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The Physical and Laying Characteristics of Golden Sex-Linked Hens under the Humid Tropical Environment

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Abstract: A total of fifty-two Golden-sex link (brown) hens in their 65th week of lay were used in a study conducted to determine the oviposition time and interval, total egg production, clutch length and number of pause days of the birds under the humid tropical environment. The hens were also divided into four classes on the basis of their laying performances as follows: good layers, intermediate layers, poor layers and non layers and their physical conditions appraised. The birds were supplied water *ad libitum* and fed layers mash containing 16.5% crude protein and 9.62 MJ/kg ME for 5 weeks. Results showed that the peak of lay was between 7.30-8.30 am and declined gradually until only one egg was laid between 3.30-4.30 pm. About 66.36% and 33.64% of the eggs were laid in the morning hours and in the afternoon hours, respectively. The mean oviposition interval was 26.61 h, while the average laying intensity was 48.90%. About 98% of the clutch lengths were of 5 cycle lengths and below, with the highest frequency of occurrence being 1 cycle length. The total number of pause days over all birds was 558 days. Hens with the longest clutches and shortest number of pause days produced the greatest number of eggs. Observation made on the physical characteristics revealed that good layers had smooth and waxy comb and wattles. The vents were moist and enlarged with flexible pubic bone, soft abdomen and worn out feathers. Intermediate layers had similar features with the good layers except that eye rings, beaks and shanks were slightly bleached. Poor layers had dry combs and wattles; tight and hard abdomen and closed pubic bones. Non layers had scaly, dry and rough comb and wattles; dull eyes and rigid pubic bones which were relatively close together.

Key words: Golden sex-linked hens, physical characteristics, laying characteristics, humid environment

INTRODUCTION

Overall egg production is an important economic factor to the poultry farmer. It is determined by clutch size and skip days and influenced by several other factors such as the breed of bird, nutrition, age and weight of bird, level of production, management system and environmental temperature (Ahmad *et al*., 1974; Oluyemi and Roberts, 2000). Laying birds appear to lay most of their eggs before late afternoon. Wolford *et al*. (1964) and Spradbrow (1997) reported that a hen lays eggs sequentially or in clutches. Each sequence or clutch is separated from others by one or more pause days on which no eggs are laid. There is also variation in oviposition time. Rose (1997) asserted that an individual laying egg can produce long sequence of eggs on succeeding days. She will then have a pause day with no egg. Further sequence of eggs will then follow. Individuals within a large flock will have different pause days and so the flock will have a smooth egg production curve that is typical for that class of bird (whether chicken, duck, turkey hens, etc.). Most poultry take more than 24 h and less than 30 h to form their eggs. However, the time of egg laying is not just a random event and there are characteristic patterns for the different species. Information on total egg production, clutch length, skip days and physical characteristics of laying and non-laying hens is very useful in culling poor layers and retaining good layers in a flock. Culling is generally not done in large commercial egg-laying flocks. These birds have been bred to lay and usually maintain high rates of lay. However, Kekeocha (1987), Obioha (1992) and Smith (2001) postulated that when the average egg production of a flock declines below expectation, even under good management in the absence of disease out break, then it is the right time to cull. McNitt (1983) asserted that identification of non-productive birds is easy in a battery system if each cage is numbered and records kept on the eggs produced by each bird. In this way it becomes easy to decide on which birds to cull. A breed of bird can be certified as a good layer or poor layer based on data collected from clutch length, pause days, egg number, oviposition interval and the physical characteristics of the hens. Good layers can be separated from poor layers based on discernible physical characteristics which are related to laying. Therefore, most of our knowledge in respect to the judging of laying ability is closely tied up with the fact that high egg production leaves its mark in the way of discerning physical characteristics. To the extent that a good hen in any one year tends to repeat the

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performance, the selection of high layers on the basis of past production has a commercial value that is not necessarily related to the breeding problem, though it is commonly used as a part of a general improvement program (Card, 1962). The use of physical characteristics to determine laying and non-laying hens or good layers and poor layers had also been documented by Obioha (1992) and Gillespie (1997). This study was therefore designed to investigate the physical and egg laying characteristics of Golden sex-linked hens under the humid tropical environment.

