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Egg production performances of a breed and three crossbreeds under semi-scavenging system of management

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Abstract

Data were collected from 54 selected farms of key rearers in Badalgachi thana in the Naogaon district in Bangladesh to investigate egg production performance of a breed and three crossbreeds.

The Rhode Island Red (RIR) x Fayoumi attained late sexual maturity (222 d). However, during a period up to 46 weeks of age they produced the highest number of eggs (41.6 eggs per hen day and 31.2 eggs per hen housed) with the highest rate of lay of the largest size (44.4 g) and the thickest shell (0.333 mm) with the highest albumen height, yolk height and yolk colour fan score (8.2 mm, 18.9 mm, 9.8), respectively. The others were the pure-bred Fayoumi and the two crosses Naked Neck × Fayoumi and Naked Neck × RIR. Feed supplement of ranged from 15 to 45 g per hen/day. Birds receiving the highest level had the highest rate of lay (39.6%) with the largest egg size (42.2 g). Supplementary feed levels did not influence age at sexual maturity, body weight, or any egg quality traits. Locations did not have an effect on age at sexual maturity and egg production. Breeds, supplementary levels of feed, and locations did not affect mortality. However, mortality due to predators was significantly higher in RIR x Fayoumi.

Key words: Body weight, breed, crossbreed, egg production, egg quality, feed supplementation, semi-scavenging

Introduction

In a developing country like Bangladesh, poultry production in rural areas is of great importance as a prime supplier of eggs and meat and as a source of income, especially to women. It provides supplementary income for about 45% and 40% of people in the rural and urban areas, respectively (BBS 1995). Scavenging village chickens have cultural, social, nutritional, economic, and sanitary functions in daily life. About 78% of the total egg and 86% of the total meat production of the country come from scavenging poultry (Alam 1995). The total poultry population in Bangladesh was estimated to be 211 million (Howlider 1999) in 2002.

The constraints for improving productivity are related to breeds unsuitable for the environment and to diseases, bad management, lack of supplementary feeding and predators (Bagust 1994, 1999). Exotic birds are more susceptible to heat stress (Arjona et al 1988). Nevertheless, Yushimura et al (1997) observed, among the indigenous chickens, that birds being homozygous Naked Neck were found superior regarding egg production, egg size, and body weight at an ambient temperature of about 30^{o}C. Merat (1986) reported good opportunities for utilizing the genetic variability of the Naked Neck genotype. Crossing Fayoumi with other standard exotic breeds improved egg size, growth rate, and adaptability of the resulting birds to farm conditions of Bangladesh (Ali 1989). A cross-breed of Fayoumi female and RIR male first produced in 1986 has several times been reported to have a higher egg production and a better chance of survival under semi-scavenging conditions compared with other exotic breed combinations (Rahman et al 1997).

Scavenging laying hens can find approximately 60 to70% of their total feed requirements (Rahman et al 1997); Jensen (1996) estimated the figure to be 30 to 70%. Thus, providing a supplement feed should help them to fully express their potential for egg laying.

A model for small holder poultry rearing has been adopted under the Participatory Livestock Development Project - PLDP (Nazir Ahmed 2000), where 95% of the beneficiaries are key rearers (Amber 2000) which means they will receive 8 week old cross-bred chickens, produced at a chick rearer. The key rearers keep their hens under semi-scavenging conditions and provide them with supplementary feed.

The present investigation was undertaken to compare the performances of a breed and three crossbreeds in a semi-scavenging system of management. The purpose was to compare the RIR x Fayoumi hen often used in the Bangladesh model with cross-bred hens in which the cock of native Naked Neck was mated to hens from the pure-breeds used to produce the RIR x Fayoumi hen. We studied egg production and the quality of eggs at different levels of supplementary feed at different locations under the management of key rearers.

Materials and methods

Data source and working area

This study was undertaken by the key rearers of the NGO: Thangamara Mahila Sabuj Shangha (TMSS) under the project Participatory Livestock Development Project (PLDP) at Badalgachi thana in the Naogaon district (northern area of Bangladesh). The annual rainfall is 2032 mm and the temperature ranges from 12 to 38°C. The main crops includes maize, aman rice, oilseed, pulse, and wheat.

