

Feed Restriction on Productive Performance of Layer Chickens: A Review

Mulugeta Walelegne^{1*} Netsanet Beyero² Geberemariyam Terefe¹

¹ Holetta Agricultural Research Center, P.O. Box 31, Holetta, Ethiopia

² College of Agriculture and Environmental Sciences, Bahir Dar University, P.O. Box, 5501 Bahir Dar, Ethiopia

Abstract

Feed restriction is method of feeding where time, duration and amount of feed are limited, and it has an impact on whether a bird is capable of achieving the same productive performance as unrestricted birds. Feed restriction included of quantitative and qualitative restriction that is in quantitative to limiting the amount of feed daily given to the animals whereas a qualitative restriction is related to nutrient dilution in the diet. Different research results indicated that restriction of feed on layers production have controversial effect on feed intake, feed conversion efficiency, body weight gain, egg weight and quality. Overall, the potential of feed restriction programs as a management's tool is important to increasing the egg production, egg quality, reduce maintenance requirements and improvement of feed efficiency in layers chickens. Also can be lead to economical saving in cost of feeding in layers chicken, thus may be usefulness for commercial layers chicks production farms.

Keywords: feed restriction, Layers, performance, production

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1. INTRODUCTION

In the poultry industry, Feed is the most expensive component. As a result, increased feed consumption has the potential to lower production costs for commercial egg producers. Several attempts have been made to limit the amount of feed consumed by layers in order to minimize feed waste and increase the use of energy and other nutrients in the egg production process. Feed restriction is one of the method used in poultry production to use feeds properly with minimum waste, and maximum utilization of nutrients for egg or meat production. Feed restriction is a form of feeding in which the amount, length, and time of feed are controlled, and it affects whether a bird can achieve the same body weight as unrestricted birds (Yu and Robinson, 1992). Feed restriction is divided into two types: quantitative and qualitative. A quantitative feed restriction denies bird's physical access to feed and water at specific times of the day, while a qualitative feed restriction denies birds maximum access to certain nutrients by providing a feed diluted primarily with inert fibres. (Giachetto *et al.*, 2003; Leeson and summers, 2005). Feed restriction is used to slow the growth rate of fast-growing broilers, especially in alternative production systems that require long growth periods (Govaerts *et al.*, 2000; Nielsen *et al.*, 2003).

According to Balnave, 1984, one of the management strategies which could be employed to reduce the cost of feeding is feed restriction. Restricted feeding has been reported to improve the feed utilization efficiency in chickens. In a study done by Crouch *et al.* (2002) reported that quantitative feed restriction reduces the body weight and feed consumption of birds without necessarily affecting the egg production. Apart from saving the quantity of feed given to chickens, feed restriction has been reported by several researchers in reducing mortality of chickens (Lippens *et al.*, 2000; Tolcamp *et al.*, 2005; Robert, 2009).

Furthermore, feed restriction in the rearing period has important effects on the laying traits, adult body weight decreases, sexual maturity age delays and mortality decreases (Bruggeman *et al.*, 2005). Also, the number of heavy follicles decreases at the onset of laying (Hocking and Robertson, 2005). In addition, it is indicated that, in light layers genotypes, 15 % feed restriction in the rearing period has positive effects on egg production traits (Ahsan-ul-haq *et al.*, 1997). In contrary, other results showed that feed restriction between 6-18 weeks positively affects egg production in brown layers. Similar authors revealed that, feed restriction has a little increase in feed consumption during laying period and does not affect egg quality traits. Therefore, the objective of this review papers is to know the effect of feed restriction on productive performance of layer chickens.

2. OVERVIEW OF FEED RESTRICTION

In all cases, feed is the most expensive part of the process, accounting for 65-80% of the total cost of producing poultry meat and eggs (Kabir *et al.*, 2007; Oyedeji *et al.*, 2007). Apart from lowering rearing costs, restricting feeding during the rearing period also results in increased egg size, longer laying capacity, and lower mortality during the laying period (Robinson *et al.*, 1978). Several approaches have been suggested for restricting nutrient intake during the rearing phase. Such methods involve alternating periods of access to feeds with periods of no access and the technique can be attributed to reduced feeding quantity on a daily basis (Robinson *et al.*, 1978). Reports seem to disagree on the best timing of restricted feeding. According to Bruggeman *et al.* (1999), some researchers concluded that feed restriction should cover almost the entire of rearing and breeding period while

others suggested that feed restriction should only be necessary during the rearing phase.