MATERIALS AND METHODS

Location of study: The study was conducted at the Poultry Teaching and Research Unit of the Department of Animal Science Farm, University of Nigeria, Nsukka. The climatic data for Nsukka as recorded at the Meteorology station of the Department of Crop Science, University of Nigeria, Nsukka is as follows: mean natural day length, 12 to 13 h; mean maximum temperatures, 33.10-33.61°C; mean minimum temperatures, 22.84-23.25°C; mean relative humidity, 57.87 to 76% and mean total rainfall, 143.5 mm.

Experimental animals and management: A total of fifty-two Golden-sex link (brown) laying hens were selected and used for the study. The birds were selected by visual observation, numbered and housed in individual battery cages. Birds were fed layers mash containing 16.5% crude protein, 9.62 MJ/kg ME, 3.8% calcium, 0.36% phosphorus, 5% crude fibre and 4.0% crude fat. Each bird received about 125 g of the layers mash per day and water was provided *ad libitum*. Feeding was done once each day between 7.30am to 8.30am. The water supplied to the birds was medicated with an anti-stress (Vitalyte) for a period of one week at the start of the experiment. The study lasted for five weeks, during which oviposition (egg laying) time for each hen was observed and recorded as soon as an egg was dropped. Eggs were collected between 6.30am to 4.30pm. The experimental hens were continuously observed from 6.30am to 4.30pm. The following parameters were calculated from the data generated:

Oviposition intervals: The oviposition intervals were obtained by calculating the differences between successive oviposition times in a clutch. The total mean oviposition interval was obtained by adding all the individual mean oviposition intervals and then dividing them by the number of hens.

Time lag: Time lag between successive eggs was obtained as the difference in time interval between successive eggs and 24 h, thus: Time lag = oviposition interval minus 24 h.

Total egg production: This was obtained by adding all the eggs produced by the 52 hens during the experimental period.

Percentage egg production: Hen-housed or hen-day production was calculated by the following method: % egg production = No. of eggs laid divided by the No. of birds housed x No. of days of lay x 100/1.

Egg number per hen for the weeks: This was calculated based on the following principle: Egg number = Total egg produced for the no of days divided by total number of hens.

Clutch length: This was determined for each hen by counting the number of eggs laid until a day was skipped. The mean clutch length per hen and the average of the total clutch length were also obtained.

Number of pause days: The number of pause days for the experimental period was obtained for each hen by subtracting the individual number of egg produced from the number of days. For example, if hen No. 5 produced 15 eggs, then the pause days would be 21 days-15 = 6 days. For the 52 hens, the total number of pause days was obtained by adding up the pause of each individual hen. The physical characteristics of the laying and non-laying hens were also observed. These were obtained by careful examination of the conditions of the combs, wattles, eyes, beak, pubic bones, shanks, abdomen, plumage and cloaca. The examination involved visual observation and palpitation of palpable physical structures of the hens. The space between the keel and cloaca was measured in centimeter (cm) with a tailor's tape.

Statistical analysis: Data were subjected to statistical analysis as described by Steel and Torrie (1980). Means and standard errors of the means for the different parameters were calculated. Frequency distributions of egg production, pause days, clutch length and oviposition interval were calculated and illustrated in a bar chart.

RESULTS

Oviposition time and interval: The oviposition interval of hens is shown in Table 1. As observed during the experimental period, more eggs were laid in the morning hours (6.30 am - 11.30 am) than in the afternoon hours (11.30 am - 4.30 pm). About 66.36% of all the eggs were laid in the morning hours and 33.64% were laid in the afternoon hours.

