ISSN 1682-8356
ansinet.org/ijps

# INTERNATIONAL JOURNAL OF POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 2 (6): 438-441, 2003


# The Effect of Housing on Layer-chicken's Productivity in the 3-tier Cage

T.A.M. Awoniyi
Department of Animal Production and Health, Federal University of Technology,
P.M.B. 704, Akure, Nigeria

**Abstract**: The productivity of layer-chickens in the different tiers of 3-tier cages using percentage Hen-day production (% HDP) in two contiguous poultry houses with different roofing materials was investigated for 10-weeks between January and March. The mean % HDP for tier 1, the lowest tier was found to be more than tier 2 while tier 3 was the least in House A. In House B, % HDP was highest in tier 2 and least in tier 1. On the average, House B had a better productivity (% HDP) than House A. From the factorial analysis of the 10 weeks data, highly significant ($P < 0.01$) differences between the % HDP for the two Houses were obtained as opposed to the non significant ($P > 0.05$) difference among the three tiers. The house-tier interaction significantly influenced % HDP in weeks 2, 5, 6 and 10. It was concluded that the better productivity of the chickens in House B than House A was ascribed to the effect of the asbestos roofing sheets in House B which generally reduced the heat stress on the birds with resultant better mean weekly egg production.

**Key words:** Housing, layer-chicken, productivity, 3-tier cage

## Introduction

Oluyemi and Robert (1979) reported that egg production is the major index of performance of commercial layer business because it accounts for about 90% of the income from the enterprise. Egg production is of great economic and nutritional importance in a pullet rearing venture which many poultry farmer-entrepreneurs approach with more enthusiasm rather than the actual knowledge of basic poultry production techniques.

The economically important traits which can be used to determine the performance of the layer-chicken include egg qualities (particularly egg size), efficiency of feed utilization and mortality. The maximum that a fowl is capable of producing in the first laying year is about 300 eggs (Oluyemi and Robert, 1979). In the tropics, production has averagely remained at 180-200 eggs although higher levels have been reported.

Nutritionally, eggs have been recognized as an important source of protein in the diet of man, and even for livestock; it is a protective food because it contains nutrients which protect and compliment body losses in a diseased state. Egg contains 74% water, it is a good source of high protein and it is often used by nutritionist as a standard reference for evaluating other protein foods. One egg supplies 11% of the recommended daily protein intake for adults. The fat of egg is readily digestible and is made up of both saturated and unsaturated fatty acids. Egg is low in calories but contains many vitamins. Eggs are used in various food industries, confectionery and for producing cosmetics and vaccines.

There are three basic systems of confinement rearing for chickens (Bogart and Taylor, 1983). They include deep litter system, slated floor and battery cages. The first important consideration arising from the confinement of the birds is the requirement of highly balanced diets with an assurance of high level of performance. Confinement with housing protects chickens from physical hazards, rain and extremes of heat and cold (Penda, 1985). Akinyosoye (1985) reported that cage system is the best because it makes the most economic use of land and labour. Cages are of different types - either the wooden type or metal, each unit having drinking and feeding troughs attached to it. Each cell can accommodate one, two or more birds, depending on the dimension of the cells used (North, 1984). The floors of the cages are made of wire and this permits the passage of the faecal dropping to the pit thus preventing the incidence of worms and coccidiosis which apart from viral diseases are the common banes of chicken egg production.

According to McNitt (1983); Mohanlal (1985), the cage is more modern, beneficial and economic than the deep litter floor. Caged birds gave higher egg production than birds on litters. Other advantages of cage poultry system include economy of space, moisture avoidance that prevent disease outbreak and integration with other systems such as fish and swamp rice farming. It also enables effective record keeping, identification of poor producers and prompt culling, control of social vices such as cannibalism and egg eating. Cage system enables the production of clean eggs, removal of stress factors and it assists in the control of feed wastage. Today, multiple hen cages have essentially replaced floor pens. North (1984) estimated that 75% of all the commercial layers in the world are now kept in cages, and in the United States 93% of layers are in cages. Although its initial capital investment is quite high, the use of battery cage is the most popular intensive system used by large-scale commercial poultry farmers (Joy and Wibberley, 1979).

