

FEED MANAGEMENT AS A PARADIGM FOR PROFITABLE POULTRY ENTERPRISE

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ABSTRACT

The purpose of this review is to provide information about feed management methods for poultry profitability. Generally, feed management in simple terms, is the management of nutrients for different stages of livestock production and purposes with no wastage and balanced diet feeding consideration. Restricted feeding gained momentum in growing birds for energy and protein intake maintenance. Phase feeding enhanced profit maximization concerning its application in conventional egg production. Alternative ingredients like industrial by-products, insects, earthworms and tree/shrub leave in feed formulation as being researched to reduce the human food/animal feed competition on grains and other important variable ingredients. Egg quality is improved by dietary manipulation to attract prime market prices. Improper feed management is consequential with poultry vices and physiological imbalances such as cannibalism, fatty liver and kidney syndrome (FLKS), fatty liver haemorrhagic syndrome (FLHS), cage layer fatigue, bone break and salt poisoning which pose loss to the poultry farmer.

Keywords: Poultry production, Feed management, Profitability, Agribusiness

INTRODUCTION

The chicken industry is one of the most dynamic components of the world agrarian business (Oyedemi *et al.*, 2007) with vast demand for their products due to their social acceptability. Generally, Livestock production constitutes an essential part of the agricultural economy of Nigeria which the country hosts more than 45 % of the poultry business in the West African sub-region (Aminu and Hermanns, 2021). Aminu and Hermanns (2021) also reported that broiler meat production as well as the vast chicken industry provides employment and regular income for entrepreneurs through its value chain activities. Having a short production cycle, low production cost and product prices, ready market, and high feed-meat conversion

ratio as their crucial features (OECD/FAO, 2021). This guaranteed reasonable returns on the investment in broiler meat production; it has to be produced at the least cost since net profit is associated with gross return and production (Adeyonu and Odozi, 2022). These with other important features made the broiler industry to be one of the most promising agribusinesses that contributes to the eradication of poverty and food security of any nation (Awad *et al.*, 2015). However, the sole objective of an enterprise is to make profits. In poultry enterprise feed and feeding management is an important factor of production. Feed accounts to the major cost of poultry (meat and eggs) production, ranging from 65 – 80% under the intensive system of production. A larger percentage of an ingredient used in feed

formulation is of both human and animal relevancies. This brought about great competition between human foods and animal feed leading to a hike in the price of ingredients and also reduced availability (Mengesha, 2012). To reduce the high cost of feeding especially in poultry, this study reviewed different techniques of feed and feeding management.

Feed restriction, limited feeding, and adoption of alternative feed ingredients as been reported as important tools of feed and feeding management for profitability in the poultry business (Hassan *et al.*, 2003). Diet and feeding manipulation improves productivity (egg and meat production). However, feed and feeding methods also have a consequence of reduced egg production, small egg size, reduced shell quality, reduced growth, excess fat storage, overfeeding, and a high mortality rate in poultry husbandry. Oyediji *et al.* (2007) reviewed limited feeding to reduce the rearing costs in which birds often give yields in the laying period in terms of egg size, more sustained laying ability, and lower mortality. Also, prevents over-consumption of energy ingredient particles which predispose birds to abdominal fat and heat stress.

Furthermore, studies have reported feeding and body temperature of chickens to influence reproductive performances, for instance, combs and wattles development respond to lower body temperature in birds, while the weights of reproductive organs (ovaries and oviducts) were found to be lower with low hatching percentage and fertility in chickens exposed to high temperatures (Ozcelik *et al.*, 2006; Blahova *et al.*, 2007; Chen *et al.*, 2007).

MATERIALS AND METHODS

A systematic search of published articles in Google Scholar and Science Direct databases was conducted using the following sentence feed management methods and poultry profitability. The results of the search were analysed and presented in text and tables.