Oviposition reached peak between 7.30 - 8.30 am and declined in the early afternoon hours between 11.30 am - 12.30 pm and then increased slightly in the mid-

Table 1: Frequency distribution of the oviposition interval of the golden-sex-link hens

Hen code No.	Oviposition interval	Relative freq. (%)	Hen code No.	Oviposition interval	Relative freq. (%)	Hen code No.	Oviposition interval	Relative freq. (%)
1	28.2	2.70	19	25.3	2.43	37	26.3	2.52
2	29.3	2.81	20	28.2	2.70	38	27.3	2.62
3	30.7	2.94	21	26.5	2.54	39	25.5	2.45
4	25.4	2.44	22	26.2	2.51	40	27.1	2.60
5	26.1	2.50	23	25.1	2.41	41	28.3	2.71
6	26.2	2.51	24	27.3	2.62	42	26.3	2.52
7	26.4	2.53	25	-	-	43	-	-
8	26.2	2.51	26	-	-	44	0	-
9	25.1	2.41	27	-	-	45	0	-
10	26.6	2.55	28	24.5	2.35	46	29.2	2.80
11	23.1	2.22	29	-	-	47	28.2	2.70
12	26.1	2.50	30	-	-	48	27.5	2.64
13	27.1	2.60	31	-	-	49	26.1	2.50
14	26.4	2.53	32	-	-	50	26.4	2.53
15	0.0	-	33	26.0	2.49	51	27.2	2.61
16	27.2	2.61	34	29.3	2.81	52	27.0	2.59
17	25.1	2.41	35	0.0	-		1042.6	99.97
18	26.6	2.55	36	0.0	-			

Table 2: Frequency distribution of egg production of the golden-sex-link hens

Hen code No.	Number observed	Relative freq. (%)	Hen code No.	Number observed	Relative freq. (%)	Hen code No.	Number observed	Relative freq. (%)
1	14	2.62	19	17	3.18	37	13	2.43
2	13	2.43	20	14	2.62	38	13	2.43
3	9	1.69	21	13	2.43	39	13	2.43
4	16	3.00	22	17	3.18	40	14	2.62
5	15	2.81	23	15	2.81	41	15	2.81
6	17	3.18	24	15	2.81	42	14	2.62
7	16	3.00	25	0	-	43	0	-
8	11	2.06	26	0	-	44	1	0.19
9	15	2.81	27	1	0.19	45	0	-
10	13	2.43	28	12	2.25	46	11	2.06
11	4	0.75	29	0	-	47	13	2.43
12	17	3.18	30	7	1.31	48	14	2.62
13	15	2.81	31	1	0.19	49	15	2.81
14	15	2.81	32	0	-	50	12	2.25
15	0	0	33	9	1.69	51	13	2.43
16	15	2.81	34	4	0.75	52	13	2.43
17	14	2.62	35	0	-		534	99.98%
18	16	3.00	36	0	-			

afternoon hours between 12.30 - 1.30 pm and then declined gradually until only one egg was laid between 3.30 - 4.30 pm (late afternoon hours). As observed during the experimental period, the mean time interval between successive eggs for Golden-sex-link hens was 26.61 h. The least oviposition interval was 23.10 h and the highest oviposition interval was 30.68 h.

Total egg production: The distribution pattern of egg production is shown in Table 2.

Result shows that a total of 534 eggs were laid by the hens during the experimental period. The average number of eggs produced by the hens was 10.27 eggs per hen and the percentage egg production or hen-housed production was 48.90% with a range of 0-17 eggs. Therefore, the least number of eggs produced by a single hen within the experimental period was 0 and the highest number of egg produced was 17 eggs. The frequency distribution of egg production is shown in Fig. 1.

