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Review Article

CONCEPTS IN VARIOUS POULTRY FEEDING PROCEDURES AND METHODS FOR OPTIMAL PRODUCTION: A REVIEW

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Abstract: The global poultry industry is facing severe economic pressure due to high prices of feed ingredients. The producers must push to make maximal use of the feed. In several markets, producers are heavily pressured to reduce the use of antibiotics and are facing increasing consumer demands for high quality, safe, welfare-friendly meat. These challenges force every link in the production chain to retune how we rear animals in terms of nutrition, management and product use. The present paper summarizes approaches to fine-tune the nutritional concept. Dietary specifications have to be reevaluated and phase feeding concepts optimized in order to maximize margin over feeding cost. If alternative ingredients are available at the right price they offer an interesting approach to reduce feeding cost. However, particularly when using alternative ingredients and reducing the dependency on antibiotics, intestinal health must become a key focus. Optimizing protein digestibility can help to minimize the intestinal problems. In addition, mycotoxin contamination must be dealt with and novel feed additives and feed ingredients considered.

Keywords: Feed Cost, Broilers, Hatching, DDGS, Protein Digestibility.

INTRODUCTION

In the poultry industry feed accounts for 65-70% of the total cost of production. So the operations have to target for optimizing feed efficiency and reducing feed cost and work daily towards the target. The sharp rise in the cost of conventional feedstuffs in general, and soybean meal in particular has forced producers to refocus on what they spend on feeding, to raise efficiency targets and to go the extra mile for converting feed protein more efficiently into lean gain. The feed ingredient prices have gone down these days, however prices are expected to stay high and keep rising in the long term. There is no doubt that extra efforts are needed to optimize the use of feed in order to stay in business for the long run. Another matter of concern is the heavy consumer demand to reduce the use of antibiotics and

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production of a high quality, safe, welfare-friendly meat and eggs. To meet these above challenges it is required to consider every step in the production chain regarding rearing of livestock and poultry in terms of nutrition, management and product use, simultaneously focusing on market demands. For maintaining sustainability of a production system, ecological and social aspects have major role. However, in the current scenario, sustainability of poultry production is primarily threatened by not achieving the economic results which a farm or a production system needs for longer term survival. There is no shortcut or single method or change can alone bring about the improvement in nutritional efficiency needed. It is therefore necessary to reevaluate and fine-tune established nutritional concepts.

The objective of a defined feeding management programme is to supply a range of balanced diets that satisfy the nutrient requirements at all stages of development & that optimize efficiency and profitability without compromising bird welfare or the environment.

DIFFERENT METHODS

Adapting dietary specifications for maximal net profit

The first critical point to verify and reflect on is dietary specifications. The level of energy, protein and amino acids needed for different stage of production is given importance. The specification must not solely aim to keep feed cost low or to maximize animal performance rather they must aim to yield maximum profit from the whole system. As feeding cost is a major production issue, this is the area for maximal net profit. In a consistent production system accurate data on bird performance and carcass value are needed to tune up the system.

Feeding as close as possible to meet the requirement

The cost of safety margins and formulation inaccuracies is increased by increased ingredient prices. The current cost for protein sources is forcing producers to minimize safety margins. Accurate knowledge of the quality and nutrient content of raw materials is essential in order to keep safety margins low and, at the same time, avoid the risk of under-formulation.

Proper phase feeding is the current approach for feeding close to requirements and set specifications as the requirement changes throughout the production cycle. The current market situation might make it interesting to add an extra feed in the phase feeding program, i.e. to go from two to three or from three to four diets throughout the growth of the animals. However, the logistical cost for an additional feed and its storage has to be weighed carefully against any gains from feeding precision. Depending on the feeding system it might be worth looking at precision feeding by changing the ratio of a starter diet (being adapted to the requirements for the first day of the grower phase) and the finisher diet (being adapted to the

requirement for the day before slaughter). With this approach, amino acid supply will exactly follow the change in requirement with no over- or undersupply at any time during the growing cycle. Liquid feeding systems or spot mix systems lend themselves well to this approach.

In order to closely meet protein and amino acid requirements of laying hens it is essential to have precise data on feed intake. The protein requirement of a healthy laying hen primarily depends on her body weight and production needs. However, energy intake is considerably affected by environmental temperature and locomotion.

Use of alternative ingredients

High soy prices make alternative ingredients more attractive. However, their availability is limited. When partially replacing soy bean meal, DGGS and rape seed meal, both by-products of the biofuel industry are of particular interest. However, their protein digestibility is lower compared to soy and can be more variable. Therefore, all formulations with alternative ingredients must be based on digestible amino acids. Formulations based on digestible protein and amino acids should be applied as standard in all diet formulations anyway. If operations are still formulating based on total amino acids, the inclusion of alternative ingredients is a good reason to adapt the system and modernize the approach to formulation.