RESULTS AND DISCUSSION

Feeding Management of Poultry Birds:

Starter feed is fed to newly hatched chicks during brooding. Starter diets are formulated to give proper nutrition to fast-growing chicks. Chicks need a ration that can provide the nutrients needed to meet their nutrient requirements for growth and development. Chick rations are relatively high in crude protein, energy content, and the vitamins and minerals required for growth and development. After brooding, the grower feed is used in place of the starter feed up to a certain stage. The grower feed can be replaced with a finisher or layers mash depending on the purpose of keeping the birds, either for meat or egg production. The typical chicks' starter and grower diets are presented in Table 1.

Table 1: Nutrient composition of chicks and grower mash

Ingredient	Chick (kg)	Grower (kg)
Maize	45	48
Soya	34	25
Wheat offal	13.10	08
Palm kernel cake	-	25
Bone meal	3	04
Fish meal	-	-
Oyster shell	4.2	07
Lysine	0.1	0.2
Methionine	0.1	0.2
Premix	0.25	-
Grower premix	-	0.25
Salt	0.25	0.4
Percentage energy	2650 ME Kcal	2500 ME Kcal
Percentage crude protein	20%	15%

Source: Fakolade (2015)

In egg production, feeding management for pullets aimed at maintaining growth rate that would lead the pullets to reach sexual maturity at the desired age and weight and to avoid obesity. Grower ration has lower energy and protein levels than chick starter rations (Olomu and Offiong, 1980). Occasionally, a pre-lay ration with an increased calcium level is recommended for feeding 2 – 3 weeks before the bird begins to lay eggs.

When the chicks are fully feathered their level of energy requirements are reduced because they can control their body temperature.

Feed Management Practices: Feed management is managing the number of nutrients fed to the poultry for their intended purpose. This involves the development of diets that supply the number of available nutrients required by the poultry for maintenance, production, performance, and reproduction. Supplying nutrients in excess of an animal's requirement results in additional nutrients being excreted. In many circumstances, confined poultry operations find themselves under a whole-farm nutrient imbalance. In this scenario, more nutrients are being imported on the farm than are being exported from the farm or utilized by current cropping rotations. As a result, soil saturation with various nutrients, especially phosphorus (P), or excess losses of nitrogen (N), can have a deleterious impact on the environment through runoff, soil erosion, and leaching. Phosphorus losses from soil emptying into surrounding freshwater bodies can lead to eutrophication (Sharpley *et al.*, 1994; Carpenter *et al.*, 1998; Correll, 1999). Nitrate leaching from soil into drinking waters can lead to fatalities in humans (Cameron *et al.*, 1996) and livestock (Schneider, 1996). Anaerobic degradation of manure or other organic matter sources (animal mortality, spoiled feed) from the operation can cause air quality pollution from the emission of ammonia and other nitrogenous compounds, sulfurous compounds, and volatile organic compounds that are often odorous, and can cause greenhouse gas (GHG) and acid rain effects.

The Natural Resources Conservation Service (NRCS) Conservation Practice Standard (CPS) Code 592, Feed Management, was developed to supply the available nutrients required by the bird for maintenance, production, performance, and reproduction, while reducing the number of nutrients, especially N and P, excreted in manure by minimizing the overfeeding of these and other nutrients (USDA-NRCS, 2021). As a result of fulfilling this purpose, livestock poultry operations can improve the whole-farm nutrient

balance and minimize the threat of nutrients from manure impacting water and air quality. In addition, using proper feed management practices may improve net-farm income by feeding nutrients more efficiently.

