

Research Article

Seasonal Variations in Egg Quality and Yolk Cholesterol in Backyard and Cage Rearing Chicken

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ABSTRACT

A study was conducted to compare the external and internal egg quality traits, egg composition and yolk cholesterol levels in the eggs of range reared rural birds, to that of urban backyard and commercial cage layer eggs. The rural, urban range and backyard reared birds laid 22–25% smaller eggs as compared to the commercial layer. Furthermore, commercial layers eggs contained higher albumen (62%) and lower yolk (23–28%) when compared with eggs of urban backyard raised birds (55% albumen and 35% yolk). From the above results, it is concluded that total cholesterol in the egg and cholesterol level/g yolk of the range reared rural (180 g and 13.4 g) and urban backyard birds (187 g and 13 g) were lower when compared to that of commercial layer eggs (207 g and 14 g). Eggs laid during the monsoon season had lower cholesterol level than those laid during summer. Hence it is inferred based on this study that an intake of cholesterol is comparatively less with consumption of eggs from range reared rural birds.

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INTRODUCTION

Poultry eggs have been highly esteemed as a wholesome food with balanced nutritional properties. The high nutritional properties of eggs make them ideal for many people with special dietary requirements. Egg consumption is decreasing in developed countries due to the “cholesterol phobia” although there are definite studies proving that egg consumption and dietary cholesterol intakes are unrelated to either hyper cholesterol or coronary heart diseases (McNamara, 2002). All over the world and particularly in India, the demand for range reared chicken egg is increasing as people believe that these eggs are superior in yolk color as compared to farm reared chicken eggs. Therefore this study was planned to compare the external and internal egg quality traits, egg composition and yolk cholesterol levels in the eggs of range reared rural birds, to that of urban backyard and commercial cage layer eggs under winter and summer.

MATERIALS AND METHODS

A factorial experiment of three rearing systems in two seasons i.e. summer and winter was conducted using eggs from rural range reared birds, backyard urban birds and commercial chicken raised in cages. The eggs from rural poultry were collected from ten villages spread throughout the state of Tamilnadu, India while urban eggs from ten places around Chennai city in the state of Tamilnadu. The commercial eggs were taken from ten wholesale outlets located in Chennai city. 300 eggs each for rural, urban and commercial eggs were collected during each season, (monsoon and summer) comprising of a sum of 900 eggs per season.

90 eggs for each season (30 eggs for each rearing system) were randomly selected and these external and internal egg quality traits were studied. The percentage composition and

the total yolk cholesterol of the eggs were measured the eggs where individually weighed by using an electronic balance to the nearest one tenth of a gram. The egg qualities were measured as described by stadelman (1986).

The shells were washed to remove the sticking albumen and dried in a hot air oven at $110^{\circ} \pm 5^{\circ}\text{C}$ overnight. After cooling, the shell thickness was measured at the equatorial region, narrow and broad ends by using a Shell thickness gauge to 0.01mm accuracy and the average shell thickness was calculated.

The albumen and yolk were separated and weighed individually using the same electronic balance. The egg shell with the shell membrane was later weighed. Based on the weight, the percent values of the same were calculated.

Representative samples of the yolk from the eggs were utilised for the calorimetric estimation of total yolk cholesterol using photo electric calorimeter. Yolk cholesterol was extracted and quantified, following the method of Washburn and Nix (1974), a modified procedure of Folch *et al.* (1956). All the data collected were subjected to analysis of variance for significance according to the methods of Snedecor and Cochran (1989) for a randomised block design. The significance was tested using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The egg laid by the cage raised commercial layer had a significant ($P<0.01$) higher weight and larger surface area than those of range raised and urban backyard birds. The rural range and urban backyard reared chicken eggs were 22–25% smaller and had 40 – 45 % better surface area when compared to the commercial layer eggs. The commercial layer birds are provided with a well-balanced nutrition and have been bred to provide larger eggs with a large surface area.

