levels across the entire grow out period (eg. {starter intake x starter ME} + {grower intake x grower ME} +… etc)

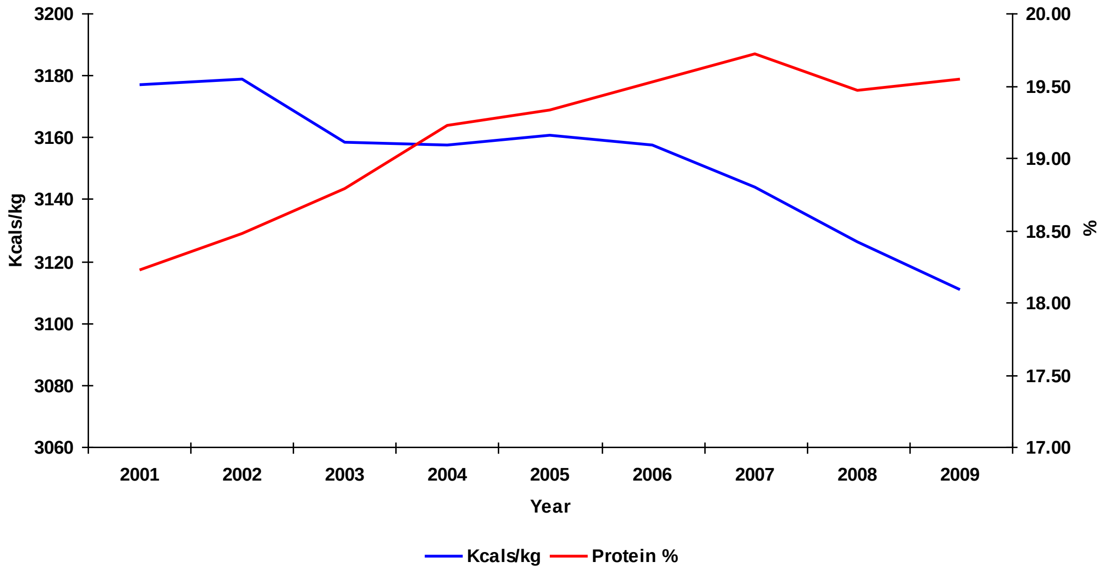

Figure 1. Metabolizable energy and protein trends in US feeds for birds grown to weights less than 2.35 kg from 2001 to 2009 (source: Agristats)