DGGS in particular poses a relatively high risk for mycotoxin contamination, thus raw material quality has to be controlled carefully. A comprehensive review on the use of DDGS in poultry has recently been published in World's Poultry Science Journal (Salim et al. 2010). The authors concluded that high quality DDGS can be fed to broilers, laying hens and turkeys without adverse effect on growth and performance. However, in order to maintain the consistency of DDGS quality from batch to batch, they recommended obtaining DDGS from a specific processing plant. For swine, Stein and Shurson (2009) have reviewed the literature and concluded that DDGS can be an excellent source of energy and digestible P in diets fed to swine at all production phases. Nutrient concentration and digestibility vary among sources, and accurate in vitro methods need to be developed to predict amino acid digestibility. Acceptable growth performance can be achieved by adding up to 30% DDGS in diets fed to grower-finisher pigs. Thus DDGS, when available at the right price and quality, can help to maximize margins over feed cost. Since the levels of glucosinolates have been reduced in rape through genetic selection, rape seed meal or other by-products from the plant oil industry are potentially good protein sources for animals. Maximum levels of inclusion for monogastrics vary depending on the source of information, however most are in the range of 5 to 15%, although in diets for young animals, only low levels should be incorporated.

Maximizing diet digestibility

Taking measures to maximize diet digestibility in general, and protein digestibility in particular is important for several reasons. Firstly, high digestibility means a high amount of absorbed nutrients and thus efficient use of the feed. Secondly, high digestibility will reduce nutrient excretion and thus lessen the environmental impact from the livestock production system. Thirdly, high ileal digestibility will reduce the flow of protein to the lower digestive tract. This decreased flow of undigested protein can improve the gut environment and impact on intestinal health and immune defenses. In poultry diets, high protein concentrations have been shown to favor the proliferation of potential pathogens such as *Clostridium perfringens* (Drew et al., 2004). High protein concentrations will also lead to increased uric acid in the excreta, which is known to be linked to higher litter moisture, and hence hock, feet and breast lesions. Many different factors such as diet composition, quality of ingredients, diet processing and enzyme use affect diet digestibility. Grinding (particle size) and thermal treatment are the two key issues in the feed manufacturing process that impact diet digestibility. Pelleting and other thermal treatments can improve diet digestibility. In times of high feeding cost any increment in improved digestibility is worth more money and thus the

economic impact of thermal treatment is larger in today's market with high ingredient cost. Particle size and overall feed structure is another factor to review and optimize. Research shows beneficial effects of whole wheat feeding on diet digestibility and production efficiency in broilers. The use of whole wheat has been shown to increase gizzard weight, and feeding 10% to 20% whole wheat can increase ME and amino acid digestibility (Biggs and Parsons, 2009). Whole wheat feeding is quite common in northern Europe. However, in the other parts of the world this approach still offers significant potential. The concept is particularly interesting for poultry farms that also produce wheat or farms which can buy wheat directly off the field from neighbor farms. Digestive enhancers such as enzymes must be applied to their full potential. The final utility per unit used will decrease with higher inclusion levels; however, at high ingredient cost, higher inclusion levels can be justified. When feeding precisely on the requirement, it is likely more economical to assign a nutrient value to the enzymes and to reformulate the diet than to add the enzyme on top of an already formulated diet.

Maximizing overall performance and intestinal health

Poor animal health is the most important factor that affects the efficient use of feed in commercial production systems. A recent study by Riklin and Hartmann (in press) shows that many farms have considerable room to improve management practices in order to optimize animal health, performance and welfare. Maximal overall animal and intestinal health can only be achieved when housing, biosecurity, health management, nutrition and host defense are at its best. Many factors which have already been discussed can positively impact intestinal heath. Dietary specifications, ingredient choice, measures to maximize diet digestibility or to control the negative impact of mycotoxins can all contribute to better intestinal health. In addition, specific feed ingredients or feed additives can give vital extra increments of improvements. Their efficacy can be challenged when exposing animals under controlled conditions to disease.

New approaches for feeding poultry

The pressure to reduce broiler feeding costs is constant, since it represents approximately 70% of the total production cost. To obtain better precision in the formulation of broiler diets, it is necessary to know the exact composition and energy value of each ingredient, as well as their limitations. Several studies have been carried out to update the nutritional values of feedstuffs traditionally utilized in the formulation of diets for poultry, and also to determine the nutritional value of new feedstuffs and byproducts, which make the composition tables

more complete and accurate (Waller,A.2007). In addition to enabling the development and qualification of technicians, graduate students, and professors/scientists, the days. Noy & Sklan (2000) determined that chicks subjected to a 48-hour fasting period after hatch most body weight. However, the small intestine grew 60% in chicks fasting and 200% in chicks receiving feed.

