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Evaluation of Laying Performance and Egg Qualitative Characteristics of Indigenous Hens Reared in Rural Areas of Isfahan Province

Research Article

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ABSTRACT

This study was carried out to investigate the egg production performance and egg quality characteristics of the indigenous chickens reared in rural areas of two different climates of Isfahan province. Totally, 2160 indigenous chickens were studied in this research. Two dominant climatic regions (cold and hot) were determined for Isfahan province. In each climate, two towns and three villages in each town were chosen. Chadegan and Khansar were considered as cold and Kashan as well as Varzane were considered as towns in hot climate. Furthermore, six families were determined as experimental units in each village (a total of 72 families). Primarily, thirty-six chicks and four roosters of 45 day-old ages were delivered to each family. Laying performance of the chicks was recorded during the laying period (21-72 weeks of age). The egg quality characteristics were recorded once every two months. The results showed that although climate affected egg production across 25-32 and 57-64 weeks of ages ($P<0.05$), it did not influence the average egg production during the entire laying period. The least egg production observed in Chadegan (25.9%) which was significantly lower than Varzane and Khansar (35.9% and 37.5%, respectively; $P<0.05$). Moreover, shell qualitative index in cold climate was statistically better than that in hot climate ($P<0.05$). Chadegan had the highest egg shell thickness and shell to egg weight ratio among four towns ($P<0.05$). Furthermore, yolk color index in hot climate was significantly improved compared to cold climate ($P<0.05$). In conclusion, the egg qualitative characteristics were affected by climate conditions.

KEY WORDS egg production, egg quality parameters, indigenous chicken, Isfahan rural regions.

INTRODUCTION

Rearing indigenous poultry is prevalent in many developing and underdeveloped countries that might improve the rural economy (Vali, 2008). The main reasons for rearing indigenous chickens are their resistance to suboptimal environmental conditions or diseases compared to exotic breeds. Furthermore, raising indigenous hens provide job opportunities, leading to extra income for civilians and consequently might reduce immigration from rural areas to big cities (Deljoisaraian *et al.* 2011). Moreover, these birds contribute considerably to protect rural poor communities from malnutrition. Therefore, rearing high potential birds, particularly indigenous chickens in developing countries meet the need of rural families to poultry productions and so research in this field seems necessary (Gheisari and Azarbayejani, 2013). On the other hand, low productivity of indigenous birds has hampered their potential to uplift the living standards of producers and decreased their contribution to rural development. In this respect, Khalafalla *et al.*

(2001) remarked that insufficient sanitary cares, inappropriate nests and low knowledge of rural people are the most important limitations to achieve optimum performance in chickens reared in rural regions. Furthermore, the low production of Kenya's chicken (40-100 egg per year) was related to factors such as genetics, poor diet, diseases and inadequate husbandry management (Kingori *et al*. 2010). Various factors including age of the chickens, diet, egg storage time and temperature were reported to affect the internal egg quality (Miles and Jacob, 2000).

For example, Elibol *et al*. (2002) announced that the egg size, height of albumen, and yolk weight were increased as they aged. Gheisari *et al*. (2008) reported that strength and Haugh unit of eggs in indigenous chickens tended to increase following the increasing in feed consumption. In another study, Nourollahi (2013) reported a significant effect of rural climates on laying production of indigenous hens. In this respect, chickens in hot climate had greater egg production than cold climate. Also, outbreak of disease such as Newcastle disease virus has been affected by climate variabilities (Nyaiyo, 2014) that can affect the performance of indigenous poultry. In general, data considering the production performance and egg qualitative characteristics of indigenous hens reared in rural areas of different climates is scarce.

Thus, the objective of present study was to evaluate laying performance and egg qualitative characteristics of indigenous hens reared in different climates and rural areas of Isfahan province.

MATERIALS AND METHODS

Birds, management, egg production and qualitative characteristics

A total of 2160 one-day-old chickens were provided from Isfahan indigenous chicken breeding center. The chickens fed a diet containing 2500 kcal metabolizable energy per kilogram and 18% crude protein, 0.9% Ca, 0.42% available phosphorous, 0.15% Na, 0.65% methionine + cystine and 1% lysine (Gheisari and Golian, 1996) up to 45 days of age. Two different hot and cold climates were determined based on reports obtained from Isfahan meteorological organization to evaluate the performance of the chickens in these two different climates.