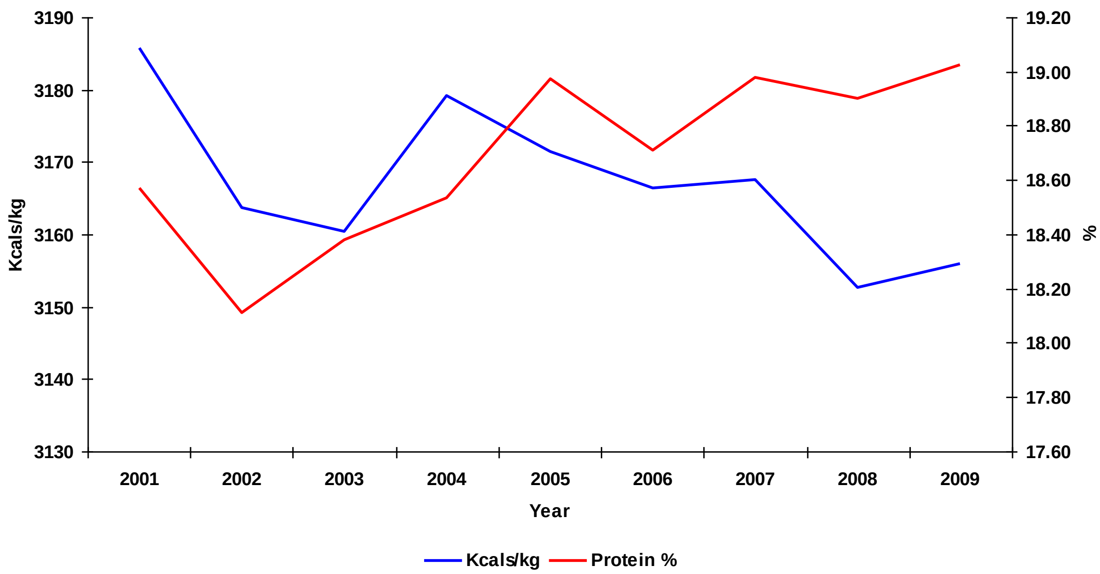

Figure 2. Metabolizable energy and protein trends in US feeds for birds grown to weights greater than 3.40 kg from 2001 to 2009 (source: Agristats)

From the data presented in figures 1 and 2 it is clear that energy density has generally followed a gradual decline in both small and big bird operations, while protein levels have tended to increase in both cases. In 2008, energy density was lower than at any other point since 2001. This coincides with periods of extremely high corn and fat source prices.

Aviagen publishes nutrient density recommendations for diets fed to broilers in the starter, grower and finisher period (Table 1), with the comment that the nutrient levels need to be adjusted to maximize profitability under local conditions. The ideal energy and amino acid levels will depend on the raw material prices as well as product mix and prices for any particular operation.

Table 1. Aviagen Energy and Amino Acid Recommendations for Broilers

		Starter	Grower	Finisher 1	Finisher 2
Age Fed	Days	0 - 10	11 - 24	25 - 42	43 - slaughter
Energy	Kcal/kg	3025	3150	3200	3225
Digestible Lysine	%	1.27	1.10	0.94	0.89
Digestible Met + Cys	%	0.94	0.84	0.73	0.69
Digestible Threonine	%	0.83	0.73	0.63	0.60

Nutrient Density in Volatile Markets

Over the last 18-24 months commodity prices have not only shown marked increases but have also become more volatile. Figures 3, 4 and 5 show the prices of corn, soybean meal and soybean oil respectively. Notice the radical fluctuations in price of each of these three commodities over the last 18 months.

Figure 3. Corn prices (US$ per bushel) from February 2008 until July 2009 (source Chicago Board of Trade)

Figure 4. Soybean meal prices (US$ per ton) from February 2008 until July 2009 (source Chicago Board of Trade)

Figure 5. Soybean oil prices (US cents per pound) from February 2008 until July 2009 (source: Chicago Board of Trade)

It is not only the prices of feed ingredients that fluctuate. The prices of whole carcasses, breasts, thighs and wings also vary quite markedly at times. Clearly the nutritionist has a multitude of variables to take into account when deciding on energy and amino acid levels for his feeds.

Alterations in energy and amino acid density will affect not only performance but also have an impact on profitability. With such volatility in the factors that affect profitability (raw material prices, meat prices etc) it is very difficult to make the right decision on nutrient density. In many cases nutritionists resort to their intuition to make such decisions. So for example, when feed prices rise, it is often intuitive to reduce nutrient density in order to control feed costs. However, while this approach may reduce costs in the short term, it may have a detrimental effect on profitability. Some nutritionists have developed tools of their own to aid in the decision making process within their companies. However, in most cases these decisions are based on intuition.

When looking to minimize feed cost, it is important to appreciate the effect on margin. The diagram below (Figure 6) shows that as nutrient level increases, feed cost increases. However, due to improved bird performance the revenue from the birds also increases, and therefore margin over feeding cost is improved. The maximum margin is clearly not produced by minimizing feed cost (indicated by red circle), but is achieved at the point where the difference between revenue and cost is greatest. This zone of maximum profitability is illustrated below.