Restricted Feeding and Diet Dilution:

Restricted feeding is sometimes practised for growing birds. Restricted feeding is a reduction in feed intake or nutrient intake, particularly energy and protein, below the normal feed intake or nutrients, respectively. Restricted feeding is done during the growing periods of layers of birds (14 – 20 weeks). The reduction is done either by limiting the total amount of feed to 85 – 90% level of the normal intake or diluting the feed with low-nutrient feed ingredients so that there is a reduction in energy and protein content of the feed to 85 – 90% of the normal level. Attempts to assess the extent to which quantitative food restriction during the finishing period improved feed efficiency ratio, reduced fat content, and lowered mortality rate but also reduced final body weight (Benyi and Habi, 1998; Urdaneta-Rincon and Leeson, 2002). Leeson *et al.* (1996) reported that feeding broilers with a finisher diet diluted with sand and oat hulls from 35 to 49 days affected the percentage of abdominal fat, breast and carcass weight. Sahraei and Shariatmadari (2007) showed that allowing birds a diet containing 7% sand and/or wheat bran from 35 – 45 days resulted in lower abdominal fat without affecting the final carcass weight. Dilution of feed can be done by adding fibrous materials of low nutrient density, such as deoiled rice bran, rice polish, wheat bran, etc. This is done to reduce nutrient intake. The reasons for restricted feeding are: to avoid the fattening of birds as obesity leads to poor egg production. Secondly, restricted feeding causes 5 – 10 days of delayed sexual maturity and thereby reducing the number of small eggs laid at the start of production. Restricted feeding is also being done in broiler breeders to check the weight gain of the breeder because the excess weight of the breeder affects fertility and egg production.

Phase Feeding: Phase feeding refers essentially to a reduction in the amino acid levels of the diet as the bird progresses through a laying cycle because the cost of protein supplements is expensive and the level of production declines as the poultry birds get older (Pope and Emmert, 2001). Phase feeding is based on the fact that as birds get older their feed intake increases because of their body mass and body weight, while their egg production decreases (Kazemi *et al.*, 2022). The nutrient concentration of the diet should be reduced to enhance profit maximization. At this time, it is appropriate to consider a conventional egg production curve of a layer, and place priority on both egg weight and daily egg mass output. If the level of nutrients is to be reduced, this should not be done immediately after peak egg numbers, but rather after a sharp decline in egg production level (Kazemi *et al.*, 2022).

There are two reasons for reducing the level of dietary protein and amino acids during the latter stages of egg production, first, to reduce feed costs, and second, to reduce egg size. The advantages of the first point are readily defined if protein costs are high, but the advantages of the second point are hinged with some speculations and will change depending on the price of eggs. If a producer is being paid a premium for extra large and jumbo eggs, there is no advantage to adopting a phase-feeding program unless there is eggshell quality is a problem.

Grouping: This involves placing animals of similar ages, weights and production levels together so that more specific rations can be developed with a minimal chance of overfeeding nutrients (USDA-NRCS, 2003).

Gender (Sex Splitting) Feeding: This involves placing animals of the same gender together. Split-sex feeding divides the animals by gender so that diets can be formulated to meet the special nutrient needs of each sex (USDA-NRCS, 2003). This is done majorly for breeder birds. A breeder's diet should have the proper level of energy and protein. Providing adequate vitamins in a breeding ration is very important. Vitamins may account for about 4%

of the cost of a breeder feed. Deficiencies of various trace elements and vitamins may lead to reduced hatchability and poor chick quality (Chang *et al.*, 2016). The amount of feed required daily depends on the body size, the rate of production and atmospheric temperature. Breeder stocks must be prevented from becoming fatty to maintain their optimum reproductive performances.

Both male and female breeders should be placed on a breeder diet for five to six weeks before laying hatching eggs. Male weight and body condition are controlled by adjusting feed quantity so that a slow constant increase in weight is achieved as the male grows older. Cocks may appear dull and listless, having excess feather loss, reduced mating ability and vent colour may become paler and overall there may be reduced fertility (Clark, 2019). Overfeeding of cocks leads to excessive breast development and excessive weight which can lead to injury of the hen while mating, more stress on the cock's joints and foot pads, and reduced sex drive (NDVSU, 2023).

