Assessment of egg quality and biochemical parameters of Aseel and Kadaknath indigenous chicken breeds of India under backyard poultry farming

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ABSTRACT Egg quality parameters are very crucial for the egg industry as egg configuration affects grading, price, hatchability, chick weight, and consumer preference. Current study was undertaken to assess and compare the egg quality parameters in 2 important Indian breeds Aseel and Kadaknath reared under backyard system. Different parameters of external and internal egg quality were measured. Biochemical parameters of egg yolk estimated were egg yolk cholesterol, high density lipoprotein (**HDL**), low density lipoprotein (**LDL**), and triacylglycerol. Means for external characters of Aseel eggs viz., egg weight, egg length, egg width, shape index, shell weight, shell thickness, and shell ratio were 41.7 g, 5.16 cm, 3.85 cm, 74.75%, 4.65 g, 0.35 mm, and 11.23%, and corresponding values for Kadaknath eggs were 40.59 g, 5.13 cm, 3.79 cm, 74.02%, 4.28 g, 0.34 mm, and 10.61%, respectively. Average albumin length, width, height, and albumin index were 83.73 mm, 65.4 mm, 6.02 mm, and 9.26% for Aseel eggs and 82.27 mm, 64.80 mm, 5.52 mm and 8.52% for Kadaknath eggs, respectively. Mean values for yolk length, width, height and yolk index were 43.32 mm, 40.10 mm, 15.30 mm, and 38.30% in Aseel and 42.15 mm, 38.97 mm, 14.26 mm and 36.66% in Kadaknath breed, respectively. Mean values for egg yolk cholesterol, HDL, LDL, and triacylglycerol were estimated as 9.38, 1.74, 0.17, and 1.94 mg/g in Aseel eggs and 8.38, 1.84, 0.11, and 1.76 mg/g in Kadaknath eggs, respectively. Biochemical analysis revealed that egg yolk quality of Kadaknath eggs was comparatively better than Aseel eggs.

Key words: Aseel, backyard poultry, biochemical analysis, egg quality, Kadaknath

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INTRODUCTION

Poultry sector has experienced considerable development in a short period of time. In India, backyard poultry farming plays a significant role in terms of economic development, women's empowerment, and nutritional security (Kumar et al., 2021a). However, because of low production performance, less attention is paid to indigenous chicken (Tajane and Vasulkar, 2014). According to Mandal et al. (2006), backyard rearing is important for producing stress-free and residue-free birds. Sale of these birds and their eggs commences a higher price than commercial eggs and broilers, thus the birds grown in backyard systems are economically advantageous (Selvam, 2004).

Aseel and Kadaknath are 2 popular indigenous chicken breeds of India that are gaining popularity because of their disease resistance, heat tolerance and meat quality with desirable taste and flavor (Rajkumar et al., 2016). The fierceness, royal gait, alertness, great stamina, and persistent fighting skills of Aseel are well recognized (Singh, 2001). Kadaknath birds are very popular among Madhya Pradesh's tribals, owing to their unique characteristics such as adaptation to the local environment, disease resistance, meat quality, medicinal value of egg and meat, and a variety of other breed-specific characteristics (Rao and Thomas, 1984). Despite its unpleasant appearance, Panda and Mahapatra (1989) found Kadaknath meat to have a delicious flavor. According to Mohan et al. (2008a), Kadaknath chickens are unique because of black coloured flesh and their meat and eggs are high in protein.

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Abbreviations: HDL, high density lipoprotein; LDL, low density lipoprotein.

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Aseel and Kadaknath chickens are poor layers, but they have good broodiness characteristics and are highly capable of protecting their young ones in free-range conditions. These desi indigenous birds are famous for their hardiness and ability to survive under high environmental temperature and adverse climatic conditions (Kumar et al., 2021b). Due to their toughness, adaptability, and tasty meat and eggs, farmers have recently been interested in raising indigenous chickens.