2.1. Types of Feed Restriction

According to Religious *et al.* (2001) quantitative and qualitative feed restriction are procedures that can be applied to manipulate the feeding strategies of poultry in order to decrease growth, and metabolic rate to some extent and so alleviate the incidence of some metabolic diseases as well as improving feed conversion in broilers and layers chickens.

2.1.1. Quantitative Feed Restriction

These methods include: physical feed restriction, limiting the level of consumption of feed in time (skip-a-day feeding) or reducing the time of illumination of feeding. Quantitative feed restriction has been observed to reduce mortality and culling (Fontana *et al.*, 1992; Yu *et al.*, 1992), improve feed conversion ratio (Deaton, 1995; Lee and Lesson, 2001) and allow a complete recovery of body weight if the degree of restriction was not too severe and slaughter ages were extended beyond 6 weeks (Deaton, 1995; Plavnik and Hurtwiz, 1988). Dozier *et al.* (2002), referred to feed restriction programs of yielding inconsistent results in the literature and that variation maybe partially attributed to differences in bird management, lighting, strain and ventilation. Also, quantitative restriction has been used for different purposes, such as reduction of broiler mortality and reduction of long bone abnormalities (Gonzales *et al.*, 1998; Pelicano *et al.*, 2005).

2.1.2. Qualitative Feed Restriction

Qualitative feed restriction is performed using diets with low energy to protein ratio (EPR); this is accomplished when dietary protein is increased or dietary energy is decreased or kept constant. As a consequence, the relative excess of protein induces higher energy utilization and, therefore, more synthesis and excretion of uric acid (Bartov, 1979). In addition, qualitative feed restriction implemented through diet dilution, and chemical methods of feed restriction and use of low protein or low energy diets (Zubair and Lesson, 1996).

2.2. Effect of Feed Restriction on Performance of Layers

2.2.1. Feed Intake and Body Weight Change

According to Iheukwumere *et al.* 2004 the average feed intake and body weight gain of the birds significantly decreased with severity of quantitative feed restriction. Similarly, Robinson *et al.* (1978) further indicated that irrespective of the length of the laying period, the ratio of the amount of feed (kg) eaten to the quantity of eggs produced declined with successive increases in laying feed restriction. In addition, Tumova *et al.*, 2002 indicated that feed intake was reduced by restrictive feeding and resulted in an improvement of feed efficiency in comparison with a control group fed *ad libitum*. The report also suggested that feed efficiency is not affected by feeding regimens. Etalem *et al.*, 2009 also studied that there were no significant ($P > 0.05$) differences in dry matter intake, initial body weight, final body weight as well as average daily weight gain of the birds under feed restricted and the unrestricted groups.

Moreover, Crouch *et al.* (2002) reported that there were differences in feed consumption during the growing phase of hens until 24 weeks of age. As birds were subjected to a phase of physical feed restriction, their feed intakes were reduced. The findings further indicated that as hens were placed back on *ad libitum* feeding, there was a subsequent and immediate large increase in feed consumption consistent with feeding behavior after restriction.

Tolkamp *et al.* (2005) indicated that restricted fed birds normally lose weight during the peak laying period because the nutrients intake of birds fails to. The results of Eitan and Soller (2001) also said that the body weight of restricted fed birds was significantly less at first egg compared to those in control. Colin *et al.* (1992) who suggested that feed restriction should be practiced on heavy breeds in order to avoid the excessive amount of body fat in pullets at sexual maturity and that feed restriction would result in targeted body size before birds start to lay.

2.2.2. Growth performance and Feed Conversion Efficiency

Hassan *et al.* (2003) indicated that a higher feed conversion value following feed restriction would probably mean that feed restriction retards growth, and therefore reduces feed efficiency. Plavnik and Hurtwitz (1985) illustrated that feed restriction induces a higher efficiency of maintenance. At the age of 11 weeks Koekoek chickens are capable of consuming 3680 grams of feeds with an average feed conversion ratio (FCR) of 3.3 when given commercial feeds unrestrictedly (Marle-Koster and Casey, 2001). During the growing period (9 to 20 weeks), birds fed unrestrictedly consumed significantly more feed than the feed restricted groups. The most restricted group consumed about 30 percent less feed than birds fed *ad libitum* which is a substantial saving in terms of feed cost per kilogram weight gain. Feed restriction treatment did not significantly affect the efficiency of feed utilization (Sekoni *et al.*, 2002). The findings by similar author concluded that quantitative feed restriction did not have any significance on feed consumption and efficiency of feed for egg production. The same study of feed restriction on Japanese quail showed a non-significant difference in feed conversion efficiency among treatments during feed restriction periods (Hassan *et al.* 2003).