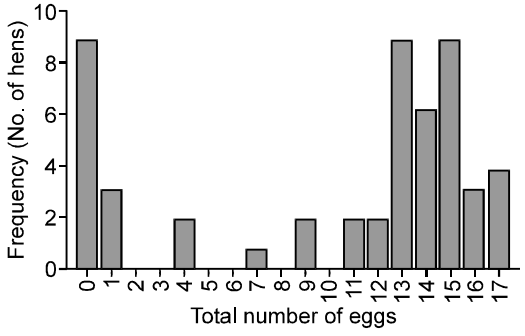

Fig. 1: Frequency distribution of egg production

Table 3: Frequency distribution of mean clutch length of the golden-sex-link hens

Hen code No.	Clutch length	Relative freq. (%)	Hen code No.	Clutch length	Relative freq. (%)	Hen code No.	Clutch length	Relative freq. (%)
1	1.6	1.95	19	2.8	3.42	37	1.6	1.95
2	1.4	1.71	20	1.8	2.20	38	1.6	1.95
3	1.0	1.22	21	1.9	2.32	39	2.2	2.69
4	4.0	4.88	22	2.4	2.93	40	2.0	2.44
5	2.1	2.56	23	1.9	2.32	41	1.9	2.32
6	2.4	2.93	24	1.8	2.20	42	1.6	1.95
7	2.7	3.30	25	0.0	-	43	0.0	-
8	1.5	1.83	26	0.0	-	44	1.0	1.22
9	5.0	6.11	27	1.0	1.22	45	0.0	-
10	1.6	1.95	28	3.0	3.36	46	1.2	1.47
11	1.3	1.59	29	0.0	-	47	1.4	1.71
12	2.4	2.93	30	1.0	1.22	48	1.6	1.95
13	2.5	3.05	31	1.0	1.22	49	2.1	2.56
14	1.9	2.32	32	0.0	-	50	2.4	2.93
15	0.0	-	33	1.1	1.34	51	1.4	1.71
16	1.8	2.20	34	1.0	1.22	52	1.6	1.95
17	2.5	3.05	35	0.0	-		81.90	99.97
18	1.9	2.32	36	0.0	-			

Table 4: Frequency distribution of the pause days of the golden-sex-link hens

Hen code No.	Pause days	Relative freq. (%)	Hen code No.	Pause days	Relative freq. (%)	Hen code No.	Pause days	Relative freq. (%)
1	7	1.25	19	4	0.72	37	8	1.43
2	8	1.43	20	7	1.25	38	8	1.43
3	12	2.15	21	8	1.43	39	8	1.79
4	5	0.90	22	4	0.72	40	7	0.90
5	6	1.08	23	6	1.08	41	6	1.08
6	4	0.72	24	6	1.08	42	7	1.25
7	5	0.90	25	21	3.76	43	21	3.76
8	10	1.79	26	21	3.76	44	20	3.58
9	6	1.08	27	20	3.58	45	21	3.76
10	8	1.43	28	9	1.61	46	10	1.79
11	17	3.05	29	21	3.76	47	8	1.43
12	4	0.72	30	14	2.51	48	7	1.25
13	6	1.08	31	20	3.58	49	6	1.08
14	6	1.08	32	21	3.76	50	9	1.61
15	21	3.76	33	12	2.15	51	8	1.43
16	6	1.08	34	17	3.05	52	8	1.43
17	7	1.25	35	21	3.76		558	99.61%
18	5	0.90	36	21	3.76			

Table 5: The mean, standard deviation and standard error of mean of egg production and pause days

No. of birds	Total eggs produced	Total pause days
52	534.00	558.00
$\bar{X}$	10.27	10.73
SE	0.85	0.85
Stand. Dev.	6.16	6.16

Clutch length: The distribution pattern of the clutch length is shown in Table 3. During the experimental period, clutch lengths of 1, 2, 3, 4, 5, 6 and 7 were observed. Clutch length of 1 occurred most frequently and clutch lengths of 6 and 7 occurred only once throughout the period. Generally speaking, the data obtained on clutch length show that about 98% of the clutch lengths were of 5 cycle lengths and below, with the highest frequency of occurrence being 1 cycle length.