Egg quality refers to the characteristics of an egg that determine its adequacy for consumption (Stadelman, 1977). Egg quality impacts characteristics like grading, price, consumer preference, hatchability and chick weight, therefore, egg quality has a big impact on the egg business (King'ori, 2012). As a result, the poultry breeding industry is focusing more on egg quality (Bain, 2005). The quality of eggs is influenced by a number of factors such as breed, season, temperature, relative humidity, and management practices (Sauter et al., 1954; Washburn, 1990). According to Narushin and Romanov (2002), the structure and internal quality of eggs affect embryo growth and successful hatching. Internal egg quality factors for hatching and customer preference include albumin thickness and yolk integrity (Sekeroglu and Altuntas, 2009). Egg yolk contain essential polyunsaturated fatty acids, total cholesterol, low-density lipoproteins (**LDL**), and high-density lipoproteins (**HDL**) fractions and these contents are influenced by genetic factors, feed composition, laying intensity, and layer age (Vorlova et al., 2001). The quality of eggs produced is essential for the success of backyard chicken farming. As a result, Sreenivas et al. (2013) concluded that evaluating egg quality criteria is crucial for maintaining good quality egg production. Keeping in mind the above facts, the current study was carried out to assess and compare different egg quality parameters (external, internal, and biochemical) in Aseel and Kadaknath breeds reared under backyard system in Haryana state (India).

MATERIALS AND METHODS

The study followed standards guidelines approved by the Institutional Animal Ethics Committee (**IAEC**), LUVAS, Hisar, Registration number: 1669/GO/ReBiBt/S/12/CPCSEA.

Egg Quality Traits

Under the Rashtriya Krishi Vikas Yojana − Remunerative Approaches for Agriculture and Allied Sectors Rejuvination (**RKVY-RAFTAAR**) project, chicks were procured from Poultry Farm, LUVAS, Hisar, and distributed to selected 16 rural families. Chicks were reared under backyard farming system and a total of 120 eggs, 60 eggs from each breed were collected from these families for estimation of various external, internal, and biochemical egg quality parameters. The eggs were collected during mid-laying phase of hens. External egg parameters included egg weight, egg length, egg width, shape index, shell weight, shell thickness, and shell ratio. Albumin length, albumin width, albumin height, albumin index, yolk length, yolk width, yolk height, yolk index, and Haugh unit were all measured as internal parameters of the egg quality. Biochemical analysis of eggs included estimation of egg yolk cholesterol, HDL, LDL, and triacylglycerol.

Measurement of External Parameters

A digital balance was used to weigh each egg to the nearest 0.01 g accuracy. A digital Vernier calliper was used to measure the length and width of the egg, and the shape index was calculated by multiplying the width to length ratio by 100. The inner shell membranes of the shells were removed and dried for 24 h in the open air. All of the dried shells were weighed using a digital balance. Shell ratio was calculated by dividing shell weight by egg weight. The thickness of 4 portions of shells were measured to the nearest 0.01 mm using screw gauze, one from each of the 2 ends (broad and narrow end) and 2 from the body of the eggs, and the average thickness was calculated.

Measurement of Internal Parameters

A Vernier caliper was used to measure the length and width of the albumen and yolk in millimetres. Albumen height was measured at 3 or 4 places and averaged. Shape index: A Vernier calliper was used to measure the width and length of each egg. The shape index was calculated by ratio of maximum width and length of egg multiply by 100. Shell thickness: after removing the shell membrane, the weight of the egg shell was measured using an electronic weighing balance. Screw Gauge was used to determine the thickness of the shell. Membrane-removed portions of shell were collected from 3 locations for this purpose, and the average shell thickness was used as the final reading. Albumen index: with the aid of a Vernier Caliper, the maximum length and width of thick albumen were measured. Height of thick albumen was calculated between yolk and the outside border of thick albumen, avoiding chalaza. After correcting for the zero error on the plain glass plate, albumen height was measured with the assistance of a tripod spherometer with a least count of 0.001 mm. The albumen index was calculated by ratio of average height and width of albumen egg multiply by 100. Yolk index: the yolk's height was measured using a tripod spherometer, and its width was measured using a Vernier calliper. The formula used to calculate yolk index was ratio of average height and width of yolk multiply by 100. Haugh Unit; the Haugh unit is the product of the log of albumin height and egg weight, and it is derived using Raymond Haugh's (1937) formula:

$$\text{Haugh Unit} = 100 \log \left(H + 7.57 - 1.7W^{0.37}\right)$$

where; H = Albumin Height; W = Egg Weight.