Numerous field tests have shown that five layers in a cage will result in lower production and lower feed efficiency. Campbell and Lasley (1975) reported that the level of performance of a laying hen depends not only on inherited capacity but also to a great extent upon her environment. The environmental conditions affecting the productivity of a hen include temperature, relative humidity, light, sunshine prevailing at a given time, housing system and ventilation.

Cages are usually constructed in single, double or triple stages which are respectively described as 1-tier, 2- tier and 3-tier. From past studies, the performances of layer chicken have been observed to vary with a number of factors such as feed utilization and body weight (Harms *et al.*, 1982), water availability (Oluyemi and Roberts, 1979), tier of cages (North, 1984), infection (McNitt, 1983) and ambient temperature (Mowbray and Sykes, 1971).

It is a common observation that a flock of layers usually does not produce the same number of eggs everyday. Some times, the figures vary reasonably but occasionally, the variations can be very sharp, appearing suspicious. The objective of this study is to compare the performance of the layer chicken in the different tiers of the 3-tier cage over a period of 10 weeks in order to reassess the hypothesis that the tier 3 (the uppermost tier) of the 3-tier cages is relatively the most inefficient in terms of egg production compared to the first and second tiers. This assumption arises from experiences of occasional unintentional missed service of feed, water or even trough cleaning by attendants to the third tier birds with consequent occasional stress and reduced productivity. The tier is also closest to the roof. This study was focussed at the effect of roof types on the productivity of layer-chickens kept in 3-tier cage.

## Materials and Methods

**Poultry houses:** Two different poultry houses A and B were used for the study. House A metal (zinc) roofing sheets and house B has asbestos. Both houses were contiguous, an indication that they shared same environmental conditions. The temperature ranged between 36.5-40.6 $^{o}$C during the period of study.

**Experimental animals:** 270 healthy Olympia Black layer-chickens in their 10$^{th}$ week in lay were selected from a medically certified flock for the study, 135 birds for each of the two houses.

**Experimental design:** One unit of a 3-tier battery cage made up of 5 cells per tier was set up with each cell having capacity for 3 layer-chickens making a total of 45 chickens per cage unit. The 45 layer-chickens were randomly assigned into the cells, fed and watered *ad-libitum* daily and observed for 10 days of acclimatization before data collection commenced. The same experiment was set up in the contiguous poultry House B with a roof different from House A as described above. The set-up was replicated thrice for each house and throughout the experimental period, the birds were fed on commercial ration (layers mash bought from Top Feed®).

**Data Collection:** The daily egg count for the 10 week study were recorded and the daily percentage Hen day production (% HDP) were calculated for the two houses.

**Statistical Analysis:** The data obtained for production parameter were subjected to the analysis of variance (ANOVA) technique for a 2 × 3 factorial experiment in randomized complete block design (Snedecor and Cochran, 1980) and tested at 5% and 1% levels of significance.

## Results and Discussion

**Mortality in the Flock:** Two and one birds respectively in Houses A and B died before the end of the experiment.

**The Effect of House on Weekly Egg Production (% HDP):** The values for the average % HDP for the 10-week study showed that egg yield from all the tiers in House B were better than the corresponding tiers in House A. The 2 x 3 factorial analysis showed that there was a highly significant ($P < 0.01$) difference between Houses A and B throughout the period of the experiment except in week 7.

Relating the findings in this study to earlier reports for better future production, it is pertinent to state that the environment to which layer-chicken is exposed is determined partly by the system of management which informs the design of poultry houses. Indeed, the birds are unlikely to perform satisfactorily if the housing is unsuitable. It is to be emphasized that housing must be suited to the climatic conditions hence poultry houses differ distinctly between the temperate and tropical countries. The population per cell of the layers is also relevant in this study. Carew *et al.* (1980) reported that as the density of hens per cage increased, hen-day egg production and efficiency of feed utilization were reduced and mortality within the flock increased. The environmental rather than population effect was demonstrated in this study because House A with more environmental (temperature) stress was less productive.