Number of pause days: The distribution pattern of the number of pause days is shown in Table 4, while Table 5 shows the mean, standard deviation and standard error of mean of egg production and pause days. The total number of pause days over all birds was 558 days. Of this, average pause days of 6, 8 and 21 days occurred most frequently and pause days of 14 least. The frequency distribution of the total pause days is shown in Fig. 2.

Physical characteristics and classification of hens: Table 6 shows the classification of hens. The hens were classified as good layers, intermediate layers, poor layers and non-layers. Yellow pigment was observed on the non-laying hens, eyes were dull and sunken. In laying hens, bright red and large combs and wattles were observed. There was evidence of bleached (white)

Table 6: Classification of the experimental hens

No. of hens	PCLAL	No. of eggs	Oviposition interval	Clutch length	Skip days	Physical characteristics
22	Good (72.2%)	15.23 (14-17)	26.50 (25.07-28.24)	2.3 (1-7)	5.8 (4-7)	White shanks, bleached beak, white cloaca or vent
15	Intermediate (57.46%)	12.07 (8-13)	27.13 (24.46-30.68)	1.7 (1-6)	8.9 (14-20)	Bleaching shank, bleaching beak, bleaching cloaca or vent
6	Poor (14.29%)	3.00 (1-7)	26.20 (23.10-29.30)	1.1 (1-2)	18 (14-20)	Dry cloaca
9	Non-layers (0)	0	0	0	0	Dry and contracted vent or cloaca

PCLAL = Performance Class of Layers and % Lay

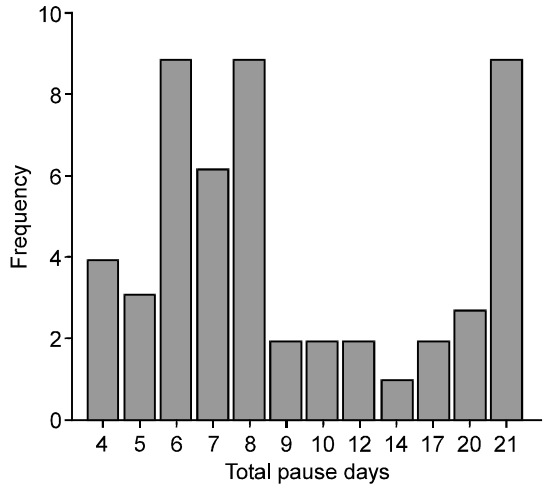

Fig. 2: Frequency distribution of pause days

physical structures, bleaching beak, shank, eye ring, ear lobe, claoca, etc. The average space between keel and cloaca in the hens were as follows: good layers-9.8 cm, intermediate layers-9.2 cm, poor layers-9.4 cm and non-layers-8.9 cm.