The effect of rearing system and season on the external egg quality traits and the interactions are presented in Table-1. The significantly higher value of albumen index and Haugh unit in eggs laid by the rural range and urban backyard birds when compared among themselves, indicates the freshness of eggs. The shell of the commercial layers egg were much significantly ($P<0.01$) thicker than the other two groups. These findings on albumen index and Haugh unit may be attributed to the place where the eggs are laid, the time of collection and delay in transport. The farm eggs due to delay in transport reaches the retail outlet much later while the urban backyard raised bird eggs were fresh. The finding of freshness with urban backyard raised egg agreed with the findings of Padhi *et al.* (1998). Season had a definite effect on all the internal egg qualities. Eggs laid

during the monsoon season had significantly higher ($P<0.01$) albumen and yolk index, Haugh unit and thick shells. Environmental changes, such as high temperature, may result in the thinning of albumen, loss of elasticity in the vitelline membrane and ultimately flattening of yolk due to leakage of water from the albumen leaking into the yolk. The shell gets thinner during the summer due to disability of birds to meet out the requirement of calcium and bicarbonate ions. Interaction between rearing system x season was significant with albumen index and yolk index only. Eggs collected from the rural range and urban backyard raised birds during monsoon season had significantly higher ($P<0.01$) albumen index and yolk index. This could be attributed to the freshness of the eggs and a cooler environmental temperature.

External egg quality	Rearing systems mean ($\pm$ S.E.)		
	Rural range	Urban range	Farm
Egg weight ** (g)	40.04 ^b $\pm$ 0.75	41.72 ^b $\pm$ 0.61	53.21 ^a $\pm$ 0.48
Shape index ^{NS}	75.54 $\pm$ 0.73	75.46 $\pm$ 0.35	75.27 $\pm$ 0.42
Surface area ** (cm ²)	35.85 ^c $\pm$ 0.78	56.36 ^b $\pm$ 0.59	64.79 ^a $\pm$ 0.37
External egg quality	Season mean ($\pm$ S.E.)		
	Monsoon	Summer	
Egg weight ^{NS} (g)	44.83 $\pm$ 0.82	45.16 $\pm$ 0.78	
Shape index ^{NS}	75.33 $\pm$ 0.41	75.52 $\pm$ 0.45	
Surface area ^{NS} (cm ²)	57.84 $\pm$ 0.71	58.82 $\pm$ 0.68	

**Means within each row bearing different superscripts differ significantly

Highly significant ($P<0.01$)

^asuperior, ^b Inferior^{NS} Not significant

Table 1: Effect of rearing system and season on external egg quality traits

Table 2: Effect of rearing system and season on percent egg components

Egg components	Rearing systems mean ($\pm$ S.E.)		
	Rural range	Urban range	Farm
Per cent albumen **	55.44 ^b $\pm$ 0.49	55.12 ^b $\pm$ 0.29	62.00 ^a $\pm$ 0.23
Per cent yolk **	34.30 ^b $\pm$ 0.47	35.14 ^a $\pm$ 0.29	28.23 ^c $\pm$ 0.19
Per cent shell *	10.19 ^a $\pm$ 0.14	9.76 ^b $\pm$ 0.11	9.79 ^b $\pm$ 0.08
Egg components	Season mean ($\pm$ S.E.)		
	Monsoon	Summer	
Per cent albumen ^{NS}	57.43 $\pm$ 0.43	57.61 $\pm$ 0.46	
Per cent yolk ^{NS}	32.65 $\pm$ 0.40	32.46 $\pm$ 0.45	
Per cent shell ^{NS}	9.90 $\pm$ 0.08	9.93 $\pm$ 0.10	

Means within each row bearing different superscripts differ significantly

^asuperior, ^b Inferior** Highly significant ($P<0.01$)

*Significant ($P<0.01$)

^{NS}Not significant

Criteria	Rearing systems mean ($\pm$ S.E.)		
	Rural range	Urban range	Farm
Total yolk cholesterol **	180.33 ^a $\pm$ 1.94	187.17 ^b $\pm$ 1.38	206.80 ^c $\pm$ 1.22
Cholesterol / g yolk**	13.40 ^{ab} $\pm$ 0.22	12.99 ^a $\pm$ 0.15	14.01 ^b $\pm$ 0.34
Cholesterol / g egg **	4.98 ^b $\pm$ 0.12	4.70 ^b $\pm$ 0.08	3.65 ^a $\pm$ 0.04
Cholesterol content	Season mean ($\pm$ S.E.)		
	Monsoon	Summer	
Total yolk cholesterol **	188.93 ^a $\pm$ 1.80	193.94 ^b $\pm$ 1.61	
Cholesterol / g yolk **	13.28 ^a $\pm$ 0.18	14.05 ^b $\pm$ 0.23	
Cholesterol / g egg *	4.35 ^a $\pm$ 0.09	4.54 ^b $\pm$ 0.09	

