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Review on the effect of feed and feeding on chicken performance

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Abstract

Body weight has an important role in the development of the hen and the emphasis should be on an undisturbed growth rate during the first eight weeks of a hen's life. Breeder pullets must obtain a minimum body weight to initiate egg production. Although the unlimited feeding chickens may obtain this body weight by 14 or 15 weeks, they do not begin lying until they are 24 or 25 weeks old. There was an indication even small degrees of over or under feeding might negatively affect egg and chick production. Some authors show as egg quality was not affected by the different feeding regimes in chickens. However, others narrate low incidences of abnormal eggs in limited fed hens compared to chickens exposed to unlimited feeds. Egg weight is better for hens that were given unlimited access to feed over those rationed either once or twice a day. Feed limited at rearing phase hindered the development of the oviducts. Males fed 85 percent of their feed intake and those fed *ad libitum* had greater average semen volumes than volumes produced by 70 percent limited fed males. Feed limited earlier (during rearing phase) and changed to *ad libitum* feeding in the laying phase had significantly higher levels of embryonic mortality compared to other feeding groups of chickens. Hens fed in proper way lay as many eggs as hens fed a traditional laying hen. Chickens should be given adequate feeder space. a supplement designed to be mixed with grains or grains and limestone to provide a complete laying hen diet should be used.

Introduction

According to Oyedeji *et al.*[1], chicken industry is one of the most dynamic components of the world agricultural business. To improve egg production manipulation of feeding regimes and diets is important. The same authors reported faulty feed and feeding methods are sometimes responsible for reduced egg production, small egg size, reduced shell quality, reduced growth, excess fat storage, overfeeding and high mortality. In a survey study that was done in Ethiopia, Halima [2] also reported that women took a larger part in chicken rearing compared to men. The same author also identified poor feeding as one of the major constraints in chicken production.

Unlimited feeding in laying hen's leads to over-consumption of energy that enhances excessive accumulation of abdominal fat predisposing layers to heat stress. If breeding flocks were fed *ad libitum*, they would become obese and suffer thermal discomfort, a high incidence of lameness and high mortality due to skeletal disorders [1]. In all situations, feed represents the major cost ranging between 65-80% of production costs of poultry meat and eggs [1,3]. Therefore, limited feeding could reduce the rearing costs, limited feeding in the rearing period often yields benefits in the laying period concerning egg size, more sustained laying ability and lower mortality.

Feeding and body temperature of chickens are related things and several studies showed the effect of body temperature on reproductive performances. The weights of reproductive organs (ovaries and oviducts) were found to be low in chickens that were exposed to high temperatures [4]. The development of the combs and wattles responds positively to the low temperatures and eggs from chickens that are raised in high temperature had a low hatching percentage and fertility compared to the ones kept in low temperature [5]. Aksit *et al.* [6] reported a reduced breast weight in chickens that were subjected to high temperatures. The weights of the liver, gizzard and intestines were lower when it was hot compared to that recorded during cool conditions [7]. Chickens that were kept in high temperature accumulate more abdominal fat [8].

Effect of feeding in chicken's performance

Productive performance

Growth performance

Body weight has an important role in the development of the hen and the emphasis should be on an undisturbed growth rate during the first eight weeks of a hen's life [9]. Breeder pullets must obtain a minimum body weight to initiate egg production, although the unlimited feeding chickens may obtain this body weight by 14 or 15 weeks, they do not begin laying until they are 24 or 25 weeks old, suggesting that an age threshold must be achieved [10]. The same author reported under *ad libitum* conditions, some strains were significantly heavier at sexual maturity. However, under a common feed limited programme, laying was initiated at a similar weight in all strains.

There was a direct relationship between the degree of feed limited and the length of the delay in the onset of lay. Pullets on the low body weight profile entered lay 7 days later than pullet on the high body weight profile [11]. The findings of the same authors revealed that the sexual maturation profile of the low treatment started to rise later

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than for the other groups but exhibited the steepest rise once it started. Unlimited feeding chickens are dependent on reaching a critical age to initiate sexual development as opposed to feed-restricted chickens that are dependent on reaching a critical body weight and body composition threshold [10].

According to the findings of Sandilands *et al.* [12] the desired growth curve of broiler breeders to 20 weeks can be achieved via an *ad libitum* feeding regime, meaning that quantitative feed limited as presently practiced in chickens, may not be required to avoid the negative health, welfare and reproduction consequences that are associated with fast growth. In broiler breeder flocks reared as a group, aggressive chickens are found to grow larger and more quickly whereas passive chickens remain smaller and under more severe limited condition due to reduced feed access and this suggests that eating behavior could also contribute to the variability in flock body weight.