Table 1. External egg quality parameters of Aseel and Kadaknath breeds under backyard poultry farming.

Traits	Aseel			Kadaknath		
	Mean ± S.E.	Range	C.V. (%)	Mean ± S.E.	Range	C.V. (%)
Egg weight (g)	41.70 ± 0.55	32.20 − 52.20	10.30	40.59 ± 0.55	24.40 − 50.0	10.58
Egg length (cm)	5.16 ± 0.04	4.55 − 6.29	5.67	5.13 ± 0.03	4.55 − 5.55	4.66
Egg width (cm)	3.85 ± 0.02	3.55 − 4.25	4.09	3.79 ± 0.02	3.51 − 4.03	3.12
Shape index (%)	74.75 ± 0.47	61.65 − 82.94	4.88	74.02 ± 0.46	65.62 − 81.98	4.80
Shell weight (g)	4.65 ± 0.06	3.70 − 5.50	10.47	4.28 ± 0.08	3.00 − 5.10	14.13
Shell thickness (mm)	0.35 ± 0.00	0.25 − 0.40	7.79	0.34 ± 0.00	0.29 − 0.39	7.52
Shell ratio (%)	11.23 ± 0.18	8.16 − 14.95	12.46	10.61 ± 0.20	6.88 − 17.62	14.43

Measurement of Biochemical Parameters of Egg Yolk

Protocol followed by Angelo et al. (1987) was used to extract total lipids from the samples. For 5 min, a 10 g egg yolk sample was homogenized in 40 mL solvent (chloroform: methanol; 3:1). The mixture was held for 10 min before being placed on the Buchner suction filter. As before, the residue was homogenized twice more. The organic filtrates were mixed together and funneled into a separating funnel. The funnel was forcefully shaken after adding 2 volumes of 0.88% aqueous potassium chloride. Nonlipid material was partitioned to the upper aqueous phase after the funnel was left undisturbed for 12 h. The bottom layer was removed and dried over sodium sulphate. After removing the top phase, a few drops of methanol were applied to clean up the bottom phase. At 60°C, lipid extract was dried to a constant weight in a water bath and subsequently in a hot air oven. Using the "ERBA System Pack" (Transasia Biomedicals Limited, Mumbai, India) in an automated analyzer (EM-200, Transasia Biomedicals Limited), egg yolk cholesterol, HDL, LDL, and triacylglycerol of extracted fat from egg yolk were estimated. The SPSS 22.0 programme was used to analyze the data.

RESULTS

External Egg Quality Parameters

Means along with standard error, range and co-efficient of variation for external egg quality parameters in Aseel and Kadaknath breeds are presented in Table 1. Means for external characters of Aseel eggs viz., egg weight, egg length, egg width, shape index, shell weight, shell thickness, and shell ratio were 41.7 g, 5.16 cm, 3.85 cm, 74.75%, 4.65 g, 0.35 mm, and 11.23%, respectively. Among, external characters of eggs, maximum variation was found in shell ratio (12.46 %) followed by shell weight (10.47 %) and egg weight (10.30%) whereas minimum variation was observed in egg width (4.09 %) of Aseel eggs. Means for external characters of Kadaknath eggs viz., egg weight, egg length, egg width, shape index, shell weight, shell thickness, and shell ratio were 40.59 g, 5.13 cm, 3.79 cm, 74.02%, 4.28 g, 0.34 mm, and 10.61%, respectively. Maximum variation was found in shell ratio followed by shell weight and egg weight whereas minimum variation was observed in egg width in Kadaknath eggs.