**The Effect of Tier on Weekly Egg Production (% HDP):** The mean weekly egg production (% HDP) was generally in the order of Tier 1 > Tier 2 > Tier 3 in House A and Tier 2 > Tier 3 > Tier 1 in House B.

This variation in weekly egg production per tier in this study is ascribable to the difference in the roofing of the houses because House A where heat effect on the layer-chickens located in the nearest tier to the metal roof had the least egg number. Mc Dowell (1972) observed that air-temperature is an important bio-climatic factor affecting the physiological function of layer-chickens. The effect of temperature on egg production rate was found to be dependent on age of laying hens; it was more evident in old birds, especially when birds were exposed to a cold climate. Oluyemi and Robert, 1979 reported that when temperature falls below the thermoneutral zone, that is below 12.8 $^{o}$C (which is rarely experienced

Table 1: Effect of housing (House/Tiers) on weekly egg production (%HDP) for the period of 10 weeks

| Houses | House A | | | House B | | | Statistical significance | | |
|---|---|---|---|---|---|---|---|---|---|
| | Tiers | | | | | | | | |
| Weeks | 1 | 2 | 3 | 1 | 2 | 3 | House | Tier | HT |
| 1 | 77.61± 5.32 | 72.96±2.83 | 72.07±4.29 | 88.22±4.57 | 92.50±1.37 | 83.21±7.32 | ** | NS | NS |
| 2 | 74.50±6.00 | 70.79±3.49 | 64.43±7.15 | 85.00±2.73 | 90.72±0.83 | 87.14±5.35 | ** | NS | * |
| 3 | 74.71±8.92 | 70.96±2.65 | 67.14±3.50 | 82.86±3.50 | 83.93±3.76 | 85.00±5.89 | ** | NS | NS |
| 4 | 80.79±9.44 | 72.61±1.97 | 68.29±4.02 | 83.57±3.78 | 85.72±3.87 | 81.79±5.39 | ** | * | NS |
| 5 | 74.57±4.98 | 73.32±3.53 | 64.86±2.94 | 79.29±2.48 | 86.07±4.27 | 82.86±3.09 | ** | NS | ** |
| 6 | 76.57±6.29 | 73.07±7.73 | 66.79±1.77 | 77.14±4.67 | 85.00±1.84 | 81.07±3.93 | ** | NS | * |
| 7 | 79.29±7.17 | 68.54±11.09 | 68.00±4.52 | 73.21±4.57 | 78.57±2.02 | 73.57±9.15 | NS | NS | NS |
| 8 | 67.61±7.36 | 64.79±11.92 | 64.46±8.02 | 76.79±3.17 | 82.14±4.12 | 82.85±4.20 | ** | NS | NS |
| 9 | 64.71±8.25 | 66.10±8.67 | 61.68±2.93 | 77.85±2.48 | 79.29±4.29 | 85.00±5.02 | ** | NS | NS |
| 10 | 69.54±8.29 | 63.96±6.23 | 67.35±8.02 | 76.79±3.17 | 82.85±5.08 | 86.79±6.10 | ** | NS | NS |
| Average 1–10 | 73.44±6.12 | 69.71±3.99 | 66.46±3.40 | 80.07±1.49 | 84.68±0.74 | 82.93±3.97 | ** | NS | * |

| | | | |
|---|---|---|---|
| N.S. | Not Significant ($P > 0.05$) | Tier 1 | Lowest stage of the cage. |
| * | Significant ($P < 0.05$) | Tier 2 | Middle stage of the cage |
| ** | Highly Significant ($P < 0.01$) | Tier 3 | Uppermost stage of the cage |
| Houses | House A, House B | HT | House-Tier interaction |
| Tiers | 1, 2, 3 | House A, B, | Tiers 1, 2, 3 - Mean ± S.D |