Egg production

The *ad libitum* fed chickens reached the maximum rate (84.5%) of lay at 28 weeks of age and the chickens under limited feeding attained their peak egg production (85%) at the age of 35 weeks [13]. Melnychuk *et al.* [10] showed that chickens on a moderate increase in feed intake had 10 more eggs than those on generous feed increase. Egg production level in the *ad libitum* fed chickens was less than that of restricted fed chickens [13]. The findings by Robinson *et al.* [14] reflected that even small degrees of over or under feeding might negatively affect egg and chick production. Marshaly *et al.* [15] explained that the eggs production was inversely related to level of temperature. Smith [16] also reported that the temperatures that exceed 32°c would normally result in a decline in egg production.

Egg quality and weight

The egg quality was not affected by the different feeding regimes in chickens [17]. Richards *et al.* [18] indicated low incidences of abnormal eggs in limited fed hens compared to chickens exposed to unlimited feeds. [1] concluded that egg weight is better for hens that were given unlimited access to feed over those rationed either once or twice a day. Feeding level contributed substantially to egg size [19].

Carcass characteristics

Breast meat is the most valuable product in the chicken industry [10]. The findings of Robinson *et al.* [19] illustrated that at 18 weeks of age, variability in percentage of breast muscle weight resulting from a diverse feed allocation needed to achieve body weights profiles was greater than the genetic variability among different lines.

Analyses of body weight profiles need to consider the relative allocation of nutrients early in life, because they affect the establishment of carcass frame and fleshing and later in rearing during the development of the reproductive system [19]. the same author reported chickens of all strains were limited to a common frame size for most of the rearing period once the feed limited programmes were imposed.

The broiler chickens that were shifted from limited feed to *ad libitum* feeding had heavier weights of the intestines compared to either the chickens that were fed without any limited or the ones that were fed limited for the entire study period [20]. Broiler chickens that were fed high fibrous diet as a form of feed limited only at initial stage of growth resulted in a higher intestine weight score compared to those feed limited by 35% [21]. The same authors indicated those that either was fed *ad libitum* or limited has lighter intestine weights.

The liver weight was similar in *ad libitum* and restricted fed broiler breeder hens [10]. Yagoub *et al.* [21] noted that even in chickens that were shifted to *ad libitum* feeding at later stage of development their liver weights were not significantly different from the rest of chickens in other treatments. However, Pishnamazi *et al.* [22] discovered that the liver weight was greater in chickens that were fed *ad libitum* as a percentage of body weight in comparison to the chickens that were under limited feeding.

Carcass composition

Ocak *et al.* [23] found a higher dry matter content in Japanese chicken that fed without limited. Robinson *et al.* [19] showed that moderate and high body weight hens had greater proportions of carcass protein and ash than low body weight hens. In a study done on commercial egg type pullets [4] reported similar carcass crude protein content between the different feeding regimes. The findings of Chen *et al.* [4] revealed that feed limited decreased the protein content in Japanese chickens.

Reproductive performance

Oviduct weight

In their investigations, Yildiz *et al.* [24] found that feed limited at rearing phase hindered the development of the oviducts. Oviduct weight has very positive response to feed allocation [19].

Ovarian weight

The stroma of the ovary is the stock of small, estrogen producing follicles from which follicles are recruited into the hierarchy [10]. Robinson *et al.* [19] further stated that ovary weight was influenced by body weight profile and was an indication that presumably this effect was related to the level of feed intake during the time of follicle formation. The same authors also showed if pullets are subjected to decreasing feed intake during this time, they enter lay with a reduced number of large yellow follicles (LYF) and fewer multiple follicles, suggesting that follicular development is closely related to feed intake rather than body weight alone.

Fertility and hatchability

In a study that was conducted in Japanese chicken it was reported that feed limited at 70 and 85% of *ad libitum* feed intake did not significantly decrease fertility between 6 and 13 weeks of age [19]. The same authors also discovered that males fed 85 percent of their feed intake and those fed *ad libitum* had greater average semen volumes than volumes produced by 70 percent limited fed males.

Embryonic Mortality

The findings of Robinson *et al.* [19] showed that feed limited earlier (during rearing phase) and changed to *ad libitum* feeding in the laying phase had significantly higher levels of embryonic mortality compared to other feeding groups of chickens. Total embryonic mortality to 17th day of incubation was reduced by early feed restriction. Mortality for the unlimited feed chickens was 56 percent more than mortalities from 15 or 30% feed limited chickens [25].

Practical implications of feeding to enhance productivity

According to Bennett [26], hens fed this way will lay as many eggs as hens fed a traditional laying hen diet as long as some basic rules are followed:

1. Do not give the hens too many choices. Hens can handle up to three choices quite well (grain, supplement and limestone or oyster shell). If more than one grain is used, such as wheat and barley, they should be mixed together in the same feeder.