Internal Egg Quality Parameters

In Aseel eggs, average albumin length, width, height, and albumin index were 83.73 mm, 65.4 mm, 6.02 mm, and 9.26%, respectively. Mean values for yolk length, width, height, and yolk index were found as 43.32 mm, 40.10 mm, 15.30 mm, and 38.30%, respectively. Haugh unit for Aseel eggs was calculated as 82.88%. Among internal parameters of eggs, maximum variation was found for albumin index (22.32%) whereas minimum was observed for yolk width (5.11%) in Aseel eggs. In Kadaknath eggs, average albumin length, width, height and albumin index were calculated as 82.27 mm, 64.80 mm, 5.52 mm, and 8.52%, respectively. Mean values for yolk length, width, height and yolk index were 42.15 mm, 38.97 mm, 14.26 mm, and 36.66%, respectively. Haugh unit for Kadaknath eggs was calculated as 79.82%. Maximum variation was found for albumin height (24.79%) whereas minimum was observed for yolk width (5.44%) in Kadaknath eggs. Means along with standard error, range and co-efficient of variation for internal egg quality parameters in Aseel and Kadaknath breeds are presented in Table 2.

Table 2. Internal egg quality parameters of Aseel and Kadaknath breeds under backyard poultry farming.

Traits	Aseel			Kadaknath		
	Mean ± S.E.	Range	C.V. (%)	Mean ± S.E.	Range	C.V. (%)
Albumin length(mm)	83.73 ± 0.71	68.55 − 99.09	6.56	82.27 ± 0.62	73.25 − 97.10	5.81
Albumin width (mm)	65.40 ± 0.54	57.53 − 77.60	6.40	64.80 ± 0.39	56.11 − 69.32	4.62
Albumin height (mm)	6.02 ± 0.16	4.29 − 9.45	20.11	5.52 ± 0.18	3.36 − 9.45	24.79
Albumin index (%)	9.26 ± 0.27	5.82 − 15.31	22.32	8.52 ± 0.27	5.86 − 15.10	24.60
Yolk length(mm)	43.32 ± 0.38	38.94 − 49.35	6.80	42.15 ± 0.32	36.78 − 46.30	5.83
Yolk width (mm)	40.10 ± 0.26	36.42 − 44.45	5.11	38.97 ± 0.27	35.59 − 42.93	5.44
Yolk height (mm)	15.30 ± 0.35	9.80 − 18.62	17.78	14.26 ± 0.35	10.29 − 18.31	18.88
Yolk index (%)	38.30 ± 0.95	26.18 − 48.10	19.14	36.66 ± 0.92	27.33 − 50.17	19.44
Haugh Unit (%)	82.88 ± 0.95	69.76 − 101.52	8.88	79.82 ± 1.09	63.97 − 102.47	10.56

Table 3. Biochemical parameters of egg yolk in Aseel and Kadaknath breeds under backyard poultry farming.

Traits	Aseel			Kadaknath		
	Mean ± S.E.	Range	C.V. (%)	Mean ± S.E.	Range	C.V. (%)
Egg yolk cholesterol (mg/g)	9.38 ± 0.02	9.16 − 10.04	1.50	8.38 ± 0.01	8.24 − 8.81	1.05
Egg yolk HDL (mg/g)	1.74 ± 0.03	1.13 − 2.17	14.97	1.84 ± 0.03	1.00 − 2.39	12.50
Egg yolk LDL (mg/g)	0.17 ± 0.01	0.04 − 0.44	53.11	0.11 ± 0.01	0.04 − 0.35	52.97
Egg yolk triacylglycerol (mg/g)	1.94 ± 0.05	1.16 − 2.87	18.36	1.76 ± 0.04	1.04 − 2.47	17.59

Abbreviations: HDL, high density lipoprotein; LDL, low density lipoprotein.