Two towns were allocated to cold (Chadegan and Khansar) and two towns (Kashan and Varzane) to hot climate. Then, three villages were chosen from each town and six families were determined in each village as experimental units (72 families). Twenty 45-day-old chickens were delivered to each family (the hen to cock ratio was 7:1) and families were trained for rearing chickens and recording their weight and egg production during the experimental period. Due to the fact that we wanted to evaluate the effect of rural condition on the performance of indigenous chickens, their feeding program was under families' condition and decision after 45 days of age. The egg production performance was recorded daily but results were reported in percentage on month basis (Table 3). Produced eggs were weighed every two weeks using digital scales (0.1 g accuracy). Furthermore, eggs were used to determine eggshell breaking strength (kg/cm^2), eggshell weight (g), eggshell thickness (mm) and Haugh unit every two months. Eggshell breaking strength was measured using OSk13473 eggshell intensity meter (Ogawa Sheiki Co., Ltd., Tokyo Central and Tokyo, Japan).

Eggshell weight was measured after washing the interior egg membrane and after drying overnight at 80 ˚C. Eggshell thickness (mm) was measured using micrometer screw from Mitutoya (Japan) which was applied to central part of an egg in the area of maximum perimeter. The height of the albumen was measured off the Chalazae at a point mid-way between the inner and outer circumferences of the thick white with a Spherometer. Haugh unit was calculated using the following formula (Haugh, 1937).

$$HU = 100 \log (H + 7.57 - 1.7 \times W \times 0.37)$$

Where:
HU: Haugh unit.
H: albumen height (mm).
W: egg weight (g).

The albumen and the yolk were separated and their weights were measured using digital scales (0.1 g accuracy). Yolk color was determined with the Hoffmann-La-Roche yolk color fan. The yolk and the shell weight ratio were calculated by dividing the weight of each part to the egg weight.

Statistical analysis

Data were analyzed as a complete randomized block design using the general linear procedure (GLM) of SAS 9.2 (SAS, 2002). Hot and cold climates were considered as blocks. Differences between the means were ascertained by LSD test and significance was declared at ($P<0.05$).

RESULTS AND DISCUSSION

Egg production

The average egg production performance in different rearing weeks and total period is presented in Table 1. The least egg production during 25-40 weeks of age was observed in Chadegan which was significantly lower than the other towns ($P<0.05$).

Table 1 Egg production percentage of indigenous chickens reared in different rural areas of Isfahan province

Main effects	Production period (week)													
	21-24	25-28	29-32	33-36	37-40	41-44	45-48	49-52	53-56	57-60	61-64	65-68	69-72	Total
Khansar	1.2	21.5^{b}	46.9^{a}	61.5^{a}	57.4^{a}	57.4^{a}	39.9	33.9	41.3^{a}	61.5^{a}	32.5^{a}	31.8^{a}	25.8^{a}	37.5^{a}
Chadegan	0	2.4^{c}	23.3^{b}	34.4^{b}	34.2^{c}	34.2^{c}	36.8	35	36.7^{ab}	34.4^{b}	27.5^{b}	20.6^{bc}	13^{c}	25.9^{b}
Varzane	4.4	42.4^{a}	56^{a}	51^{a}	49^{ab}	49^{ab}	36.1	40.2	36.8^{ab}	51^{a}	30.3^{ab}	25.8^{ab}	22.5^{ab}	35.9^{a}
Kashan	1.4	41.8^{a}	45.1^{a}	51.8^{a}	45.8^{ab}	45.8^{ab}	33.3	26.3	24.5^{b}	51.8^{a}	22.9^{c}	17.9^{c}	16.6^{bc}	31.1^{ab}
Cold	1.0	11.9^{b}	35.1^{b}	47.9	45.8	43.9	38.4	34.4	39	38.8^{a}	30^{a}	26.2	19.4	31.7
Hot	2.9	42.0^{a}	50.6^{a}	51.4	47.4	39.3	34.7	33.2	30.6	29.2^{b}	26.6^{b}	21.8	19.5	33
Total Mean	1.9	27	42.8	49.7	46.6	41.6	36.5	33.89	34.8	34	38.3	24	19.5	32.4
SEM	0.7	5.4	4.4	3.2	2.8	2.5	1.9	2.7	2.5	2.3	1.1	1.8	1.7	1.7