DISCUSSION

Oviposition time and interval: Although there was a great variation in the oviposition (egg laying) time, most of the eggs were laid before late morning hours. As a matter of fact, 66.36% of the eggs were laid in the morning hours and 33.64% of the eggs were laid in the afternoon hours. This observation is in agreement with the findings of McNitt (1983), Orji and Nwakalor (1984), Rose (1997) and Ajaero and Ezekwe (2006). McNitt (1983) reported that 70% of hens lay their eggs within the first 5 h after bright light begins and 90% within 7 h. Rose (1997) reported that domestic fowls lay most of their eggs in the morning hours. However, the observation disagrees with the findings of Nys and Morgan (1981) who reported that ovipositions were distributed virtually at random throughout the day. The disparity could be because of differences in the amount of daily light in the different study locations. The birds the earlier researchers worked with could have received less natural light within the range of time given compared with the amount of day light the birds in the present study were exposed to in South-East Nigeria. Besides breed of bird, nutrition, age and weight of bird, level of production, management system and environmental temperature, laying is also much affected by season, especially day length (Ahmad *et al*., 1974; Oluyemi and Roberts, 2000). The sharp decline in the number of eggs produced after 4 pm could be as a result of the fact that oviposition rarely occurs after 3.00 pm (Card and Neshiem, 1972). Smith (2001) reported that chickens do not normally lay eggs in the late afternoon and therefore once the egg laying is delayed beyond mid-day, oviposition is delayed until the following day. This assertion is in agreement with the low output of eggs observed during the afternoon hours in the present study. The average oviposition interval obtained for the Golden-sex link hens was 26.61 h. The oviposition intervals were 26.50 h, 27.13 h and 26.20 h for good layers, intermediate layers and poor layers, respectively. The range of oviposition interval for the three categories of layers was 25.07-28.24, 24.46-30.68 and 23.10-29.30, respectively. These results are not in conformity with the reports of Cole and Cupps (1977) and Gilbert and Wood-Gush (1977) that the oviposition interval by most hens ranges from 24-28 h. This might be due to breed difference, nutrition, age and weight of bird, level of production, management system and environmental temperature (Obioha, 1992; Oluyemi and Roberts, 2000; Smith, 2001). Old age in particular is known to cause the laying of thin-shelled eggs and this was frequent among the layers used in the present study. This suggestion is in agreement with the report of Austic and Neshiem (1990) that ageing hens lay more watery albumen, thin-shelled eggs and yolk without shell.

Total egg production, clutch lengths and number of pause days: Observation showed that a total of 534 eggs were produced by the 52 experimental hens. Hens with the longest clutches and shortest number of pause days produced the greatest number of eggs. This finding is in conformity with the report of Nalbandov (1966) who reported that hens with the longest clutches would produce the largest number of eggs each laying year because they have the fewest number of non-productive

days. Hens with one - or two - egg clutches cannot produce more than 180 or 240 eggs a year. Clutch size during the experiment varied from 1-7, with one occurring most frequently and 7 occurring once. The high frequency of hens with shorter clutch length might be due to old age of the hens. Robinson (1999) reported that hens that have slow rate of follicular maturation (26-28 h or more) lay short (2-3 days) sequences or clutches. On the other hand, hens that lay very long sequences typically have maturation rates of 24 h or perhaps less. The high frequency of short clutch length of 1 and 2 in the experimental hens might then be due to slow rate of follicular maturation. From the data obtained, good and intermediate layers had lower number of pause days while poor and non-layers had higher number of pause day. It is evident from the data obtained in the present study that the pause days of laying hens occurred more frequently following oviposition in the afternoon than in the morning hours. This is in agreement with the report of Smith (2001) that chickens do not normally lay eggs in the afternoon and therefore once the egg is delayed beyond midday, oviposition is delayed until the following day. It was also observed that when oviposition occurred after 3 pm, hens tended to pause the next day and following the pause, they would then return to early morning oviposition earlier than their contemporaries which laid the previous day. It does seem that there is an inverse relationship between oviposition interval and clutch length. Thus, oviposition interval was found to decrease as clutch length increased and vice versa. Similarly oviposition lag decreased as clutch length increased and the lag became negative with long sequence.

Physical characteristics and classification of hens: Based on number of eggs produced, clutch length, oviposition interval; number of pause days and physical characteristics, the hens were classified into four classes as follows: good layers, intermediate layers, poor layers and non-layers (Table 6).

Good layers were those that produced 14-17 eggs in 21 days, had oviposition interval of 25.07-28.24, clutch length of 1-7 and pause days of 4-7. They also had the following physical characteristics: full, plump, smooth and waxy comb; prominent, soft and smooth wattles; bright eyes, bright red face, beak, eye ring, earlobe and vent (cloaca), as well as white or well bleached shanks. Their vents were white or well bleached, large, soft, moist, oval and some times overhanging; the pubic bones were thin, pliable and relatively wide apart to accommodate about two or more fingers within the inter-pubic space as described by Obioha (1992) and Oluyemi and Roberts (2000). The distance between keel and vent of good layers was 9.8 cm. While this is higher than the range of 6.25-7.50 cm reported for laying hens by Smith (2003), it compares with 10.55 cm reported by Ajaero and Ezekwe (2006).