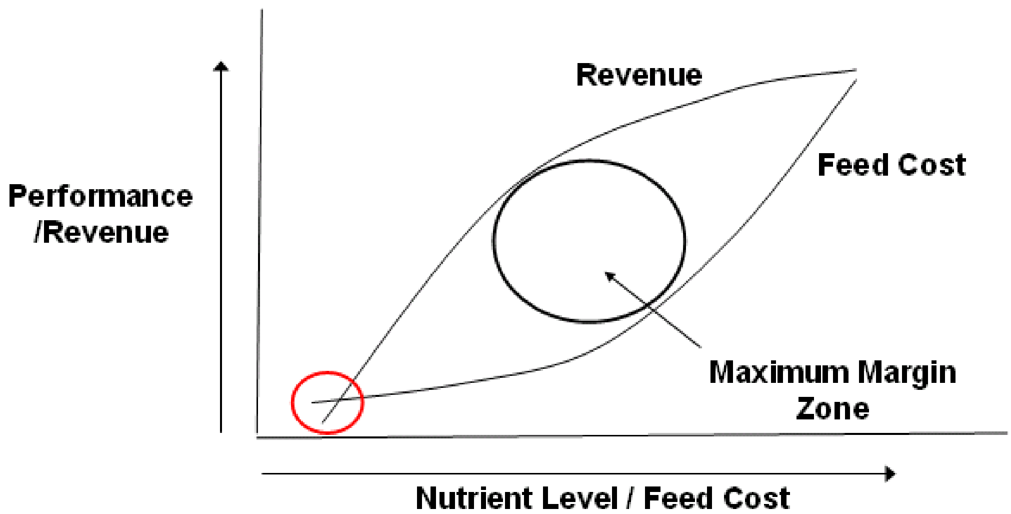

Figure 6. Diagram illustrating the effects of nutrient density on feed cost, performance/revenue and margin over feed cost.

The producer should aim to feed the bird to ensure margin is in the maximum zone in the diagram above. To do this, maintaining or increasing dietary nutrient density will often be justified. Lowest feed cost does not necessarily produce maximum margin

It is very important to make a distinction between reducing feed cost per bird and reducing feed cost per kilogram of live weight or carcass component(s). By reducing nutrient density of the feed, the feed cost per bird can very easily be reduced. However, this will reduce performance and when corrected back to equal live weight will often actually result in increased cost of production.

The amino acid density of the feed will have a major influence on margin achieved and profitability. However, balanced protein is only one of the two main components of the nutritional package and energy also needs to be considered. With regard to energy sources, it has become clear that growth of the biofuels industry has resulted in feed energy prices becoming more affected by oil prices than conventional commodities markets. With an increase in the use of cereals and feed fats for the biofuels sector, and firm oil prices, energy will likely continue to be relatively expensive.

The question thus becomes, "What nutritional program is best for my company's overall profitability?"

Aviagen broiler nutrition research has been focused on answering this question, always keeping in mind the economic factors involved as well as bird health and welfare. A multitude of studies have been conducted to determine the impact of energy and amino acid density on live and processed yield results.

Modeling Approach

In order to address nutrient density decisions when faced with volatile markets Aviagen has developed a bio-economic model called BEEP (Broiler Economics for Energy and Protein). The model contains pooled data from 11 trials conducted within the last 3 years in various regions of the world. Each of the trials examined the effects on broiler performance of dietary ME and amino acid density. In each of the trials the ideal protein concept was applied and amino acids were kept in the ratios shown in table 2.

Table 2. Aviagen amino acids ratios

Digestible Amino Acid	Starter Feed	Grower Feed	Finisher Feed
Lysine	100	100	100
Methionine + Cystine	74	76	78
Methionine	37	38	39
Threonine	65	66	67
Valine	75	76	77
Isoleucine	67	68	69
Arginine	103	104	105
Tryptophan	16	16	16

A variety of energy and amino acid levels were tested always using Aviagen's recommended levels (Table 1) as a reference (100%). Table 3 shows the range of energy and digestible lysine levels tested in each diet.

Table 3. Range of dietary ME and amino acid density (expressed as digestible lysine) tested in Aviagen nutritional trials

Diet and Ages Fed	Dietary ME (kcals/kg)		Digestible Lysine (%)	
	Min	Max	Min	Max
Starter (0-10 days)	2723	3276	0.89	1.65
Grower (11-24 days)	2761	3308	0.77	1.43
Finisher 1 (25-42 days)	2802	3360	0.62	1.26
Finisher 2 (43-slaughter)	2903	3386	0.58	1.13

The first step in the model is to clearly define the biological response of the broilers to both ME and amino acid density. A stepwise regression analysis is used for this purpose and each performance parameter can be expressed graphically as shown in Figures 7, 8 and 9.