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

The egg production of Khansar was significantly greater than Kashan across 53-56 and 61-72 weeks of age (P<0.05). The least egg production from 60 weeks of age up to the end of the experimental period (72 weeks of age) was observed in Kashan and Chadegan. Furthermore, Chadegan had significantly lower egg production than the other towns across the entire production period (P<0.05). Indigenous chickens in hot climate outperformed the cold ones during 25–32 weeks of age (P<0.05). The greater egg production during 57 to 64 weeks of age belonged to hens kept in cold climate as compared with hot climate (P<0.05). The egg production trend of indigenous hens in various towns is demonstrated in Figure 1. As shown, indigenous hens kept in Khansar achieved the peak of egg production faster than hens reared in hot towns, especially Kashan. In addition, their egg production curve was steadily higher than the other egg production curves during the experimental period.

On the other hand, indigenous hens in Chadegan started egg production slightly later and had lower peak point as well as lower stability. Although egg production was different between climates in different weeks, the average egg production was not influenced by climate during the entire laying period. Regarding the laying performance between towns, the most and the least average egg productions were found in Khansar (37.5%) and Chadegan (25.9%), respectively. It has been reported that environmental factors are more important than genetics for traits such as egg production and egg weight of indigenous hens in rural conditions. In the current study, significant differences between the average egg production in towns located in cold climate (Chadegan and Khansar) could be due to different methods of management and family incomes. Furthermore, lower egg production of hens in Chadegan may be attributed in part to the suboptimal environmental condition during the rearing and laying periods that resulted in chicken malnutrition. Nourollahi (2013) declared that the highest egg production percentage was observed in native chickens kept in hot climate of Fars province.

Kingori *et al*. (2010) reported that lower egg production of native chickens was related to poor quality of their diet, diseases and improper husbandry management. Otherwise, the average egg production of Malaysian indigenous chickens was reported 17% and 48% in semi-intensive and intensive systems, respectively (Ramlah, 1996), suggesting lower laying performance compared with results in the extensive production system of this study. Accordingly, it seems that the laying potential of indigenous hens in our experiment is higher than that of indigenous hens in many above mentioned countries. It seems that, although indigenous birds are affected by environmental and management variations, using nutritional supplements, proper housing and control of disease are parameters by which the growth and production efficiency of indigenous chickens can be improved in rural regions.

Egg weight

The egg weight of indigenous hens at different ages and the average egg weight across entire experimental period (21-72 weeks of ages) are presented in Table 2. The egg weight of hens at 29-44 weeks of age was higher in Khansar than Kashan (P<0.05). Moreover, egg weight of the hens reared in Khansar was higher than the other towns across 41-44 and 49-52 weeks of ages (P<0.05). Additionally, the egg weight of hens reared in cold climate was significantly higher than that in the hot climate during 33-40 weeks of age (P<0.05). It should be possibly owing to the fact that high environmental temperature could be a reason for low feed intake and low egg weight in chickens (Etches, 1998). More research on the effect of climate variations on egg weight of indigenous hens is warranted. Total average egg weight in the studied indigenous chickens was 49.6 g during entire laying period. In this regard, Kalita *et al*. (2009) declared that the average egg weight of Indian indigenous chickens (Assam) was 36-40 g. Moreover, Gheisari and Golian (1996) determined that the average egg weight in Isfahan indigenous chickens was 53.3 g under an intensive production system.