Breed and crossbreeds

A breed (Fayoumi) and three crossbreeds [RIR*Fayoumi, Naked Neck (NN)*Fayoumi and NN*RIR] were used in the present study. NN cocks from the local market were crossed with RIR hens from Bogra Government Poultry Farm. RIR x Fayoumi was produced by crossing RIR cocks with Fayoumi hens, both from Rangpur Government Poultry Farm. The eggs were hatched in an artificial incubator and the chicks were reared separately, according to the breed and crossbreeds, at the poultry rearing unit under the same management and environmental conditions. At 14 weeks of age all the pullets were taken to the study area to be distributed among the key rearers.

A total of 100 pullets for the RIR x Fayoumi and the same for the pure-bred Fayoumi and 35 pullets for each of the breed combinations of NN*Fayoumi and NN*RIR were used for this study. Owing to heterozygocity in the local NN cocks about half of the offspring did not have the naked condition of their neck. Thus, a total of 270 pullets of the 4 different breeds were distributed to the 54 key rearers, so that a key rearer got 5 pullets, all from the same breed. In 7 villages four key rearers in each village got a different breed; for the rest two key rearers per village got either RIR*Fayoumi or Fayoumi. The term village is here used to indicate a narrow territory in which the chickens were offered almost the same conditions for scavenging.

The whole study area was divided into three study locations named Location 1 (riverside area), Location 2 (semi-terraced area), and Location 3 (terraced area).

Feeding and scavenging

During rearing in a confinement system at Rangpur Government Poultry Farm, the chicks were fed with a balanced diet delivered by the Bangladesh Rural Advancement Committee (BRAC), containing 20% CP and 2850 kcal ME/kg of feed. After transfer to the key rearers the chickens were kept for one week in confinement. Subsequently, they were allowed to scavenge around the homestead and in the neighbourhood for a period of 2 hours in the morning and 2 hours in the evening, and between the 2 scavenging periods they were provided with supplementary feed for 6 to 7 hours in a cafeteria feeding system in the day shelter. The amount of supplement was measured to be one of three different levels of approximately 15, 30 and 45 g/hen/day during the study period.

The chickens were supplemented with crushed maize/wheat, mixed with paddy rice and broken rice as energy source, soybeans as vegetable protein, and oyster shells as calcium source, in three separate compartments of a bamboo cafeteria feeder. There was a continuous supply of drinking water in the shelter as well as during the scavenging periods of the day. At night and during bad weather conditions they were sheltered in a bamboo basket placed on the ground in a room. Laying boxes were placed in the day shelter for the hens safely to lay their eggs without being disturbed.

Vaccination

The two major viral diseases, Newcastle and Infectious Bursal, are very often met in Bangladesh. Therefore, the chickens were vaccinated against those diseases.

Data collection

Field assistants collected data on egg production, body weight (bimonthly), and egg quality (monthly) from the start of December 2001 to the end of April 2002. Thus, the egg production has only been checked during part of the whole laying period.

Age at sexual maturity was - on a farm basis - defined to be the day when two eggs were collected from the 5 hens. Egg production on a farm basis was calculated as number of eggs in relation to existing hens during the period (hd) and in relation to number of hens placed (hh). The production in terms of hens placed (hh) is also given as rate of lay in which the numbers of eggs were divided by the duration in days from age of sexual maturity as found for each farm to the end of the test..

The experimental birds were wing-tagged for identification and body weight was measured individually, starting at the age of sexual maturity and then every second month, three times in total.

Egg quality (egg weight, eggshell thickness, albumen height, yolk height and yolk colour) was determined using fresh eggs ranging from 7 to 40 per breed, fifteen days after sexual maturity and then every month, four times in total. Eggs were weighed using a battery-operated electronic digital balance. The thickness of cleaned, washed and air-dried eggshells were measured using a micrometer delivered by Futura, Germany on pieces of shell from the equator lines of the eggs.