Egg Yolk Biochemical Parameters

Means along with standard error, range and co-efficient of variation for biochemical egg quality parameters in Aseel and Kadaknath breeds are presented in Table 3. Mean values for egg yolk cholesterol, HDL, LDL, and triacylglycerol were observed as 9.38, 1.74, 0.17, and 1.94 mg/g, respectively in Aseel eggs. Biochemical analysis revealed maximum variation in egg yolk LDL while minimum was observed for egg yolk cholesterol in Aseel breed. In Kadaknath eggs, mean values for egg yolk cholesterol, HDL, LDL, and triacylglycerol were observed as 8.38, 1.84, 0.11, and 1.76 mg/g, respectively. Biochemical analysis revealed maximum variation in egg yolk LDL, whereas minimum variation was observed for egg yolk cholesterol in Kadaknath breed.

DISCUSSION

External Egg Quality Parameters

In the present study, average egg weight in Aseel and Kadaknath chickens was found to be 41.7 and 40.59 g which was in agreement with the results of Singh et al. (2000b) in Aseel breed, however, Singh et al. (2000a) reported higher egg weight (47.81 ± 0.18) for the same breed under field conditions. The difference in egg weight might be attributed to the age of the chickens at the time of egg collection in the field. Dalal et al. (2019) reported comparatively higher egg weight in Aseel while egg weight of Kadaknath chicken was comparable with the present results. Jena et al. (2018) found that the egg weight of Kadaknath chickens was 42.90 g. The weight of the Kadaknath eggs ranged from 40.31 to 41.3g, according to Haunshi et al. (2011) and Valavan et al. (2016) and this was in correspondence with the present findings. However, Jha et al. (2013) reported a higher egg weight as 46.23 g in Kadaknath breed. RajKumar et al. (2014) reported similar average egg weight in Aseel chicken, though, the egg weights observed by them at 32 and 40 wk of age were comparatively low while higher egg weight was found at 72 wk of age. Singh et al. (2007) also reported comparatively higher (47 g) egg weight in Aseel chickens. Usman et al. (2014) observed higher egg weight (51.62−55.65 g) in Aseel variants from Pakistan. Mohan et al. (2008b) observed heavier eggs than the present results in Aseel birds. Parmar et al. (2006) and Biswas et al. (2010) reported slightly higher egg weight as 42.33 g and 41.84 g in Kadaknath chickens.

In Aseel and Kaddaknath chickens, current study revealed egg length as 5.16 and 5.13 cm, respectively. Jena et al. (2018) observed comparatively lesser egg length (4.51 cm) in Kadaknath chicken. Singh et al. (2018) reported similar egg length (5.46 cm) in Indian native Uttara fowl. The differences in egg length might be due to variability in genotypes and environmental conditions. Rajaravindra et al. (2015) found that the egg length of synthetic coloured broiler female line chickens was 5.57 cm. In current study, egg width observed in Aseel and Kadaknath chicken was 3.85 and 3.79 cm, respectively. These findings were in line with Jena et al. (2018) in Kadaknath chicken and they reported egg width as 3.37 ± 0.01cm, however, Singh et al. (2018) reported relatively higher average egg width (4.06 cm) in native Uttara fowl.

Shape index was calculated as 74.75 and 74.02% for Aseel and Kadaknath eggs in this study and similar shape index (75.46) was reported by Singh et al. (2000a) for Aseel eggs under field conditions. Jena et al. (2018) found a shape index of 74.67% for Kadaknath breed of chicken, which was similar to the current study. However, Haunshi et al. (2011) and Valavan et al. (2016) found a higher value of shape index in the Kadaknath breed, ranging from 76.39 to 77.23%. Relatively higher shape index (77.07%) was also observed by Rajkumar et al. (2014) in Aseel chicken. Haunshi et al. (2011) found a shape index of 77.36% in Aseel eggs, and Sohail et al. (2013) found shape index values ranging from 77.25 to 83.87% in indigenous Aseel eggs in Peshawar. Parmar et al. (2006) found that in Kadaknath breed shape index was 73.95% while Jaishankar et al. (2020) reported the shape index of Kadaknath eggs as 73.64%.