Figure 7 shows the body weight of straight run broilers in response to changes in dietary energy and amino acid levels. The ME and digestible lysine levels depicted in the graphs represent weighted averages for the entire grow out (eg. {starter intake x starter ME} + {grower intake x grower ME} +… etc). It is clear that response to amino acid density is very significant for body weight (Figure 7), FCR (Figure 8) and breast yield (Figure 9). FCR is the parameter most affected by dietary ME (Figure 8). The affect of ME on body weight (Figure 7) and breast yield (Figure 9) is not as great as that of amino acid density.

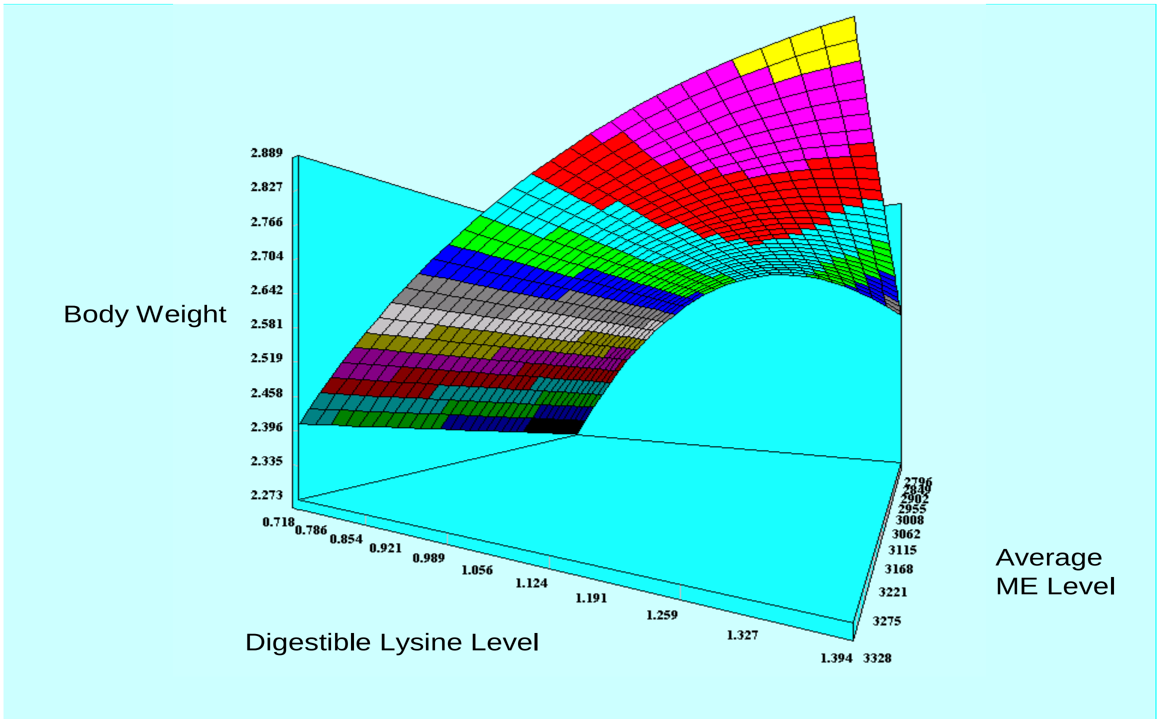

Figure 7. Surface plot showing the body weight of straight run broilers in response to varying levels of dietary metabolizable energy and amino acid density (expressed here as digestible lysine level)