Albumen and yolk height were measured using a semi-automatic device, also from Futura. The eggs were broken on a metal plate and the height of albumen and yolk, respectively, was measured as the distance between the metal plate and the electrode placed on top of the albumen and the yolk of the broken egg. In order to correct for the difference in egg weight, the albumen height was converted into Haugh units as reported by Haugh (1937). The formula was as follows:

The formula was as follows: $HU=\log_{10}(-1.7e^{(0.37)\ln(\text{egg weight, g})} +7.6 + \text{albumen height, mm})100$.

Yolk colour was determined by adjusting the score of yolk colour fan from Roche.

Each farm recorded the number of dead birds and the causes of death (diseases or predators) and the mortality was estimated separately for breeds, locations, and levels of supplementary feed.

Statistical methods

Data were subjected to analysis using the following models:

$$Y_{ijkm}=\mu+B_i+L_j+S_k+L_j*B_i+L_j*S_k+S_k*B_i+e_{ijkm} \quad (1)$$
$$Y_{ijkm}=\mu+B_i+L_j+S_k+e_{ijkm} \quad (2)$$
$$Y_{ijm}=\mu+B_i+L_j+L_j*B_I+e_{ijm} \quad (3)$$
$$Y_{ijklm}=\mu+B_i+L_j+S_k+A_l+L_j*B_i+L_j*S_k+S_**B_i+B_i*A_l+A_l*S_k+L_j*A_l+e_{ijklm} \quad (4)$$

B_i is the fixed effect of breed. i = 1 - - 4.
L_j is the fixed effect of location. j = 1 - - 3.
S_k is the fixed effect of supplementary levels. k = 1 - - 3.
A_l is the fixed effect of age of hen. l =1 - - 4.
e_{ij} ,e_{ijk} ,e_{ijkl} , and e_{ijklm} are the unexplained residuals.
Here, Y_{ijklm} is the observation of the m^{th} farm in the l^{th} age, in the k^{th} supplement, in the j^{th} location, and in the i^{th} breed/breed combination.

Model (1) was used for egg production performances and age at sexual maturity, model (2) for body weight and mortality, model (3) for mortality due to predators, and model (4) for egg quality.

An ANOVA of the data was performed using one of the above models by means of the GLM procedure (Type III SS) of SAS (1994). Multiple comparisons among the breeds, locations, levels of supplementary feed, and age of hens were tested by their least square means corrected for other effects in the model.

Results and discussion

Age of sexual maturity

A significant difference in age at sexual maturity between breeds was observed. The age of sexual maturity was lowest in NN x Fayoumi followed by NN x RIR and Fayoumi, whereas RIR x Fayoumi was 3 weeks older before start of lay (Table 1).

Table 1. Sexual maturity (days) and egg production performance of

different breeds and crossbreeds (least square means)

	NN × RIR*	**NN × Fayoumi**	**RIR × Fayoumi**	**Fayoumi**
Age of sexual maturity, days	200.8^{b}	194.9^{b}	222.0^{a}	201.2^{b}
Egg production				
Number of eggs, hd	29.3^{ab}	23.6^{b}	41.6^{a}	36.2^{ab}
Number of eggs, hh	21.1^{ab}	16.0^{b}	33.2^{a}	28.4^{a}
Rate of lay, hh %	16.7^{bc}	12.0^{c}	32.0^{a}	22.4^{b}
Body weight, g				
At age of sexual maturity	1142.0^{bc}	1033.7^{c}	1325.9^{a}	1197.1^{b}
1^{st} bimonthly body weight	1242.5^{b}	1133.6^{c}	1376.4^{a}	1276.9^{b}
2^{nd} bimonthly body weight	1241.6^{ab}	1112.5^{b}	1310.6^{a}	1299.9^{a}
Mortality, %				
Mortality, excluding predators	40.0	37.0	27.0	31.0
Mortality, by predators	0.0^{b}	0.0^{b}	10.2^{a}	0.7^{b}
External egg quality				
Egg weight, g	41.9^{b}	39.2^{c}	44.4^{a}	41.4^{b}
Eggshell thickness, mm	0.306^{b}	0.315^{b}	0.333^{a}	0.330^{a}
Internal egg quality				
Albumen height, mm	7.2^{b}	7.1^{b}	8.2^{a}	7.9^{a}
Yolk height, mm	18.7	18.4	18.9	18.8
Yolk colour fan score	8.8^{b}	9.6^{a}	9.8^{a}	9.3^{ab}
Haugh unit	73.5^{b}	73.7^{b}	79.9^{a}	79.2^{a}