In Aseel and Kadaknath breeds, present study revealed shell weight as 4.65 and 4.28 g, respectively and the results were in concordance with Rajkumar et al. (2014), although, Sohail et al. (2013) reported higher egg shell weight in Aseel chickens. Haunshi et al. (2011) reported similar shell weight in Aseel and Kadaknath breeds of chicken as 4.94 and 4.34 g, respectively. Jena et al. (2018) reported shell weight of Kadaknath eggs as 4.36 ± 0.04 g. Jaishankar et al. (2020) reported that the shell weight of Kadaknath eggs as 6.01 g which was higher than present study. Average shell thickness was observed as 0.35 and 0.34 mm in Aseel and Kadaknath, respectively in this study which was in line with the results of several studies (Islam et al. 2001; Rajkumar et al. 2014) in different breeds of chicken, however, Yakubu et al. (2008) and Rajkumar et al.

(2010) reported higher egg shell thickness in Naked Neck birds. Parmar et al. (2006) and Jaishankar et al. (2020) reported that shell thickness of eggs in Kadaknath chickens was 0.31 mm and 0.36 mm, respectively. In the present study, shell ratio in Aseel and Kadaknath chickens was calculated as 11.23 and 10.61%, respectively. Aygun and Olgun (2019) reported similar shell ratio in chicken (10%) and slightly less in quail (9.56%).

Internal Egg Quality Parameters

In the present study, albumin length in Aseel and Kadaknath chickens was found to be 83.73 and 82.27 mm whereas albumin width was 65.40 and 64.80 mm, respectively. Thicker albumin (70.03 ± 0.01 mm) was reported by Jena et al. (2018) in Kadaknath chickens. Present study revealed albumin height as 6.02 and 5.52 mm, respectively in eggs of Aseel and Kadaknath chickens. Jena et al. (2018) reported albumin height in Kadaknath breed of chicken as 5.05 ± 0.003 mm. Albumen index of an egg is a measure of protein content of egg, and higher value indicate intact albumin, which means superior albumin and egg quality. In present study, albumin index was higher in Aseel (9.26 ± 0.27) as compared to Kadaknath chicken (8.52 ± 0.27). Similar estimates for albumin index were reported by Hussain et al. (2013) in commercial farm eggs (9.90 ± 0.27) but lower estimates were found in market (07.54 ± 0.35) and indigenous eggs (6.11 ± 0.32). Jena et al. (2018) reported albumin index as 7.20 ± 0.003 in Kadaknath chickens. Haunshi et al. (2011) reported comparatively lower albumin index in Aseel and Kadaknath chickens as 7.6 and 7.2, respectively.

The yolk length in Aseel and Kadaknath chickens was found to be 43.32 and 42.15 mm, whereas yolk width was 40.10 and 38.97 mm, respectively. Rajkumar et al. (2014) reported comparable findings of yolk width (39.55 mm) in Aseel chicken. However, Jena et al. (2018) reported higher yolk width (42.21 ± 0.037 mm) in Kadaknath chicken. Yolk height in current study was 15.30 and 14.26 mm in Aseel and Kadaknath chickens, respectively. Rajkumar et al. (2014) reported similar findings of yolk height (14.57 mm) in Aseel chicken. Yolk height in Kadaknath chicken was 15.01 ± 0.04 mm (Jena et al., 2018).

In the present study, yolk index was found to be 38.30 and 36.66 in Aseel and Kadaknath chicken. Rajkumar et al. (2014) reported comparable findings for yolk index in Aseel chickens. In Kadaknath chickens, Jha et al. (2013) and Valavan et al. (2016) reported yolk index values in the range of 35.2 to 36.7 and Parmar et al. (2006) reported yolk index value as 37 under field conditions. Jena et al. (2018) reported yolk index in Kadaknath breed of chicken as 35.56%. Haunshi et al. (2011) reported yolk index in Aseel and Kadaknath breed of chicken as 39.5 and 36.7 g, respectively.