2.2.3. Egg Production

The study conducted by Sekoni *et al.* (2002) indicated that quantitative feed restriction did not have any significant effect on hen day egg production. Feed restriction delays onset of egg production by approximately two days as compared to control (full fed) in quail production (Hassan *et al.*, 2003). Early feed restriction does not significantly affect first egg weight and the number of eggs produced from 6 to 13 weeks of age in quail as reported by Hassan *et al.* (2003). In contrary, Bruggeman *et al.* (1999) showed that generally chickens restricted during the rearing period (7-15 weeks) had the highest average weekly egg production whereas chickens fed on ad libitum intake throughout the periods showed the lowest egg production per week. In addition, Robinson *et al.* (1978) also reported that it appears that the level of feed restriction imposed in the laying period is more critical than that imposed in the rearing period. Regardless of the length of the laying period, feed restriction in the rearing period consistently increased the hen-house production of laying periods.

Moreover, Feed restriction during egg production resulted in significantly higher egg production with a lower incidence of abnormal eggs. Feed restriction has significant effects on circulating levels of key metabolic hormones before the onset of egg production since pullets that are on restricted feeding for 21 weeks before being switched to *ad libitum* feeding exhibited dramatic changes in the levels of insulin, and glucagon's (Richards *et al.*, 2003). Onagbesan *et al.*, 2006 explained that restricted fed chickens slightly longer to reach peak than full-fed chickens. The *ad libitum* fed birds reached the maximum rate (84.5%) of lay at 28 weeks of age and the birds under restricted feeding attained their peak egg production (85%) at the age of 35 weeks.

2.2.4. Egg Quality and Egg Weight

In a study done on Rhode Island red chicken by Etalem *et al.* (2009) conclude that feed restriction by skip a-day feeding system at 35, 42, 49 and 56 days of age resulted in higher egg weight and can be considered as the optimum age for pullet rearing. Additionally, feed restriction at 63, 70, 77 and 84 days of age could also be recommended due to heavier uterus weight and longer length in absolute term as these attributes indicate good consistency for the subsequent egg production. Crouch *et al.* (2002) showed that for the entire lay period, cracked and soft-shelled egg production percentage was greater for the birds that were fed restricted from 3 to 16 weeks of age. There was also no effect of feed restriction treatment on percentage of double yolked and large egg production. Similar author also illustrated that Percentage of eggs cracked in the incubator was also significantly higher from hens that were under restricted feeding during the rearing period compared to hens subjected to other regimes (*ad libitum* feeding from 3 to 24 weeks; *ad libitum* feeding from 16 to 24 weeks and feed restriction from 3 to 24 weeks) (Crouch *et al.*, 2002). Robinson *et al.* (1978) indicated that *ad libitum* fed birds can have as many as 12 to 15 large yellow follicles. A high proportion of those follicles are destined to become double yolked eggs. Sometimes two ovulations may occur in a single day, but both eggs have poor shell quality. Miles and Jacqueline (2000) showed that a feed restriction programme would result in a slight decrease in egg size that is of less consequence once the majority of the eggs are in the large category.

According to Robinson *et al.* (1978) significantly larger number of eggs heavier than 60 grams and significantly fewer eggs lighter than 45 grams were produced in each period by the birds that had been restricted during rearing than those that had not. On the other hand, restrictive feeding in the laying period depressed egg size. According to Renema *et al.* (1999), the early sexual maturity of *ad libitum* fed chickens compared to restricted fed ones throughout rearing is believed to be nullified by production of small eggs early in the laying period. The report by Robinson *et al.* (1978) further indicated that the proportion of cracked eggs tended to decrease with increasing severity of feed intake restriction in the laying period. Specific gravity of eggs was also markedly increased by feed intake restriction in the rearing period and tended to increase with increasing severity in the laying period. Feeding level contributed substantially to egg size (Renema *et al.*, 2007).

3. CONCLUSION

In general, the potential of feed restriction programs as a management's tool is important to increasing the egg production, egg quality, reduce maintenance requirements and improvement of feed use efficiency in layers chickens' production. Also can be lead to economical saving in cost of feeding in layers chicken production, thus may be usefulness for commercial layers chicks production farms.

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