abc Means in the same row without superscript in common are different ($p<0.05$).
** NN: Naked Neck; RIR: Rhode Island Red*

The differences in attaining sexual maturity might be due to the genetic differences. Cross-breeding results in early sexual maturity compared with pure-bred hens (Wodzinowski 1945). Fairfull (1990) found, as an average of many studies, that F_2 crosses often had a 5% earlier start of lay than the average of the parent breeds. The fact that NN x Fayoumi is the smallest in size might be the cause of early attainment of sexual maturity. Sexual maturity tends to be attained at later ages for heavier breeds. This character is also influenced by many environmental factors, such as temperature, nutrition and day length.

Results obtained from the present study show that age at sexual maturity was reduced with increased amount of supplementary feed (Table 2). Rahman et al (1997) found similar results in RIR x Fayoumi of decreased age at 1^{st} egg with the increase of supplementary feed. Poor nutrition and management retard the start of production (Singh and Belsare 1994). This underlines the general expectation that sexual maturity depends on the physiological age of the organism and if this process is postponed, e.g. by lack of food, it will be reflected in a later start of laying.

Table 2. Effect of levels of supplementary feed (g/hen/day) on sexual maturity and egg production of different breeds

	15 g	**30 g**	**45 g**
Age of sexual maturity, days,	210.6	205.0	198.6
Egg production			
Number of eggs, hd	31.6	30.0	36. 3
Number of eggs, hh	23.1	21.0	30.1
Rate of lay, hh %	19.5	18	25.1
Body weight, g			
At the age of sexual maturity	1175.7	1191.0	1157.4
1st bimonthly body weight	1235.5	1243.2	1293.3
2nd bimonthly body weight	1258.0	1208.0	1256.0
Mortality			
xcluding predator	42.0	31.6	28.1
External egg quality			
Egg weight, g	41.2b	41.7ab	42.2a
Shell thickness, mm	0.321	0.319	0.323
Internal egg quality			
Albumen height, mm	7.4	7.7	7.6
Yolk height, mm	18.6	18.6	18.8
Yolk colour fan score	9.5	9.4	9.2
Haugh unit	75.9	77.6	76.3

abc Means in the same row without superscript in common are different ($p<0.05$)..

Location had no effect on age at sexual maturity (Table 3), possibly because they were situated at a short distance.

Table 3. Effect of location on sexual maturity and egg production of different breed/breed combinations

	Location 1	**Location 2**	**Location 3**
Age of sexual maturity, days	201.5	205.6	207.2
Egg production			
Number of eggs, hd	26.9	34.0	36.8
Number of eggs, h	16.7	26.0	31.2
Rate of lay, hh %	13.8	22.2	26.4
Body weight, g			
At the age of sexual maturity	1168.0	1198.0	1191.0
1st bimonthly body weight	1305.0^{a}	1274.0^{a}	1243.2^{b}
2nd bimonthly body weight	1232.0	1240.0	1208.0
Mortality			
Excluding predator	39.3	31.3	31.2
By predators	2.5	2.3	3.3
External egg quality			
Egg weight, g	42.0	41.4	41.7
Shell thickness, mm	0.325^{ab}	0.317^{b}	0.326^{a}
Internal egg quality			
Albumen height, mm	7.5^{ab}	7.9^{a}	7.4^{b}
Yolk height, mm	19.0	18.6	18.5
Yolk colour fan score	9.3^{b}	9.9^{a}	8.8^{c}
Haugh unit	75.8^{b}	78.9^{a}	75.1^{b}

abc Means in the same row without superscript in common are different (p<0.05)..
Location 1=Riverside area, Location 2=Semi-terraced area, and Location 3=Terraced area