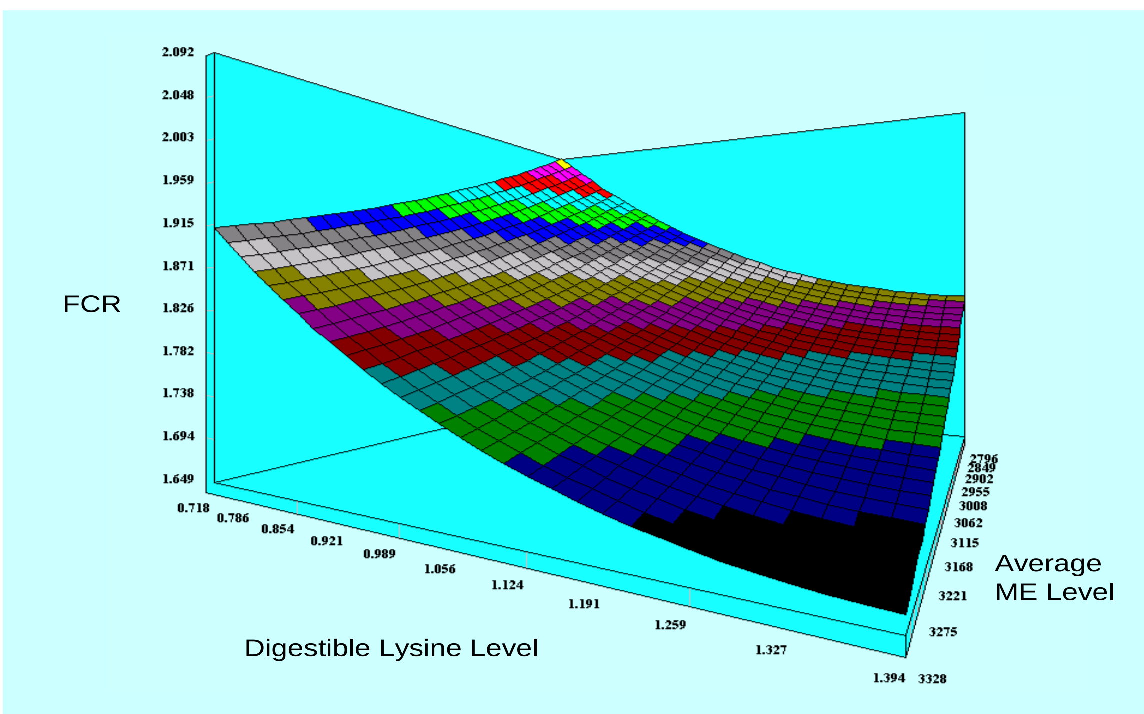

Figure 8. Surface plot showing the FCR of broilers between 1.8 and 2.4 kg in response to varying levels of dietary metabolizable energy and amino acid density (expressed here as digestible lysine level)

