International Journal of Science, Environment and Technology, Vol. 8, No 4, 2019, 790 – 794
ISSN 2278-3687 (O)
2277-663X (P)

Review Article

ENERGY AND PROTEIN REQUIREMENTS DURING VARIOUS STAGES OF PRODUCTION IN JAPANESE QUAILS

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Japanese quail (*Coturnix coturnix japonica*) is a diversified domesticated poultry species reared for commercial egg and meat production. It is blessed with the unique characteristics of fast growth, early sexual maturity, high rate of egg production, short generation interval and shorter incubation period that makes it suitable for diversification. Other quail species include European quail (*Coturnix coturnix*), the bobwhite (*Colinus virginianus*), the California (*Lophortyx californica*), and the Chinese painted (*Excalfactoria chinensis*) (Ani *et al*., 2009).

Japanese quail is also known by other names such as Common quail, Eastern quail, Asiatic quail, Stubble quail, Pharoah's quail, Red-throat quail, Japanese gray quail, Japanese migratory quail, King quail and Japanese King quail (NRC, 1991). Japanese quail are raised mainly for meat and egg production and also are valued research animals (NRC, 1994). Japanese quails have less feeding requirement (about 20-25 g per day) compared to chicken (120-130 g per day) (Ani *et al*., 2009). Quail attain a market weight of 140-180 g between 5-8 weeks of age and reaches peak egg production at the age of 5-8 weeks (Garwood and Diehl, 1987). Quails lay 200-300 eggs in their first year of production.

Genetic selection for higher body weight and egg production in Japanese quail is practiced during the last few decades leading to the evolution of new genetic line of quail with considerably higher growth rate and egg production compared with the original quail population (Hussain *et al.*, 2013). A new meat type Japanese quail strain "TANUVAS Namakkal quail" and egg type Japanese quail strain "TANUVAS Namakkal gold Japanese quail" has been evolved by the Department of Poultry Science, Veterinary College and Research Institute, Namakkal under Tamil Nadu Veterinary and Animal Sciences University.

*Received June 12, 2019 * Published Aug 2, 2019 * www.ijset.net*

The NRC (1994) recommendations have been followed throughout the production cycle. Since they have better growth rate, high production performance in terms of egg number and egg weight, it requires different nutrient level than the conventional Japanese quails.

Energy and protein are the main nutrients considered in feed formulation. Rather than a nutrient, energy is a property of energy-yielding nutrients when they are oxidized during metabolism (NRC, 1994). Energy is an essential component of poultry diet that must be supplied in adequate amount to meet up the bird's requirement for maintenance, optimum growth, egg production and reproduction (Farrell *et al*., 1982) and its requirement for quails depends on age of the birds, reproductive status and ambient temperature (Shim and Vohra, 1984). The NRC (1994) recommended energy levels of 2900 Kcal/kg for quails in the rearing and production periods. Central Avian Research Institute recommends 2800 Kcal/kg during the starter and finisher phase of Quail broiler variety, while 2750 Kcal/kg for layer quails in the chick and grower stage and 2600 in the layer stage.

The main sources of energy are cereal grains which are the main ingredients for most diets. Fat such as animal tallow, lard or vegetable oils are added to the diet if high energy is required (Shrivastav, 2000). Increasing the dietary energy levels affects significantly the efficiency of feed utilization as the feed consumption was reduced significantly. Energy regulates feed intake, since quails have relatively higher feed intake compared with chicken (Silva and Costa, 2009) thereby supply of diets with inadequate energy level can change consumption and reduce the performance.

Protein provides the amino acids for tissue growth and egg production. Hence, the requirement for protein is mainly requirement for amino acids. The dietary protein and amino acids requirement of quail is influenced by age, egg production and metabolizable energy content and the ingredients used to formulate the diets. The type of protein to be fed to quails must be provided from a high quality source. Protein quality is generally based on amino acid composition of the feedstuff and the availability of these amino acids from the feedstuff following digestion in the gut. Thus, the great knowledge of the metabolism of protein in birds and the production of amino acids on a commercial basis have enabled the utilization of the concept of ideal protein during the formulation of diets. Amino acids are considered as the building blocks of proteins (Babangida and Ubosi, 2006). Excess protein increases the oxidation of amino acid as source of energy and nitrogen excretion leading to environment pollution, whereas the deficiency increases the catabolism of tissue protein and fat from the poultry carcass (Filho *et al.*2012).