Egg production

The RIR x Fayoumi had the highest level in all three ways used to express egg yield in this study (Table 1). However, regarding Rate of lay, hh, RIR x Fayoumi scored significantly higher than the other breeds/breed combinations. Rahman (1995) reported that RIR x Fayoumi had the best performance with the highest egg production in semi-scavenging production systems among the high-yielding varieties. Rahman et al (1997) reported the best performance of RIR x Fayoumi with the highest egg production when compared with other crosses of Lohmann Brown, Fayoumi, RIR, and WLH. Nawar and Abdou (1999) reported higher rate of lay in cross-breeds than in pure-breeds in commercial production systems and the highest was for (RIR x Fayoumi). RIR x Fayoumi seems to have a better genetic combination than the others used in this study.

The laying curves (Figure 1) showed that the rate of lay was less in NN crosses compared with RIR x Fayoumi and Fayoumi. At the age of 37 weeks almost all the breeds/breed combinations had a tendency to increase the laying intensity. The NN crosses did not rise to the level of the other two and after 44 weeks they tended to have a fall in production. In case of RIR x Fayoumi and Fayoumi they remained on the level of 30 to 45%. Although the pattern of the curve was similar both for RIR x Fayoumi and Fayoumi, RIR x Fayoumi was found to lay at a higher intensity except for the last 3 weeks. The laying curve indicates that RIR x Fayoumi and Fayoumi still have good chances of production in the next laying period. The poor potential of the NN hybrids might be due to their pronounced broody character, which obviously is brought into the cross by the NN cocks.

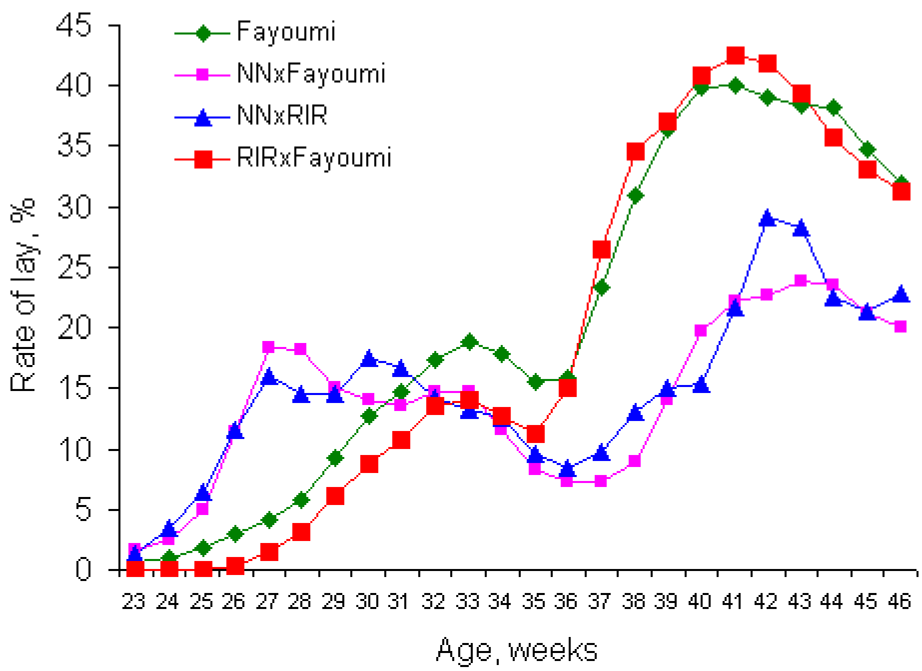

Figure 1. Rate of lay for hen housed production

Location had no effect on egg production in the present study (Table 3). In contrast to this Rahman et al (1997) reported significant differences in egg production at three locations of the country with different cropping patterns. This may just illustrate that within the three locations of this study, there are no definite differences reflected in the laying pattern of the hens. In the present study the highest rate of lay, hd was obtained with the highest level of supplementary feed (Table 2). The results indicate that the level of supplementary feed biologically influences the hens. Although significant interaction of breed x supplement was not found (P=0.28 for rate of lay, hh), the data illustrated a higher influence of supplement on RIR x Fayoumi than on NN crosses. Ahmed and Islam (1985) reported significant improvement in egg production with a provision of supplementary feed. Rashid et al (1995) reported similar findings in ducks.