2. Give the hens choices that are nutritionally distinct. For example, grain is high in starch and energy, the supplement is high in protein and vitamins and limestone is high in calcium. When provided such clear choices, the hens learn which feeders to go to and how much to eat to meet their basic nutritional needs. Some choices may not be clear enough for the hens. For example, wheat and peas both are high in starch and have moderate levels of protein and having separate feeders of wheat and peas may not provide a distinct enough nutritional difference for the chickens.

3. Introduce the whole grain and choice-feeding a month before the onset of lay (at about 15 weeks of age for commercial layers and 24 weeks for village hens). This adjustment period will allow the chickens time to learn how to choice-feed themselves before they are exposed to the nutritional demands of egg production. It will also allow the pullets the opportunity to increase their calcium consumption and build up the calcium reserves in their bones before they start to lay eggs. Finally, it takes the gizzard three weeks to build muscle mass to enable the hen to be able to efficiently grind the grain once egg production begins.

4. Vitamins or micro-minerals (e.g. copper, zinc *etc.*) should not be provided in a separate feeder, rather mixed with the supplement. If vitamins or micro-minerals are placed in a separate feeder, some chickens may not eat them because they do not like the taste while other chickens may over consume them and suffer toxic side effects.

5. Chickens should be given adequate feeder space. For large backyard flocks, several feeders for each ingredient may be needed. For a one hundred-hen flock, two hanging feeders each of grain, supplement and limestone are suggested.

6. A supplement designed to be mixed with grains or grains and limestone to provide a complete laying hen diet should be used. A supplement formulated in this manner will contain a range of 25% to 40% CP. A grower supplement may be used prior to the start of egg production but a laying hen supplement used once the chickens begin laying eggs.

7. It is not necessary to grind grains when choice-feeding hens. The chickens will readily eat whole wheat, whole oats or whole barley (but they can have difficulty eating whole maize). After about three weeks of eating whole grains, the hens' gizzards will increase in muscle mass and will grind the grain as efficiently as a hammer mill. Hens can successfully consume 70% of their diet as whole grain when it is choice-fed. It is important to note that if the grains, supplements and limestone are provided in different feeders, these separation problems are avoided.

Conclusion

Unlimited feeding chickens may obtain sexual maturity at body weight by 14 or 15 weeks, but they do not begin laying until they are 24 or 25 weeks old. Similarly, some strains were significantly heavier at sexual maturity. However, under a common feed limited programme, laying was initiated at a similar weight in all strains. Chickens on a moderate increase in feed intake had 10 more eggs than those on generous feed increase. Egg production level in the *ad libitum* fed chickens was less than that of restricted fed chickens. Hens fed in proper way lay as many eggs as hens fed a traditional way. This comes true if some basic rules are followed.

Although some authors indicate egg quality was not affected by the different feeding regimes, others show low incidences of abnormal eggs in limited fed hens compared to chickens exposed to unlimited feeds and egg weight is better for hens that were given unlimited access to feed over those rationed either once or twice a day. Breast meat is indicated as the most valuable product in the chicken industry. Variability in percentage of breast muscle weight resulting from a diverse feed allocation needed to achieve body weights profiles was greater than the genetic variability among different lines. Some authors also showed moderate and high body weight hens had greater proportions of carcass protein and ash than low body weight hens. However, others reported similar carcass crude protein content between the different feeding regimes.

Feed limited at rearing phase hindered the development of the oviducts. Oviduct weight has very positive response to feed allocation. Ovary weight was influenced by body weight profile and was an indication that presumably this effect was related to the level of feed intake during the time of follicle formation. Moreover, males fed 85 percent of their feed intake and those fed *ad libitum* had greater average semen volumes than volumes produced by 70 percent limited fed males. The total embryonic mortality to 17th day of incubation was reduced by early feed restriction. Mortality for the unlimited feed chickens was 56 percent more than mortalities from 15 or 30% feed limited chickens.

Recommendation

Feeding affects several productive traits like an age threshold to obtain sexual maturity and body weight, to have similar body weight in all stains, egg production, egg quality, carcass characteristics and composition. Hence, analyses of productive traits need to consider the relative allocation of nutrients

Feeding affects several reproductive traits like development of the oviducts, ovary weight, semen volumes and embryonic mortality. Therefore, analysis of reproductive system development should be done in consideration to feeding.

Different studies show different results on effect of different feeding regimes on productive and reproductive performances of chickens. Therefore, there is a need for furthermore studies to properly demonstrate the relative effects of feed on various chicken performances.

Proper practical feeding systems should be practiced enhancing productive and reproductive performances of chickens.

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