Haugh unit, which evaluates albumin quality, was 82.88 for Aseel eggs and 79.82 for Kadaknath eggs in present study. Usman et al. (2014) reported comparable estimates of Haugh unit in different varieties of Aseel. Rajkumar et al. (2014) reported lower values of Haugh unit in Aseel. In the Kadaknath breed, Jena et al. (2018) reported a Haugh unit value of 76.46, whereas Jha et al. (2013) and Valavan et al. (2016) recorded Haugh unit values of 72.57 to 74.99. Parmar et al. (2006) found that the Haugh unit of Kadaknath breed chickens was 73.77. Haunshi et al. (2011) reported Haugh unit in Aseel and Kadaknath breed of chickens as 75.43 and 74.99, respectively. Haugh unit value as reported by Haunshi et al. (2011) was comparatively lower than current study in Aseel and Kadaknath chickens. Parmar et al. (2006) and Sohail et al. (2013) observed a large variation of Haugh unit in Kadaknath and Peshawer Aseel eggs, respectively.

Egg Yolk Biochemical Parameters

In the present study, egg yolk cholesterol in Aseel and Kadaknath chickens was found as 9.38 ± 0.02 and 8.38 ± 0.01 mg/g, respectively. Egg yolk cholesterol was slightly less in Kadaknath as compared to Aseel eggs. Higher mean values of egg yolk cholesterol (13.55 mg/g) as compared to present study were reported by Sheoran et al. (2017) in white leghorn chickens. Ukachukwu et al. (2017) reported mean values for egg yolk cholesterol as 6.79 mg/g in quail eggs and mean values for egg yolk cholesterol was 4.03 mg/g in chicken eggs. Aziz et al. (2012) reported mean values for egg yolk cholesterol as 7.65 ± 0.28, 10.36 ± 0.94, 16.05 ± 0.63 mg/g in chicken, duck and quail eggs, respectively.

Egg yolk HDL in Aseel and Kadaknath chickens was found to be 1.74 ± 0.03 and 1.84 ± 0.03 mg/g, respectively. Sheoran et al. (2017) reported comparatively higher value for egg yolk HDL (5.58 mg/g) in white leghorn chickens. Ukachukwu et al. (2017) reported mean values for egg yolk HDL as 3.95 mg/g and 1.84 mg/g in quail and chicken eggs, respectively. In current study, egg yolk LDL in Aseel and Kadaknath chickens was found to be 0.17 ± 0.01 and 0.11 ± 0.01 mg/g, respectively. Higher mean values of egg yolk LDL (7.67 mg/g) was reported in white leghorn chickens by Sheoran et al. (2017). Ukachukwu et al. (2017) reported mean values for egg yolk LDL as 1.80 mg/g and 0.40 mg/g in quail and chicken eggs, respectively. Egg yolk triacylglycerol in Aseel and Kadaknath chickens was found as 1.94 ± 0.05 and 1.76 ± 0.04 mg/g, respectively in present study. Ukachukwu et al. (2017) reported mean values for egg yolk triacylglycerol as 1.60 mg/g in quail eggs and 1.53 mg/g in chicken eggs.

In conclusion, Aseel chickens had better external and internal egg quality characteristics than Kadaknath chickens. The amounts of lipids in Aseel egg yolk were more than those in Kadaknath. Further, egg yolk cholesterol and LDL content were lower, while HDL content was higher in Kadaknath eggs as compared to Aseel eggs. Biochemical analysis revealed that egg yolk quality of Kadaknath eggs was comparatively better than Aseel

eggs. The findings of this study will be helpful for the poultry breeders in selecting high-quality eggs for propagation of next generation as well as for egg consumers in selecting high-quality eggs for consumption.

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DISCLOSURES

All authors (Manoj Kumar, S. P. Dahiya, Poonam Ratwan, Nancy Sheoran, Sandeep Kumar, and Narender Kumar) of the manuscript entitled "Assessment of egg quality and biochemical parameters of Aseel and Kadaknath indigenous chicken breeds of India under backyard poultry farming" have no conflict of interest.

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