Body weight

Body weight was lowest in NN x Fayoumi (Table 1). Huque (1999) found similar results of lowest body weight in NN x Fayoumi compared with that of NN x NN, NN x RIR, NN x WLH, RIR x RIR, WLH x WLH, and Fayoumi x Fayoumi at the age of the first egg in a scavenging system. Variation in size is highly genetically determined (Nordskog and Briggs 1967) which underlines findings of many authors to the effect that body size has a high heredity ranging from 0.4 to 0.6.

It has been reported that cross-breeding with improved breeds and provision of supplementary feed significantly improve body weight both in chicken (Ahmed and Islam 1985) and ducks (Rashid et al 1995). We did not find this, as no significant effect of supplement on body weight was seen, nor was any breed x supplement interaction observed.

Mortality

Mortality (excluding predators) was not significantly different among the breeds/breed combinations (Table 1) and the lowest was observed in RIR x Fayoumi. Rahman et al (1997) showed significantly lower mortality in RIR x Fayoumi than in other cross-breeds of Lohmann Brown, RIR, Fayoumi, White Leghorn (WHL), and RIR x WLH. In contrast Amin et al (1992) obtained higher mortality (55%) in RIR x Fayoumi compared with indigenous chicken in a scavenging system. Differences of genetic resistance might be the cause of differences in mortality between breeds.

Mortality by predators was significantly highest in RIR x Fayoumi, while there was no mortality in NN crosses and just a few in Fayoumi (Table 1). Rahman et al (1997) showed mortality due to predators in all of the cross-bred groups except RIR x WLH. Amin et al (1992) reported RIR x Fayoumi to be affected more (17%) than indigenous chicken. Poor escaping ability and the heavy body weight might cause this mortality.

The effect of location showed significant differences in body weight as hens at location 3 had a lower body weight 2 months after start of lay, but no location effect was observed at start of lay or 4 months after start of lay. The protein sources available in the different locations are suggested to be the reason for this variation. There was no significant variation in mortality due to predators between the locations (Table 3). In the study area the farmers used to produce sugarcane, which favours the inhabitance of predators. Jensen (1996) reported that sugarcane areas with many predators are a threat in a semi scavenging system.

Egg quality

The scores for egg size, shell thickness, yolk colour, Haugh unit, and albumen height were highest in RIR x Fayoumi (Table 1), but no significant differences were found in the other breeds except regarding egg size.

Increased egg weight was obtained with increased level of supplementary feed (Table 2). Eggshell thickness did not differ significantly with different levels of supplementary feed. Farida et al (2000) stated that supplement of oyster shells did not improve the eggshell quality in different feeding schedules of Lohmann LSL hens. Albumen height, yolk height, yolk colour, and Haugh unit did not differ significantly with different levels of supplementary feed (Table 2).

Yolk colour scores were comparatively better with decreased amounts of supplement (Table 2). Green grass during scavenging might be responsible for carotenoid deposits in the yolk, which improves the colour. Among the feed ingredients only supplemented maize contributes to improved colour intensity of the yolk. Thus, if a hen has access to green grass or supplemented feed ingredients containing carotenoids/xanthophylls it will be enough to give the yolk the colour preferred by consumers.

Egg weight did not differ, but egg shell thickness was lowest in the semi-terraced area (Table 3). Albumen height, yolk colour fan score, and Haugh unit were significantly highest in the semi-terraced area and there was no significant difference in yolk height between locations.

