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Study of egg traits among improved varieties of chicken reared under backyard poultry production system

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ABSTRACT

The aim of the study was to evaluate the egg traits among improved varieties of chicken reared under backyard poultry production system. The results indicated superiority of rearing these improved varieties under backyard production system in terms of their external and internal egg traits. Significant differences were observed in egg weight, shape index and shell weight of eggs which was superior in CARI-Devendra birds followed by CARI-Sonali and CARI-Hitkari. The yolk weight in different varieties of chicken differ significantly. However, no difference in albumin weight was observed in the study. The egg indices and haugh unit was also superior in CARI-Devendra than other varieties of chicken. Further, it was found that management and its interaction had significant effect on egg weight and yolk colour in few varieties. Thus, it may be suggested that egg traits differ in different improved varieties of chicken and CARI Devendra and CARI Sonali may be promoted under backyard production system according to the demand for brown and white eggs, respectively.

Keywords: Backyard system, CARI Devendra, Egg traits, Varieties

Indigenous (‘deshi’) chickens play an important role in providing livelihood and food security to the rural families, who raise them under backyard production system with low inputs and poor resource situation. In spite of their significant roles, their low performances masked their potential to uplift the living standards of the owners and producers, contributing little to the rural developments in country. Therefore, to have more returns with a larger produce, certain improved varieties have been developed which could be reared in backyard to meet the consumer demand for eggs (Padhi, 2016). In common surveys, the poultry farmers care little about the number and quality of eggs produced by these local birds, which can be improved by introducing superior germplasm in these indigenous birds to have more performance under existing managemental conditions (Mengesha *et al*. 2011; Kahdda *et al.* 2017). Understanding these characteristics under the production system in which we rear has a paramount significance in designing and implementing performance improvement strategies for better livelihood (Markos *et al.* 2017). Hence, evaluation of different egg quality traits is necessary in today’s production system to maintain superiority in the overall egg quality as well as breed/ varieties reared for production.

MATERIALS AND METHODS

Improved varieties (5) of chicken, namely CARI Devendra, CARI Priya, CARI Sonali, CARI Upkari and CARI Hitcari and one non-descript chicken were studied based on their egg quality parameters. 50 eggs were collected for each variety from the farmer’s door, rearing these chickens under backyard production system. The same was also collected from the university farm at PRTC, SVPUAT to compare the egg quality traits under farm conditions. The external characters like colour, cleanliness, egg weight, length, width, shape index and specific gravity were measured. Thereafter the eggs were broken and the internal traits like shell thickness, shell weight, yolk weight, colour, height, albumin weight, height of albumin were recorded using standard procedure. Egg weight, Haugh unit, albumin height and yolk colour were measured using automatic egg analyzer. All the parameters were estimated using standard procedures. The data were analyzed as per standard methods in SPSS version 20 (SPSS Inc, Chicago, IL, USA). The effect of varieties and management on the different egg quality traits was studied. The individual means among varieties and in different management were tested by DMRT for their significance.

RESULTS AND DISCUSSION

The egg quality traits in CARI Devendra, CARI Hitcari, CARI Priya, CARI Sonali, CARI Upkari and local chickens were studied based on difference in external and internal characteristics of egg. The results revealed that there were considerable variations in egg colour and cleanliness of eggs in these birds (Table 1). The eggs of CARI-Devendra, CARI

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Hitkari and CARI-Upkari were predominantly dark brown in colour, and few eggs were found to be light brown in colour both in the farm as well as field conditions. Similar variation in egg colour was observed in eggs collected from local chickens ('deshi' type) reared by farmers under village conditions (Table 1). The highest percentages of un-clean eggs were found in CARI-Priya birds both in farm as well as field conditions. Parmar *et al.* (2006) in their study in Kadaknath chicken breed of poultry also reported brown shell colour to be most frequent as compared to light brown shell colour. They reported difference in percentage of shell colour in two different regions of Jhabua, with Jhabua I (Meghnagar) having 70.62 and 29.38% and Jhabua II (Jobat) having 65.11% and 34.89%, dark brown eggs and light brown eggs, respectively. Similarly, variation in egg colour was reported by other researchers in different indigenous breeds of poultry (Singh *et al.* 2000). The appearance of dirty eggs in layers may be caused by several factors, but the major issues are hen health and nutrition (Mavromichalis 2013). The percentage of un-clean eggs in CARI-Priya may be more due higher production inter-related with its nutritional requirement.