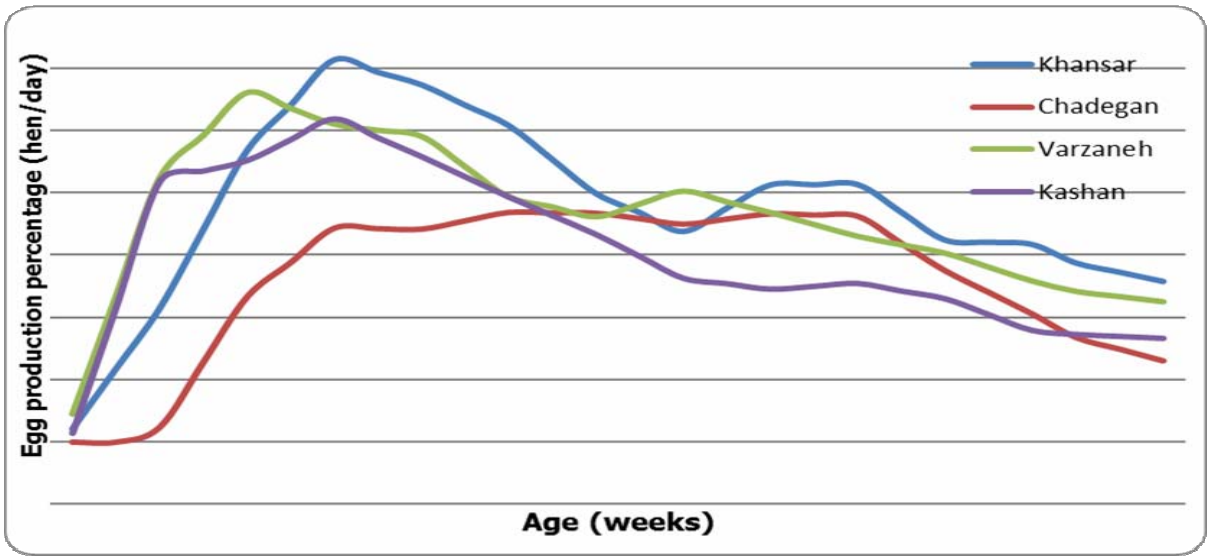

Figure 1 Egg production of studied hens in leaying period (21-72 weeks)

Table 2 Egg weight of indigenous chickens in different ages and the entire laying period reared in different rural areas of Isfahan province

Main effects	Production period (week)													
	21-24	25-28	29-32	33-36	37-40	41-44	45-48	49-52	53-56	57-60	61-64	65-68	69-72	Total
Khansar	48.1	48.5	50^{a}	52^{a}	53.3^{a}	53.8^{a}	51.9	53.2^{a}	50.1	48.8	49	50.1	49.4	50.6^{a}
Chadegan	46	46.6	49.3^{ab}	50.7^{ab}	51.2^{ab}	49.1^{b}	50.3	50.4^{b}	50.6	49.8	48.6	48.6	50.9	49.4^{b}
Varzane	48.8	49	48.7^{ab}	50.1^{ab}	48.9^{b}	49.9^{b}	50.3	50.6^{b}	48.7	49	48.5	49	50	49.4^{b}
Kashan	45.8	45.9	46.4^{b}	47.8^{b}	48.7^{b}	49.3^{b}	51.2	50.4^{b}	48.6	49.9	50.4	50.4	50.4	48.9^{b}
Cold	47.1	47.6	49.7	51.4^{a}	52.2^{a}	51.5	51.1	51.8	50.4	49.3	48.8	49.4	50.1	50.0^{a}
Hot	47.3	47.5	47.5	49 ^{b}	48.8^{b}	50	50.7	50.5	48.6	49.4	49.5	49.7	50.2	49.1^{b}
Total Mean	47.2	47.5	48.6	50.2	50.5	50.5	50.9	51.2	49.5	49.4	49.1	49.5	50.2	49.6
SEM	0.67	0.62	0.61	0.52	0.67	0.68	0.46	0.44	0.44	0.29	0.4	0.39	0.28	0.23

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Additionally, the average egg weight of Malaysian chicken eggs were reported between 39.7 g to 46 g in an intensive production system (Ramlah, 1996). In our study, nutritional situation was considerably affected by the life style of rural families in various regions which could be a main reason for the variations observed in the average egg weight. It has been shown that diet, body weight, age and genetics were effective factors on the egg weight (Afifian, 2006). On the other hand, Naroshin *et al.* (2002) reported that at least more than half of the egg weight was under genetic control. Pedroso *et al.* (2005) showed that the egg weight was increased by age promotion. Spratt and Leeson (1987) proposed that egg weight depends on the weight of its contents, although, changes in contents also associate with feed consumption and nutritional situation.