Early Posthatch Feeding (From Hatching to Housing)

The incubation period of broiler chicks is 21 days. However, this time may vary in function of several factors, such as egg storage time and temperature; temperature and relative humidity in the incubator; genetic strain and age of the breeder hen, etc. In addition to staying for an extended period of time inside the hatcher, chicks are also classified, vaccinated, sexed and placed in chick trays for transportation. Preferably, after placed in the trays, the chicks will be taken to the farm on the same day; however, it is not uncommon to find cases where the chicks spend the night in the hatchery to be delivered the following day. Because of the long post-hatch holding period, studies aiming at supplying feed to the chick still in the hatchery or in the transport trays have been carried out, in order to reduce weight loss and increase the bird's growth performance. Experiments have been conducted at Federal University of Viçosa with the objective of evaluating the utilization of special diets in the transport tray. Toledo (2011) investigated the effect of fasting versus a diet (crumbled or mini pellets + 20% water) in the transport tray. The chicks remained in the trays for 20 hours to simulate the transport from the hatchery to the broiler house. The supply of an early post hatch diet promoted not only smaller weight loss for the chicks that remained in the trays for 36 hours, but also the weight gain at 42 days was statistically similar to the Broilers promptly housed and fed after hatch.

Composition of feedstuffs: metabolizable energy

Weight gain was not affected by the dietary levels of the amino acids; however, feed conversion and uniformity improved linearly. The energy content of the feedstuffs is the most important factor to be considered when feeding broilers. The formulation of poultry diets based on the metabolizable energy (ME) started in the 1960s replacing productive energy. According to Hill and Anderson (1958), the productive energy values of the ingredients were very difficult to determine and quite variable. Thus, the metabolizable energy of feedstuffs started to be used to express the amount of energy available in the feedstuff, because it was relatively simple to determine, and with low variation. Currently, there are prediction equations that allow the calculation of the ME of ingredients, according to the nutrient

content of each sample. Rostagno *et al*. (2011) published equations to estimate the energy of feedstuffs for broiler chickens and laying hens, which can be used to correct and adjust the energy levels of ingredients by the nutritionists in the feed industry.

Composition of feedstuffs: amino acids

Amino acids are the basic units of protein, and are critically important in poultry nutrition. Amino acids are used for many functions in the organism, but there is one that predominates over the others: protein synthesis. The knowledge of the exact amino acid content of the ingredients, allows for more precision in the formulation of diets. Precisely providing the minimum amino acid requirements avoids excess of protein in the diet, and reduces the impact in the environment. It must be emphasized that the reduction of 1% of protein in the diet results in 8 to 10% less nitrogen excreted, which also decreases the levels of ammonia in the air. Review of 14 experiments with different lysine levels for broiler chickens, allowed concluding that lysine affects first, linearly, and second, quadratically the feed conversion ratio. Considering only the linear effect, the reduction of 0.10% digestible lysine, below the requirement, will increase feed conversion in 3.2%. If the lysine level in the diet is adequate (at requirement level), the increase in lysine does not result in improvement of feed conversion.

Available phosphorus equivalency of phytases:

There is an increased demand for inorganic phosphorus (P) by agricultural and livestock systems, and production is expected to peak around 2030.Phosphorus is the most expensive mineral in poultry diets, and has been the subject of many studies, because of the environmental impact caused by the excretion of non-digested P(Cordell, D. et al., 2009). Phytases have received special attention, because this enzyme breaks the phytate molecule, making available not only P, but also other nutrients bound to phytic acid. However, in the literature, different reported responses to phytase supplementation are found, which evidences the multiple factors that can affect such response; such as the amount of phytase added to the diet, the phytate level, dietary Ca and inorganic P contents, additives and vitamin D (Selle and Ravindran, 2007;Singh, 2008).

Summary

Early posthatch feeding of a special diet in the transport tray increases broiler performance. Adding Glutamine or Glutamine-Glutamic Acid in the diet improves the uniformity of broiler chickens. Part of the variation in animal performance is caused by the lack of adjustment of the feedstuff composition matrix. The quality control of feedstuffs allows formulation of

more efficient and economical Diets. Equations have been developed to determine the equivalence in available phosphorus of different levels of 3-Phytase and 6-Phytase. The use of equations to estimate nutrient requirement enables determination of nutritional requirements, according to performance and feed intake of broiler chickens. The lysine and methionine + cystine requirements can be higher to maximize lean meat yield than for optimum feed conversion.

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