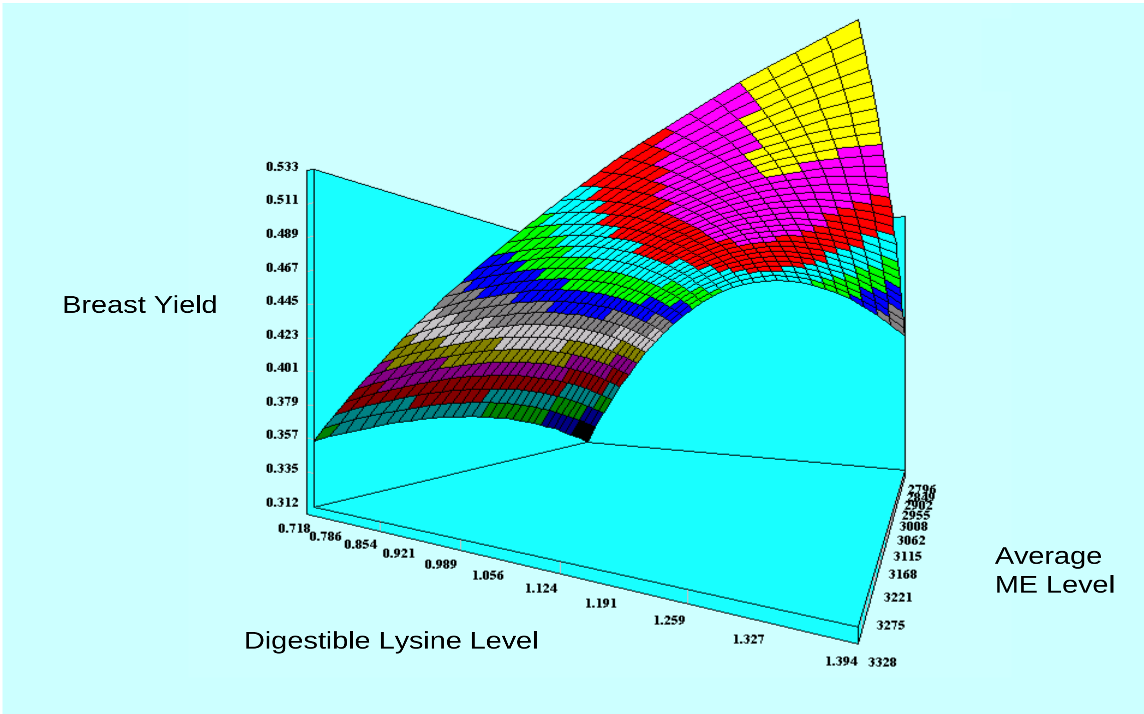

Figure 9. Surface plot showing the breast weight of straight run broilers in response to varying levels of dietary metabolizable energy and amino acid density (expressed here as digestible lysine level)

Similar graphs can be derived for mortality, eviscerated carcass yield, wing, thigh and drum yield. Once the biological responses have been clearly defined some basic economic calculations can be made. These basic calculations require knowledge of the input cost (feed costs), the biological response to those inputs and the value of the outputs (live bird prices, whole carcass prices or portions prices). The result is a value representing margin over feed cost for each possible scenario.

The model offers the user the flexibility to vary feed prices as well as prices of all potential products (live birds, carcasses etc). Once the feed price, product prices and product mix have been specified the model will provide the user with an ME and digestible lysine level that will optimize margin over feed cost under their conditions. The model relies entirely on the pooled data from the 11 trials conducted over the last 3 years. As new trials are run they are added to the database.

Dietary energy and amino acid levels recommended by BEEP can be compared to the user's current levels. Rather than changing immediately to the levels the model is suggesting, it may be sensible to make smaller incremental changes in the direction the model suggests. This will give the producer the opportunity to evaluate the effectiveness of the changes.

Figure 10 is an example of one of the outputs of the model. The following scenario was evaluated:

- Average feed price: $280/ton
- Boneless skinless breast price: $3.66/kg

- Thigh price: $2.68/kg
- Drum price: $1.42/kg
- Wing price: $3.00/kg
- Product mix: 100% deboned