in the tropics), egg production becomes uneconomic since feed consumption increases, whereas egg production falls and shell thickness is reduced. Temperature higher than 26 $^{o}$C (which prevail in the tropics) usually depressed egg yield and egg qualities. Payne (1966) reported that an environment whose dual temperature fluctuates between 15 and 30 $^{o}$C is highly productive for the layers. Veterinarinarski (1967) reported a decrease in egg production from 77.83% in March to 44.23% in September, indicating that egg production is more favoured by warmer environment. Ebisawa *et al.* (1978) found no significant difference in egg production between birds exposed to minimum temperature of 20 $^{o}$C at 1400hr. Also correlating with environmental temperature to influence the productivity of the layer-chicken is feed intake. Charles (1980) reported that feed intake of a laying hen decreased by 1.5g a day for every degree centigrade rise in temperature above 30 $^{o}$C, decreased egg production by about one egg per bird a year for every degree rise in temperature above 25-30 $^{o}$C and that the depressive effect of environmental temperature by heat stress significantly increases water consumption, reduces egg production, egg weight, shell weight, shell thickness causing a significantly higher production of shellers or very thin-shelled eggs.

The 2 x 3 factorial analysis showed no significant difference among the different tiers throughout the ten weeks except in week 4 at ($P < 0.05$) for which no ready explanation has been found.

**The effect of House/Tier (HT) interaction on Weekly Egg Production (% HDP):** From the result shown in Table 1, the interaction between houses and tiers in weeks 1, 3, 4 and 7-10 showed no significant ($P > 0.05$) difference. The influence of this interaction on % HDP was clearly expressed in weeks 2, 5 and 6 when the % HDP were significantly influenced at $P < 0.05$ and in week 5 when a highly significant ($P < 0.01$) difference was observed.

The low egg production (% HDP) particularly in tier 3 of House A was ascribed to the effect of the heat absorbed and radiated to the environment by the metal roof; the resultant stress caused the birds in tier 3 of House A to eat less than expected but they drank more water. This observation is in agreement with the report of Sykes (1977) and Oluyemi and Roberts (1979). Harms *et al.* (1982) also reported that the amount of feed consumed by fowls is dependent upon the metabolizable energy content of the diet, the size of the bird, the number and size of eggs laid and variation in the maintenance requirements of the chickens as influenced by their activity and the environmental temperature.

In relating the effect of temperature to feed consumption by chickens and feed formulation manipulation, Harms *et al.* (1982) suggested an increase feed consumption in chickens by a reduction of the energy content in feeds. When reduced by fibre dilution or restriction (Lillie and Denton, 1966), it resulted in low productivity and high mortality arising from poor utilization of dietary protein. Because protein and energy are closely related, changes in one nutrient demand adjustment in the other, to ensure optimal utilization of both nutrients (Khoo, 1977). Other factors associated with environmental temperature effect include phosphorus requirement of the laying hen. For example, Daglier *et al.* (1983) reported that phosphorus requirement increases with an increase in environmental temperature.

Explaining how body weight influences egg production, Dunnington and Siegel (1984) postulated that there exists a threshold body weight for each strain of bird; the strain of the birds to be caged for egg production should therefore be properly considered. Renden *et al.* (1984) reported that lightweight hens generally convert feed to egg mass more efficiently than heavy weight hens with *ad libitum* feeding. Deviation from this threshold can cause decrease in efficiency of egg production. Therefore nutritional weight gains up to the necessary weight threshold for the onset of egg production should be closely monitored.

**Conclusion:** The revelation from this study is that egg production under the asbestos roof is better than under the metal roof. Under normal management conditions, that is disease-free, regular feeding and watering and good lighting as established in this study, cage tier alone does not influence egg production. The interaction of the house and tier influenced egg production because the metal roof radiated heat to tier 3 causing reduced egg number from the tier.