There were significant differences in egg shell thickness with the differences of age in the present study (Table 4). Egg shell thickness decreased at age 2, which may be due to a poor laying period (Figure 1). Decreased eggshell thickness was observed over time by Akbas et al (1996). Ketelaere et al (2002) obtained diminished egg shell thickness in Hisex White, Bovans White, and a White Leghorn line (M) over time, which is partially inconsistent with the present study. This discrepancy might be due to a different management system that is mainly manifested in the large difference in egg laying, which in our study is only half or lower than in the work of Ketelaere et al (2002). It is well known that high yielding hens have reached the limit of their shell formation capacity and this is mainly seen at the end of a production period. Therefore, the shell formation will probably not be a problem in a semi-scavenging system if the nutritional requirements are covered as the hens are far from having reached their highest laying capacity.

Table 4. Effect of age of hen on the external quality of egg

	Age 1	Age 2	Age 3	Age 4
External quality				
Egg weight, g	39.6d	41.2c	42.5b	43.5a
Shell thickness, mm	0.325a	0.310b	0.324a	0.325a
Internal quality				
Albumen height, mm	6.6b	8.2a	7.8ab	7.8ab
Yolk height, mm	17.9d	19.4a	18.5b	18.9ab
Yolk colour fan score	9.6a	9.4a	9.8a	8.6b
Haugh unit	71.5b	81.8a	79.3a	78.9a

abc Means in the same row without superscript in common are different ($p<0.05$)..

Age of hen: age 1 = age of sexual maturity, age 2 = 1st monthly period, age 3 = 2nd monthly period, and age 4 = 3rd monthly period.

Age was found significantly to influence albumen height. Noddegaard (1992) demonstrated the influence of age in albumen height, which is in agreement with the findings of the present study. Akbas et al (1996) and Lapao et al (1999) found decreased albumen height with the increase of hen age. In contrast, Petersen and Linn (1990) did not notice any differences in the albumen quality with age. Albumen height seems to be influenced by several factors.

Highly significant differences were found in Haugh units at different ages (Table 4). Increased Haugh units were obtained at age 2 and then decreased over time. Akbas et al (1996) showed that the Haugh unit decreases with the increase of hen age.

Yolk height was found to increase with the increase of age up to age 2 and then had a tendency to decrease over time (Table 4). Akbas et al (1996) found decreased yolk height with the increase of hen age. The explanation used above for the egg size might also be valid here. Yolk colour did not differ up to age 3 and then decreased at age 4 (Table 4). Stockberg and Wegner (1971) reported yolk colour to improve during the laying year. The colour of yolk basically depends on the amount of carotenes ingested from the food, but also on the ability of the hens to deposit it during yolk formation.

A highly significant interaction was found between breed and age of hen regarding: egg weight, egg shell thickness, albumen height, yolk height, yolk colour, and Haugh unit, and interaction between breed and location was seen regarding egg weight, yolk colour, and Haugh unit. In most cases the interaction was due to bigger changes over time in RIR x Fayoumi - and sometimes Fayoumi - than in the Naked Neck crosses.

Conclusions

- The results of the present study showed that RIR x Fayoumi had the highest level of egg production, body weight, and the best quality of eggs with the lowest mortality due to disease, but that they seem more vulnerable to attack from predators. These results were similar to some already reported research findings in semi-scavenging production systems.

- In order to improve the genetic potential, a selection procedure aimed at maintaining the production potential of RIR and Fayoumi should be adapted to improve the yield of RIR x Fayoumi. At the same time management, availability of scavenging feed, and rate of supplement are important factors and need to be improved as RIR x Fayoumi seems to respond more to variation in management than any other of the tested breeds.

- The type of test presented in this work is an ever-ongoing object for study as new breed combination/hybrids continue to appear in the market. It is very important to perform these tests in the environment in which the practical production takes place, because a considerable Genotype x Environment interaction is the general observation in many studies in which the scavenging system is one of the environmental sources.

- It can be concluded that with improved conditions RIR x Fayoumi might have potential in semi- scavenging production systems and is probably the best bid at the moment.

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