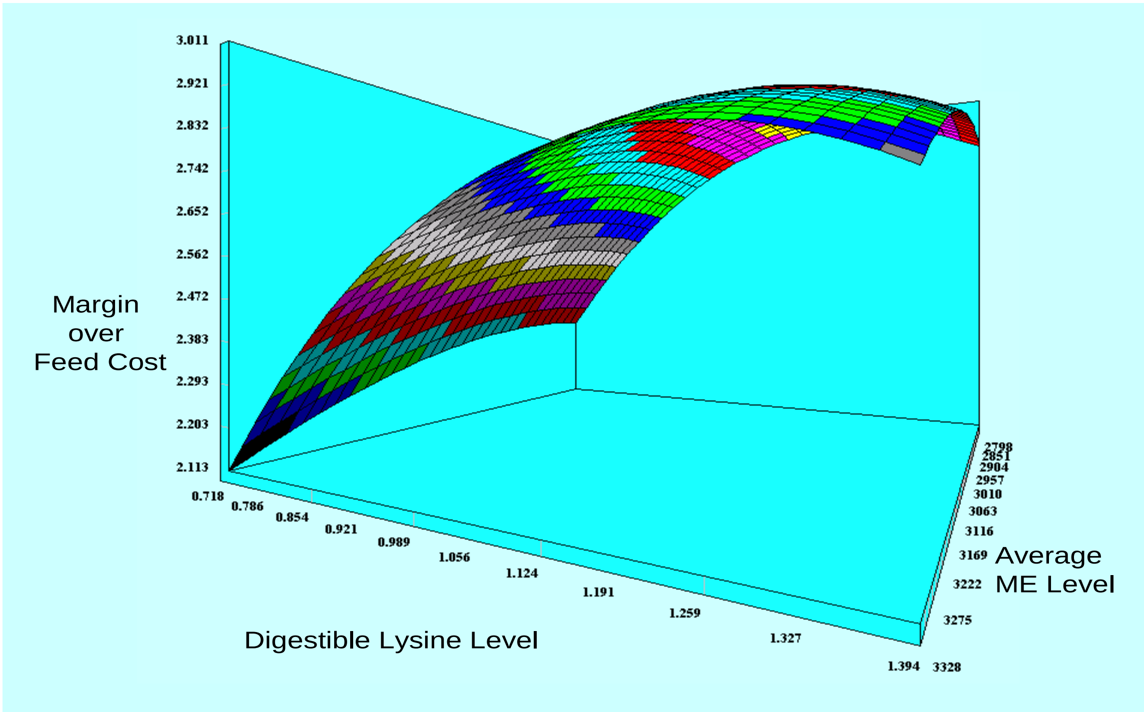

Figure 10. Surface plot showing the effect of varying ME and amino acid levels on margin over feed cost for deboned birds under a specific set of market conditions (average feed price: $280/ton; boneless breast price: $3.68/kg; thighs: $2.68/kg;drums: $1.42/kg; wings: $3.00/kg)

The graph shows that optimum margin is obtained at an ME level of approximately 3020 kcals/kg and a digestible lysine level of 1.20%. Any possible combination of prices, product mixes and feed costs can be entered. For example, if the feed price from the scenario above was increased by 25% and all the product prices were reduced by 25% the ME and digestible lysine levels to optimize margins would be 3050 kcals/kg and 1.14% respectively.

The scenario above represents a producer selling deboned product. What about those selling whole carcasses? From the scenario above with feed prices of $280/ton, if a producer was selling whole carcasses at $1.96/kg the optimal ME level would be close to 3075 kcals/kg and the optimal digestible lysine level would be close to 1.10%. The lower recommended lysine levels and higher recommended energy levels are indicative of the product mix. With whole carcasses being the product, FCR becomes more important than white meat yield for example. This is evident in the model's recommendations.

A further feature of BEEP is its capacity to conduct a parametric analysis to show how optimum energy and amino acid density changes as feed prices vary. The model is also able to offer an indication of what would happen to both performance and margins if ME or amino acid levels were to be changed. All of these features allow the nutritionist not only to make the right decisions but also to understand the potential impact of wrong decisions.

These are just a few examples of an infinite set of possible market scenarios. Without a tool such as BEEP it would be incredibly difficult to react appropriately every time market conditions change. With a tool such as this we are able to exploit our understanding of basic biological responses and economics to make information-based decisions rather than intuition-based decisions. It is clear that the appropriate nutritional strategy is a function of input costs and the value of outputs. The ideal nutritional strategy is a moving target and feeding programs should be reviewed regularly to ensure we remain close to this target.

Feeding for the future

Breeding companies use very complex programs to select the best bird for future performance. It takes four years before the current pedigree birds produce the commercial broiler. Therefore genetic companies spend a lot of effort in anticipating future developments in management, nutrition and broiler performance. The improved breeder and broiler performance will change the future nutritional responses and therefore influence the nutritional strategy that maximizes profitability. This emphasizes the importance for poultry producers and nutritionists to explore the genetic potential of the continuously improving modern breeder and broiler and tailor specifications accordingly. It also represents one more factor that a nutritionist must account for when formulating. With changing market places and constant genetic progress tools such as BEEP help nutritionists make more informed decisions for maximum profitability.