Intermediate layers were those that produced 8-13 eggs in 21 days. They had oviposition interval of 24.46-30.68, clutch length of 1-6 and pause days of 8-13. They had the following physical characteristics: the combs, wattles, eyes and abdomen were the same as seen in good layers. The beak showed some degree of bleaching. The lateral part (side) of the beak was bleached or white (fully bleached). The caudo-cranial part (base) was bleached or white (fully bleached) while the tip was white. The shanks showed some degree of bleaching. The region of the meta-tarsal joint and some parts of the toes were yellow. The dorsal part (back) and lateral parts (side) were white. The frontal aspect-the region above the meta-tarsal joint and the hock joint were white. Besides, the eye lids, eye ring and ear lobe were bleached. They had moist, enlarged, dilated, bleached and pliable cloaca when compared with poor and non-layers and moist, bleached, pliable and intermediately enlarged and dilated when compared with good layers. Their feathers were worn, soiled and scruffy layers as in good layers. The distance from the public bones to the point of keel was also increased. Moreover the pubic bones were soft, thin and relatively wide apart, while the face was bright. Just like good layers, the intermediate layers were relatively active, alert and fed well. The observed features were similar to the features described by Smith (2001).

Poor layers were classified based on the fact that they produced 1-7 eggs in 21 days, had oviposition interval of 23.10-29.30, clutch length of 1-2 and pause days of 14-20. They had the following physical characteristics: combs were shriveled, dry and covered with white scales; eyes were dull; wattles were rough and dry; face was yellowish; abdomen was tight, hard and tucked up with the rear end of keel; the pubic bones were close and could not accommodate about two or more fingers within the inter-pubic space as described by Obioha (1992) and Oluyemi and Roberts (2000). Unlike in good and intermediate layers where the abdomen is loose, pliable, soft, full when in laying condition, the pubic bones were rigid, thick, blunt and relatively close together. Moreover the beak was yellow at the base, tip and sides, whereas the vent (or cloaca) was yellow or tinted, small, hard, dry, round and some times appeared contracted-the vent of non-layers are usually contracted. The eye ring, ear lobe and shanks were yellow or tinted.

Non-layers were those that produced no eggs, had no oviposition interval, had zero clutch length and had zero skip days. They had the following physical characteristics: scaly, dry and shriveled comb; dull eyes; rough and dry wattles; yellowish tint face and rigid, thick and blunt pubic bones which were relatively close together so that less than two fingers could be accommodated in the inter-pubic space. Besides the beak was yellow at base, tip and sides while the vent was yellow or tinted, small, hard, dry, round and

contracted. Moreover the eye ring, ear lobe and shanks were yellow or tinted, while the abdomen was tight, hard and tucked up to the rear end of keel. Their pubic bones were so close that they could accommodate less than three finger's width unlike in laying hens.

The marked difference between good layers and intermediate layers in terms of physical characteristics was that while the bleachable parts (shanks, beak, vent, eye ring, ear lobe) were sparingly bleached in intermediate layers, they were fully bleached in good layers. The other physical characteristics like conditions of the comb, eye, pubic bones and abdomen were the same in good and intermediate layers. The striking difference between the poor and non-laying hens was that the non-laying hens did not have yellowish bleachable parts (shanks, beak, vent (cloaca), eye ring and ear lobe) as the laying hens had.