Means within each row bearing different superscripts differ significantly

^asuperior, ^b Inferior

** Highly significant ($P<0.01$)

* Significant ($P<0.05$)

Farm eggs had the highest percent of albumen and the lowest percent of yolk. The effect of rearing system and seasons on the egg composition has been summarized in Table-2. The eggs from the urban backyard reared birds had the highest percent of yolk, the same was observed by Chatterjee *et al.* (2007) and

Yadav *et al.* (2009) while the range reared rural bird had the highest per cent of shell. Seasons did not have any effect on the percent components of eggs. This agreed with the findings of Izat *et al.* (1986) The total yolk cholesterol, cholesterol per gram yolk and cholesterol per gram egg is summarized in Table-3.

The overall mean values of total yolk cholesterol per gram yolk and cholesterol per gram egg exhibited significant ($P<0.01$) differences under different rearing systems and seasons while cholesterol per gram egg showed a significant difference ($P<0.05$) during different seasons. Total yolk cholesterol of eggs collected from rural bird raised on range gave significantly ($P<0.01$) lower cholesterol levels, while the cholesterol per gram yolk was found to be significantly ($P<0.01$) lower in the backyard raised urban bird egg. The cholesterol/g egg was significantly ($P<0.01$) lower in the cage reared commercial layer

Traits	Rearing system		
	Rural range	Urban range	Farm
Yolk weight with total cholesterol	0.158 ^{NS}	0.100 ^{NS}	-0.240 ^{NS}
Egg weight with total cholesterol	0.121 ^{NS}	0.13 ^{NS}	0.092 ^{NS}
Traits	Season		
	Monsoon	Summer	
Yolk weight with total cholesterol	0.146 ^{NS}	0.013 ^{NS}	
Egg weight with total cholesterol	0.161 ^{NS}	0.083 ^{NS}	

^{NS} Not significant

Kundu and Singh (1991) agreed with the present result that they observed a high yolk cholesterol level but low cholesterol / g egg in Rhode Island Red and the indigenous bird from range and the urban backyard birds lay a smaller egg compared to the hybrid layer raised under the intensive rearing system. Turk and Barnett (1971) also observed lower cholesterol concentrations in caged layer.,

McNaughton (1978) opined that the backyard raised urban bird had the lowest cholesterol/g yolk followed by the range reared rural bird. Although genetics play an important role on cholesterol levels in the egg (Campo, 1995), the low cholesterol / g yolk of range reared and urban backyard birds might be Most probably due to consumption of the greens, kitchen wastes and herbs. Harris and Wilcox (1963) also observed that eggs collected during summer had the highest concentration of cholesterol / egg and cholesterol / g yolk as reported in the present study. During heat stress, an increase in plasma corticosteroid might have triggered triglyceride and cholesterol level in the blood and further, the lag period between clutches might have attributed to massive accumulation of cholesterol in eggs laid during summer. In contrary, Season did not show any significant correlations as per Ansah *et al.* (1985) and Kundu and Singh (1991).)

CONCLUSION

Based on this study, it is inferred that we consume comparatively less cholesterol as we take eggs from range reared rural and backyard birds irrespective of summer and winter seasons.

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egg. The commercial layer egg had the highest yolk cholesterol level/egg. Although the per cent yolk was lowest, the total yolk weight of the commercial bird egg was higher than the other village and urban backyard and chicken. Eggs laid during the winter season had significantly ($P<0.01$) lower cholesterol in total yolk and in per gram of yolk. Correlations of yolk cholesterol with yolk and egg weight was studied and presented in (Table-4). Egg weight and yolk weight with total cholesterol had no significant correlation within rearing systems and seasons.

Table 4: Correlations within rearing system and season for egg weight and yolk weight with total cholesterol

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