The egg weight in different varieties of chicken differed significantly (P<0.01), CARI-Sonali and CARI-Devendra laid heavier eggs (59.52±0.38, 59.22±0.38, respectively) compared to others (Table 2). The egg weight of CARI Hitkari and CARI Upkari were similar to local chickens of western Uttar Pradesh. The management of bird had significant (P<0.01) effect on egg weight, although the interaction effect of varieties under different management situations were found to be non-significant (Table 3). The mean shape index of chicken eggs was similar in all varieties, except CARI-Devendra and CARI-Upkari. The variation in shape index due to management practices was found to be non-significant. The mean specific gravity of eggs from different varieties was found to be similar in all birds. There was no effect of management on specific gravity of eggs, either from field or from farm. Similarly, the interaction effect was also non-significant (P<0.05) (Table 3). The results of present study were similar to the reports of Islam and Dutta (2010) and Chatterjii *et al.* (2006) and (2007) that compared indigenous chicken with other varieties. Chaudhary (1997) reported similar egg weights in different varieties of back yard chicken, i.e. CARI

Table 1. Colour and cleanliness of egg in birds reared under different management

Breed	Management	Colour			Cleanliness	
		Dark brown	Light brown	White	Clean	Dirty
CARI-Devendra	Farm (n=20)	80% (16)	20% (04)	–	80% (16)	20% (04)
	Field(n=50)	84% (42)	16% (08)	–	78% (39)	22% (11)
CARI-Hitkari	Farm (n=20)	85% (17)	15% (03)	–	80% (16)	20% (04)
	Field (n=50)	84% (42)	16% (08)	–	78% (39)	22% (11)
CARI-Priya	Farm (n=20)	_	_	100% (20)	85% (17)	15% (03)
	Field (n=50)	_	_	100% (50)	86% (43)	14% (07)
CARI-Sonali	Farm(n=20)	_	_	100% (20)	75% (15)	25% (5)
	Field (n=50)	_	_	100% (50)	76% (38)	24% (12)
CARI-Upkari	Farm (n=20)	75% (15)	25% (05)	–	80% (16)	20% (4)
	Field (n=50)	76% (38)	24% (12)	–	82% (41)	18% (9)
Non-description	Field (n=70)	51% (36)	26% (18)	23% (16)	83% (58)	17% (12)

Table 2. Effect of variety and management on external and internal traits of egg

Factor	N	External egg traits					Internal egg traits		
		Egg weight (g)	Shape index	Specific gravity (g/cm^3)	Shell thickness (mm)	Shell weight (g)	Yolk weight (g)	Albumin weight (g)	Yolk colour
Variety									
CARI Devendra	70	59.22±0.38^B	67.17±0.56^A	1.073±0.002	0.35±0.00	6.82±0.62^C	18.56±0.14^D	34.02±0.37	5.98±0.20^{BC}
CARI Hitkari	70	57.35±0.38^A	76.80±0.56^B	1.071±0.002	0.35±0.00	6.83±0.60^C	17.35±0.14^{AB}	33.19±0.37	6.37±0.20^C
CARI Priya	70	58.56±0.38^B	75.87±0.56^B	1.068±0.002	0.35±0.00	6.50±0.60^B	17.61±0.14^{BC}	34.57±0.37	6.26±0.20^C
CARI Sonali	70	59.52±0.38^B	76.46±0.56^B	1.072±0.002	0.35±0.00	6.69±0.60^C	17.83±0.14^C	34.93±0.37	6.32±0.20^C
CARI Upkari	70	57.54±0.38^A	79.32±0.56^C	1.073±0.002	0.34±0.00	6.67±0.60^C	17.05±0.14^A	33.72±0.37	5.80±0.20^{AB}
Non-Descript	70	57.13±0.34^A	75.30±0.50^B	1.072±0.001	0.35±0.00	6.27±0.55^A	17.09±0.13^A	33.79±0.34	5.02±0.20^A
Management									
Field	320	57.19±0.16^P	75.14±0.24	1.072±0.001	0.35±0.00	6.62±0.05	17.53±0.06	33.086±0.16	6.81±0.15^P
Farm	100	59.68±0.28^Q	75.14±0.42	1.071±0.001	0.34±0.00	6.72±0.03	17.75±0.11	35.220±0.28	5.40±0.09^Q
Overall mean	420	58.32±0.18	75.14±0.23	1.071±0. 001	0.35±0.00	6.66±0.03	17.63±0.06	34.056±0.16	6.04±0.82

Means bearing different superscripts in column differ significantly (P<0.05).