Egg qualitative characteristics

According to the results shown in Table 3, qualitative traits of eggshell (strength, thickness and shell weight) in the cold climate were higher than that in the hot climate (P<0.05).

Eggshell thickness in chickens reared in Chadegan was significantly greater than that of the other towns (P<0.05). The average eggshell weights of two hot climate towns (Kashan and Varzane) was lower than Chadegan (P<0.05). Eggshell strength in Kashan was significantly lower than towns in cold climate (P<0.05).

Yolk color index in hot climate was higher than the cold climate (P<0.05) but the effect of town was not significant. Hough unit of two climates were not different, however, between cold towns, egg of chickens in Chadegan had higher Haugh unit than Khansar (P<0.05).

Therefore, observed difference in Haugh unit of two cold towns can be due to the selection time and storage situation of the eggs. Moreover, the higher eggquality in cold than the hot climate in the present study might be attributed to the reduction in temperature that decrease the evaporations from the egg and consequently lead to save of albumen height and quality.

Otherwise, Nourollahi (2013) failed to show any effect of the climate on the egg qualitative traits.

Table 3 Average qualitative characteristics of the eggs produced by indigenous chickens reared in different rural areas of Isfahan province

Main effects	Shell				Yolk			Albumen	
	Weight (g)	Strength*	Thickness**	Shell to egg weight ratio (%)	Weight (g)	Color	Yolk to egg (%) weight ratio	Height (mm)	Haugh unit
Khansar	4^{ab}	2.2^{a}	33.5^{b}	7.9^{b}	14.6^{a}	6.1^{b}	28.4	5^{b}	71.7^{b}
Chadegan	4.2	2.4^{a}	38.2^{b}	8.9^{b}	14.2^{ab}	6.1^{b}	28.5	5.9^{a}	79.9^{a}
Varzane	3.9^{b}	2^{ab}	33.3^{b}	7.9^{b}	14^{a}	8.5^{a}	28.6	5.2^{ab}	75^{ab}
Kashan	3.3^{c}	1.7^{b}	30^{b}	7.3^{b}	12.4^{b}	8.9^{a}	27.7	5^{b}	76.5^{ab}
Cold	4.2^{a}	2.3^{a}	35.9^{a}	8.4^{a}	14.4	6.1^{b}	28.4	5.5	75.8
Hot	3.6^{b}	1.9^{b}	31.6^{b}	7.6^{b}	13.2	8.7^{a}	28.1	5.2	75.7
Total Mean	3.92	2	33.8	8.02	13.8	7.4	28.3	5.3	75.7
SEM	0.114	0.081	0.855	0.187	0.361	0.369	0.684	0.164	1.150

* Strength's unit is kg/cm^2.
** Thickness's unit is hundreds of millimeters.
The means within the same column with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Gheisari *et al*. (2008) reported that average egg strength, thickness, shell weight, yolk weight, and Haugh unit produced by Isfahan indigenous chickens under intensive conditions were 2.7 (kg/cm^2), 0.40 (mm), 4.93 (g), 16.04 (g) and 80.81, respectively. In another study on egg qualitative characteristics in Fars province, yolk weight percentage and Haugh unit of indigenous chickens' egg were 14.3 g, 33% and 80.5, respectively across 32-34 weeks of age (Pourreza, 1991). Yakuba *et al*. (2008) determined that shell weight, yolk weight, Haugh unit in Nigerian indigenous chickens were 4.7 g, 16.1 g and 71.4%, respectively.

CONCLUSION

In conclusion, results showed that indigenous chickens distributed in rural areas produced 130 eggs by the average weight of 45 g which had higher potential of egg production than studied indigenous chickens in some other countries. Environmental conditions such as climate can affect the egg qualitative traits in indigenous chickens. In addition, performance of these poultries in rural regions could be further promoted by improvement of environmental and nutritional conditions as well as amending management practices on indigenous chickens during rearing and laying periods.

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