For increased egg production, it is being recommended that asbestos rather than metal sheets be used for roofing poultry pens because it could minimize temperature effect on the birds.

## References


Akinyosoye, V.O., 1985. Poultry Production, In, Senior Tropical Agriculture. Macmillan Publisher Limited, London. Reprint 1985. Pages 161-165.

Bogart, R. and R.E. Taylor, 1983. Poultry Management: Scientific Farm Annual Production. Mammalian Publishing Company, Canada. 2nd Edition, pp: 310-319.

Campbell, J.R. and J.F. Lasley, 1975. The Science of Animals that Serve Humanity. Mc Graw Hill Co., USA, pp: 369-394.

Carew, L.B., D.C. Foss and D.E. Bee, 1980. Dietary Energy Concentration Effect of Performance of White Leghorn Hens at Various Densities in Cages. Poult. Sci., 59: 1090-1098.

Charles, D.R., 1980. Environment for poultry. Vet. Rec., 106: 307-309.

Daglier, N.J., M.T. Farran and S.A. Kaysi, 1983. Phosphorus requirements of laying hens in a semi continental climate. Poult. Sci., 64: 1382-1383.

Dunnington, E.A. and P.A. Siegel, 1984. Age and body weight at sexual maturity in female white leghorn chicken. Poult. Sci., 63: 823-830.

Ebisawa, S., H. Mekada, N. Hayastic and K. Sekiya, 1978. Effect of Intervention of diurnally fluctuating environmental temperature on laying performance. Poult. Abst., Vol. 14 No., 41978.

Harms, R.H., P.T. Costa and R.D. Miles, 1982. Daily Feed Intake and Performance of Laying Hens Grouped According to Their Body Weight. Poult. Sci., 61: 1021- 1024.

Joy and Wibberley, 1979. Tropical Agricultural Handbook. Cassel Limited, London, pp: 191-193.

Khoo, T.H., 1977. Effects of nutrient concentration and dietary presentation on performance of dwarf hens. Br. Poult. Sci., 18: 223-226.

Lillie, R.J. and C.A. Denton, 1966. Effect of nutrient restriction white leghorns in the grower and subsequent layer periods. Poult. Sci., 45: 810-818.

Mc Dowell, R.E., 1972. Improvement of livestock production in warm wet climate. W. H. Freeman and Company San Francisco U. S. A., p: 3-22.

McNitt, J.I., 1983. Livestock husbandry Techniques. Gramada Publishing Limited great Britain copyright 1983, p: 215-222.

Mohanlal, G.M., 1985. Livestock and poultry enterprises for rural development, pp: 920-923.

Mowbray, R.M. and A.H. Sykes, 1971. Egg production in warm environmental temperature. Br. Poult. Sci., 12: 25-29.

North, M.O., 1984. Commercial chicken production manual. 3rd edition. Avi publishing Company Inc. West Port C.T.

Oluyemi, J.A. and F.A. Robert, 1979. Management and housing of adult birds, In, Poultry production in warm wet climates, pp: 49-106.

Payne, C.G., 1966. The influence of environmental temperature on poultry performance. World Poult. Sci., 22: 126-139.

Penda, P.C., 1985. Egg and Poultry Technology. Publishing house PVT LTD Janipura India, P: 2-4.

Renden, J.A., G.L. Mc Daniel and J.A. Mcquire, 1984. Egg characteristics and production efficiency of dwarf white leghorn hens divergently selected for body weight. Poult. Sci., 63: 214-221.

Snedecor, C.W. and W.G. Cochran, 1980. Statistical Methods. 6th Edition. Iowa State Univ. Press, Iowa.

Sykes, A.H., 1977. Nutrition-environment interactions in poultry. Haresign, W. Swan, H. and Lewis, D.ed. Bulterworths, London, U.K.

Veterinarinarski, P., 1967. Egg production, feed consumption and maintenance energy requirements of leghorn as influence by dietary energy at temperature of 15.6 and 26.7 $^{o}$C. Poult. Sci., 58: 674-680.