Table 3. Interaction effect of varieties under different management

Breed	Management	Egg weight (g)	Shape index	Specific gravity (g/cm^3)	Shell thickness (mm)	Shell weight (g)	Yolk weight (g)	Albumin weight (g)	Yolk colour
CARI Devendra	Farm (n=20)	60.50±0.64^A	67.60±0.94	1.07±0.003	0.36±0.004	6.89±0.11	18.77±0.24	35.17±0.63^A	5.40±0.21^B
	Field (n=50)	57.94±0.40^B	66.75±0.59	1.07±0.002	0.35±0.003	6.75±0.07	18.34±0.15	32.89±0.40^B	6.55±0.34^A
CARI Hitkari	Farm (n=20)	58.98±0.64	77.10±0.94	1.07±0.003	0.35±0.004	6.84±0.10	17.40±0.24	34.76±0.63^A	5.68±0.21^B
	Field (n=50)	55.73±0.40	76.50±0.60	1.06±0.002	0.35±0.003	6.81±0.07	17.30±0.15	31.62±0.40^B	7.05±0.34^A
CARI Priya	Farm (n=20)	59.60±0.64	75.66±0.94	1.07±0.003	0.35±0.004	6.48±0.11	17.68±0.24	35.54±0.63	5.72±0.21^B
	Field (n=50)	57.52±0.40	76.07±0.60	1.07±0.002	0.35±0.003	6.53±0.07	17.54±0.15	33.60±0.40	6.80±0.34^A
CARI Sonali	Farm (n=20)	60.60±0.64	76.13±0.94	1.07±0.003	0.35±0.004	6.72±0.11	17.97±0.24	35.76±0.63	5.58±0.21^B
	Field (n=50)	58.44±0.40	76.80±0.60	1.07±0.002	0.35±0.003	6.67±0.07	17.68±0.15	34.11±0.40	7.05±0.34^A
CARI Upkari	Farm (n=20)	58.70±0.64	79.22±0.94	1.08±0.003	0.34±0.004	6.66±0.11	16.90±0.24	34.92±0.63	5.00±0.21
	Field (n=50)	56.38±0.40	79.41±0.60	1.07±0.002	0.35±0.003	6.67±0.07	17.20±0.15	32.52±0.40	6.60±0.34
Non-descript	Field (n=70)	57.13±0.34	75.30±0.50	1.07±0.001	0.35±0.002	6.27±0.06	17.09±0.13	33.79±0.34	7.02±0.18

Means bearing different superscripts in column differ significantly ($P<0.05$).

Nirbheek, CARI-Shyama and CARI-Hitcari. However, Niranjan *et al.* (2008) while working with other chicken varieties developed for back yard poultry revealed that egg weight of Vanaraja and Gramapriya were lower than the varieties developed at CARI (53 g and 51 g, respectively). The present results on egg weight were in agreement to the reports of above researchers, which was suggested as inherent property of a particular breed of chicken. However, in contrast to our findings, Garcaoa-Lapez *et al*. (2007) and Bonekamp *et al*. (2010) reported non-significant difference in egg weights in different heavy and light breeds in their study, may be due to rearing conditions.

The variation in shape index is due to variation in length and breadth of egg, which is peculiar to breed characteristics. The average values of trait were within the range which was reported by previous workers. Haunshi *et al*. (2006) reported shape index (70.67) in Vanaraja, whereas Parmar *et al.* (2006) reported 74.35 shape index in Kadaknath breed. Monira *et al.* (2003) also observed significant difference in shape index in commercial breeds of chicken. Choudhuri *et al*. (2014) studied egg quality traits of endangered Nicobari fowl and its crosses (Nicorock and Nishibari) under intensive (deep litter) as well as backyard system, in the regions of Andaman and Nicobar Islands and found that egg length, width and shape index differed significantly ($P<0.05$) among the genetic groups. The results differ from the reports of above researcher may be due difference in genetic make-up and difference in climatic conditions of the region and difference in management. The specific gravity of eggs in the present study were lower than those reported by Haunshi *et al.* (2006) who compared Vanaraja and White Leghorn chicken and found higher values of specific gravity (1.098 and 1.086, respectively) in these eggs. Similarly, Singh *et al.* (2000) reported higher values in eggs of white leghorn chicken. Due to relation of specific gravity to shell strength, eggs of proper specific gravity, ranging from 1.07 to 1.10 g/cm^3, are usually selected for a better hatchability (Cordts *et al.* 2002). Therefore, the eggs in the present study were equally suitable for purpose of hatchability.

The mean egg shell thickness and shell weight in different varieties of chicken under back yard system was found to be 0.35±0.00 mm, 6.66±0.03 g. The egg shell thickness was neither influenced by varieties nor by management (Table 2 and 3). The shell weight in chickens vary significantly ($P<0.01$) amongst varieties, it was found to be highest in CARI Devendra and CARI Hitkari, whereas, it was lowest in the local chicken. There were no difference in shell weight of chicken eggs either in field or in farm conditions (Table 2). The results were in agreement with the reports Negi (2008) who reported similar shell thickness in Kalinga Brown breed of chicken. However, it was lower than the value reported by earlier workers (Haunshi *et al.* 2006 in Vanaraja; Mohan *et al.* 2008 in Aseel chicken). The higher shell thickness in the birds developed for rural/back yard poultry is a better indicator for their suitability for free range farming. The shell weight was similar to reports of Chatterjii *et al.* (2007) in Nicorock breed of chicken, and Niranjan *et al.* (2008) in Vanaraja and Gramapriya varieties of back yard chicken. Chatterjii *et al.* (2007) also reported non-significant breed difference in egg shell weight for 6 indigenous chicken breed from Andman.