Conclusion: It is evident from the data obtained in the present study that Golden-sex link hens are adapted to the tropical environment and lay 66.36% of their eggs in the morning hours with the mean percentage egg production or hen-housed production of 48.90% (178.49 eggs in a year) in their second laying phase. Although good layers, intermediate layers and poor layers could lay 263.53 eggs, 209.73 and 52.16 eggs, respectively in a year, with the mean egg production of 178.49 eggs, it may not be economical to keep the birds beyond the first laying phase of 365 days.

REFERENCES

Ahmad, M.M., F.B. Mather and E.W. Gleaves, 1974. Effects of environmental temperatures and dietary energy on dwarf and normal hens and normal roosters. Poult. Sci. J., 53: 929-935.

Ajaero, O.I. and A.G. Ezekwe, 2006. The laying and physical characteristics of shaver brown hens in a hot humid environment. Agro-Sci. J. Agric., Food, Environ. Ext., 5: 25-32.

Austic, R.E. and M.C. Neshiem, 1990. Poultry Production 13th Edn., Lea and Febiger. Philadelphia, USA.

Card, L.E., 1962. Poultry Production. 10th Edn., Lea and Febiger, Phildelphia, USA.

Card, L.E. and M.E. Neshiem, 1972. Poultry Production. 11th Edn., Lea and Febiger. Phildelphia, USA.

Cole, H.H. and P.T. Cupps, 1977. Reproduction in Domestic Animals, 3rd Edn., Academic Press Inc. New York, USA.

Gilbert, A.B. and D.G. Wood-Gush, 1977. Ovulatory and Ovipository Cycles. In: Physiology and Biochemistry of the Domestic Fowl.D.J. Bell and B.M Freeman, eds. Academic Press, London.

Gillespie, J.R., 1997. Modern Livestock and Poultry Production, 5th Edn. by Delmar Publishers, An International Thomson Publishing Company, pp: 640-647.

Kekeocha, C.C., 1987. Poultry Production Handbook, Pfizer Corporation.

McNitt, J.I., 1983. Livestock Husbandry Techniques. 1st Edn., Great Britain Granada Publishing Ltd.

Nalbandov, A.V., 1966. Egg laying in Introduction to Livestock Production, 2nd Edn. Edited by H.H. Cole USA W. H. Freeman and Company.

Nys, Y. and P. Morgan, 1981. The effect of 6-and 8-hour light-dark cycles on egg production and pattern of ovipositions. Br. Poult. Sci., 22: 391-397.

Obioha, F.C., 1992. Poultry Production in the Tropics, 1st Edn., Acena Publishers. Enugu, pp: 212.

Oluyemi, J.A. and F.A. Roberts, 2000. Poultry Production in Warm Wet Climate. London Macmillan Press Ltd.

Orji, B.I. and L.N. Nwakalor, 1984. The pattern of egg laying in domestic fowls kept in warm tropics. Nig. J. Anim. Prod., 11: 123-129.

Robinson, F.E., 1999. Management for control of ovarian development in broiler breeders. Ross Technical Bulletin April 1999. Ross Breeders, inc.

Rose, S.P., 1997. Principles of Poultry Science. CAB International.

Smith, A.J., 2001. Poultry. 2nd Edn., Macmillian Publishers Ltd. London, pp: 1-11.

Smith, T.W., 2003. Culling Hens. In: Publication 358 Extension Service of Mississippi State University, Cooperating with U.S Department of Agriculture, USA.

Spradbrow, P.B., 1997. Policy frame work for small holder rural poultry development. In:sustainable Rural Poultry Production in Africa (Ed. E.B. Sonaiya). Proceedings of an International Workshop, 13th-16th June, 1995. International Livestock Research Insitute, Addis Ababa.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statstics. A Biometric Approach. 2nd Edn., McGraw-Hill Publishers, New York, pp: 633.

Wolford, J.H., R.K. Ringer and T.H. Coloman, 1964. Lag time, interval between successive eggs and oviposition time in Turkey. Poult. Sci., 43: 612-615.