Alternative Feed Ingredients: The rise in the cost of conventional feed resources such as maize, guinea corn and oil seed cakes due to competition with human food call for the need of livestock farmers and researchers to explore the use of alternatives to the expensive conventional feed resources so that livestock would not only exist but expand (Kperegbeiy and Ikperite, 2015).

Conventional feed resources are those ingredients or feed resources internationally adopted and used to formulate livestock diets. They have been tested, proven, certified and recommended for use in the livestock industry (Devendra, 1988). Alternative feed resources, as opposed to the conventional ones, are those that are known and found at different localities, which have not been properly harnessed but have been found useful as animal feed. Various studies have been carried out on several alternative feed resources found in the tropics (Singh, 2021). They include those that serve as sources of energy (Table 2) and protein (Table 3) such as by-products from industries, maggots, earthworm, foliage from legume

trees/shrubs, etc. These can also be referred to as unconventional feed resources.

Table 2: Examples of alternative energy feed resources

By-products	Examples	Source
Grains	Wheat bran and middling, sorghum bran, rice bran and husk, haulms as well as brewers' dried grain	Ndams <i>et al.</i> (2009); Abdullahi <i>et al.</i> (2008)
Roots and tubers	Cassava peels, yam peels, potato peels and cocoyam peels	Mosobalaje and Tewe (2009); Etuk <i>et al.</i> (2011)
Animals	Meat meal, bone meal, and blood meal	Bamgbose <i>et al.</i> (2011)
Fats and oils	Palm oil slurry, soap stock, and vegetable fats	Afolabi <i>et al.</i> (2007); Ojewola <i>et al.</i> (2007)
Miscellaneous	Molasses, syrups, sugar, sugar cane scrapings	Ajuonuma and Awodi (2012); Alu <i>et al.</i> (2012)

Table 3: Examples of alternative protein feed resources

Ingredients	Crude protein (%)	Source
Blood meal	77.35	Aduku <i>et al.</i> (2005)
Feather meal	85.00	Aduku <i>et al.</i> (2005)
Animal manure	20.00	Abeke <i>et al.</i> (2008)
Poultry waste	25.00	El-Ashry <i>et al.</i> (2000)
Maggot meal	54.00	Ketelaars (1990)
Earthworm	65.00	Sabine (1978)
<i>Glyricidia sepium</i> leaf	32.00	Agbede and Aletor (2004)

Dietary Manipulation for Improvement of Egg Quality: The nutritional quality of eggs is also affected by the type of feed consumed by birds. The quality of feed can be enhanced by following dietary manipulation: i) Egg yolk is considered one of the richest sources of cholesterol in the human diet. The normal cholesterol content of eggs (about 200 – 250 mg) and blood (around 150 mg %) in chicken has been found to vary quite considerably. The

cholesterol content of chicken eggs can be reduced by up to 25% through the use of additives, dietary fibre, and polyunsaturated fatty acid supplementation (Réhault-Godbert *et al.*, 2019). ii) Omega-3 fatty acids have cardioprotective and other beneficial effects. Poultry nutritionists have started research to incorporate more of these fatty acids in the egg and have succeeded in developing such an egg called Omega-3 enriched 'designer egg'. This egg can be called the 'diet egg' or the 'functional egg' (Kralik *et al.*, 2023). iii) Diet eggs can have a high percentage of Vitamin E, an antioxidant, which prevents the oxidation of cholesterol and therefore its ill effects. These eggs may also contain 600 mg of Omega-3 fatty acids. Omega-3 fatty acids help to reduce cholesterol triglycerides, clog formation, tumour growth, and improve immunity (Shakoor *et al.*, 2020). iv) To improve the quality of these eggs further selenium, carotenoid pigments, among many others are also being increased in these eggs (Singh *et al.*, 2012).

Effect of Proper Feed Management on Poultry: When feed management is properly done, it leads to the following: control of food wastage, effective feed utilization, minimized nutrient loss and cost minimization.