The NRC (1994) recommended protein levels of 24 and 20% for quails in the rearing and production periods, respectively. Central Avian Research Institute recommends 27 and 24% during the starter and finisher phase of Quail broiler variety, while 24, 20 and 18% for layer quails in the chick, grower and layer stage for layer quails.

Feedstuffs differ qualitatively and quantitatively in their amino acid composition. Quail diets consist mainly of plant materials, the most commonly used plant products are maize, soybean meal, groundnut cake, sorghum, millet and rice or wheat bran. Methionine and lysine are generally low in plant products (Babangida and Ubosi, 2006). Animal protein products such as fish meal, meat meal, blood and bone meal etc., are good sources of most of the essential amino acids, but they are usually more expensive than plant protein ingredients (Murakami *et al.*, 1993). Synthetic methionine and lysine are usually added to the diets to balance the amino acid composition (Shim and Lee, 1993). The major commercial source of plant protein concentrates for the livestock feed industry are groundnut cake and soybean cake or meal. Soybean meal is very rich in lysine and other essential amino acids except methionine. However, it is expensive and at times if not properly processed may impair performance of the ingesting animals due to the presence of trypsin inhibitors (Nagalakshmi *et al.,* 2007).

Supplementing the required limiting amino acids in diet will reduce dietary protein (CP) content. The information on the amino acid nutrition of Japanese quail, as a whole, is scanty (Shrivastava and Panda, 1999). This concept can be defined theoretically, as the exact balance of the amino acids in the diet capable of meeting, without excess or deficiency for production and maintenance of birds, expressing them as percentage in relation to the lysine which is adopted as reference amino acid.

The ideal protein concept implies feeding the best ratios between lysine and other amino acids, thus reducing the crude protein content of the diet. Lysine in lower or excess levels may bring metabolic damages, which affects the bird's performance (Kidd and Kerr, 1998). For many decades, studies on the utilization of lysine, based on the concept of ideal protein in the diets of birds, have been developed because of the great applicability, ease of utilization in the formulation of diets and low costs of the acquisition.

Out of 19 total amino acids required by quail, 13 are considered as essential, because they cannot be produced in the quail's body and must be supplied in the diet. Six are considered as nonessential, because they are synthesized by the body and need not be supplied in the diet. The 13 essential amino acids are: arginine, cystine, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, tyrosine and valine (Murakami *et*

al., 1993). In Japanese quails methionine, threonine and lysine are the first, second and third limiting amino acids. The ratio of lysine to crude protein and ratio of other essential amino acids in relation to lysine is important rather than studying individual amino acids to achieve optimum growth and feed efficiency. The NRC (1994) recommended lysine levels of 1.3 and 1.0% and methionine levels of 0.5 and 0.45% for quails in the rearing and production periods respectively. Central Avian Research Institute recommends lysine levels of 1.3 and 1.2% during the starter and finisher phase of Quail broiler variety, while 1.2, 1.1 and 0.8% for layer quails in the chick, grower and layer stage for layer quails. The methionine recommendation as per CARI is 0.48 and 0.45% during the starter and finisher phase of Quail broiler variety, while 0.45, 0.4 and 0.44% for layer quails in the chick, grower and layer stage for layer quails.

Consequently, there is a need of updating optimal nutritional requirements of genetically improved Japanese quails to exploit production potentiality. Precise nutrient supply reduces feed cost, wastage of nutrients, environmental pollution, and bad aroma in poultry house, and thus improves bird welfare. The advancement in the knowledge of the nutritional requirements of birds, at their many phases, has constantly brought improvement to the quality of the diet; firstly in the sense of reaching maximum production, followed by the search for the lowest price of the feed and for the conversion of these birds into egg numbers (Ceccantini and Yuri, 2008).

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