Mohan *et al*. (2008) reported that the mean egg shell weight higher in Aseel breed of chicken reared under local conditions than the varieties under study.

The mean yolk weight in different varieties of chicken differ significantly (P<0.01). CARI-Devendra birds had highest yolk weight compared to local chickens. The yolk weight was not influenced by the type of management to rear these birds (Table 2). The interaction effect of variety and management on yolk weight was also found to be non-significant. The albumin weight was similar in all varieties, but the interaction effects were significant in CARI-Devendra and CARI-Hitkari (Table 3). Significant difference (P<0.01) in yolk colour was found which differ in varieties with their management. Chatterjii *et al.* (2007) reported similar yolk weight (17.08 g) in Nicorock, a dual purpose chicken for back yard, while Parmar *et al.* (2006) reported lower yolk weight of 14.36 g in Kadaknath breed of chicken. The yolk weight in the present study indicated suitability of these varieties for rearing under backyard production system. Similar to our finding, Hussain *et al.* (2013) and Tulin and Ahmet (2009) reported non-significant effect of management on eggs under intensive and village production system. The mean yolk weight recorded in the present study was also comparable to the report of Tadesse *et al.* (2013) rearing Rohde Island Red breed under intensive management. The albumen weight were within the range which was reported by previous worker (Niranjan *et al.* 2008 in Vanaraja and Gramapriya and Negi 2008 in Kalinga Brown). However Parmar *et al.* (2006) reported lower albumen weight, i.e. 20.20 g in indigenous Kadaknath breed of poultry. Lower albumen weights 23.46 to 26.67 gm than the present study were recorded by Chatterjii *et al.* (2007) in indigenous fowl of Andman. These differences among the reports for traits could be expected because of difference in genetic constitution and also might be due to the variation in weight of the egg. The yolk colour is determined by the xanthophyll (plant pigment) content of the diet consumed**.** Green grass during scavenging might be responsible for carotenoid deposits in the yolk, which improves the yolk color. This might be the reason for higher value of yolk colour in birds reared in field compared to farm.

The mean albumin index did not vary among the varieties. However, significant differences were observed in yolk indices and haugh unit values. The haugh unit of eggs differ significantly among varieties and was highest in CARI-Devendra birds (Fig 1). The index values was found not to vary under different management either in field or farm, indicating suitability of these varieties in either condition. The interaction of variety and management was also not significant in the present study. The present estimation on albumin index was lower than those reported by Haunshi *et al.* (2006) and Parmar *et al.* (2006) in Vanaraja and Kadaknath breed of chicken, respectively. However, Negi (2008) reported similar values of albumen index in Kalinga Brown chicken. The yolk index of eggs was in agreement with the report Haunshi *et al.* (2006) who reported 36.8% of yolk index in Vanaraja, and Parmar *et al.* (2006) who reported 37.53% yolk index in Kadaknath breed of poultry. However, higher estimates of yolk indices were also reported by some workers in their study (Negi 2008). The yolk index indicates the quality of egg which affects consistency and height of yolk. The haugh unit values were similar to those reported by Chatterjii *et al.* (2007) in White Leghorn strain. Mohan *et al.* (2008) reported higher haugh values in Aseel birds. These observable differences in haugh values might be due to genetic structure, health condition, feeding practices, care and managemental conditions. Parmar *et al.* (2006) observed wide range of haugh unit value for Kadaknath birds starting from 52.58 to 90.00 in under field conditions.

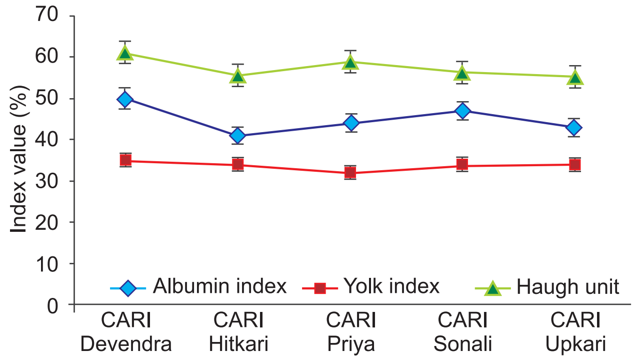

Fig. 1. Egg indices in different improved varieties of chicken.

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