Effect of Improper Feed Management: Due to imbalance in nutrition, some poultry diseases might emerge accompanied by some conditions in poultry. Some of these include: cannibalism, fatty liver and kidney syndrome, disease and condition due to vitamin deficiency.

Cannibalism: It occurs in flocks due to a deficiency of a common salt of sodium and also due to a deficiency of crude fibre. If a fibre-fibre diet that contains less than 3% crude fibre is fed to chicken cannibalism is more observed. Methionine deficiency also results in cannibalism. However, an overall deficiency of feed or nutrient(s) for some days can produce cannibalism in chickens (Kjaer and Sørensen, 2002).

Fatty liver and kidney syndrome (FLKS): The deficiency of biotin can lead to this

condition in young broilers. This condition is most commonly seen in 2-4week old birds fed a wheat-based diet because wheat is biotin-dependent. Pyruvate carboxylase enzyme is biotin-dependent and due to its deficiency death is caused by hypoglycemia due to failure of hepatic gluconeogenesis. This affects kidneys because kidneys are vitamins-organs that have high energy demand and are affected adversely leading to a condition called FLKS (Zaefarian *et al.*, 2019).

Fatty Liver Haemorrhagic Syndrome (FLHS): The fatty liver haemorrhagic syndrome is accompanied by excessive accumulation of fat in the liver. The main reason is the low protein and high energy ratio. Amino acid deficiency is also responsible for this condition. A deficiency of lipotropic factors is responsible. The lesions are excessive fat deposition in the liver with haemorrhage. This condition may be prevented by increasing the level (1-2%) of dietary protein supplementation with 50g of CuSO₄, 500 g of choline, 3 mg of Vitamin B12, 500 I.U of Vitamin E and 500 g of methionine per 100 kg of ration (Zaefarian *et al.*, 2019).

Cage Layer Fatigue and Bone Break: High-producing laying hens maintained in cages, sometimes show paralysis at peak egg production. The condition is caused by breakage of the vertebrae which subsequently affects the spinal cord. The reason is impaired calcium mobilization due to the high output of calcium through the eggshell. This condition is more common in caged birds and the birds reared on deep litter systems are rarely affected. It is because of the deficiency of exercise and the effects which influence the metabolism of calcium. The condition can be cured or prevented by increasing birds' exercise, reducing the deposition of fat in the body, and improving calcium metabolism by birds (Habig and Distl, 2013).

Salt Poisoning: The requirement for salt is very less in poultry as compared to other animals. The excess of salt either in water or in feed is toxic. The symptom of salt poisoning is watery drops, increased water intake, muscular

weakness, convulsion, and death. On post-mortem examination, severe congestion and haemorrhages are observed in the alimentary canal, liver, lungs, kidney and muscles. The level of salt should not exceed 0.5% in ration and 3000 ppm in drinking water (Ebrahimi *et al.*, 2015).

Disease and condition due to vitamin deficiency: Vitamin deficiencies are most commonly due to the inadvertent omission of a vitamin premix from the birds' diet. Multiple deficiency signs are seen in poultry, although in general, problems with deficiencies of the B vitamins appear first (Leeson, 2022).

Conclusion: Since feed has been adjudged to contribute 60 – 80% of total production in livestock production, different feed management techniques should be put in place to reduce the cost of production. It is very important to have a proper understanding of feed management practices for profit maximization and also to save the stress of production. Feed restriction, limited feeding, and adoption of an alternative feed ingredient are some of the feed management techniques that can be practised to increase profitability in the poultry enterprise. Over the years, there has been great competition between human and, animal feed leading to a hike in the price of feed ingredients and also reducing its availability. The study recommends: i) The establishment of a quality control unit to monitor the processing, and handling of these resources, and the distribution of information from research institutions on the potential of these resources to prospective livestock farmers as an alternative to the more expensive conventional feed resources should be of priority, and ii) There should be methods to educate farmers to understand the importance of feed management as it enhances proper feed utilization, prevent feed wastages, and enhances cost maximization.

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