A Comparison of Egg Quality of Pheasant, Chukar, Quail and Guinea Fowl

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ABSTRACT : The quality characteristics and proximate composition of the eggs of pheasant, chukar, quail, and guinea fowl were compared. Eggs of the 4 species had a similar ovalish conical shape with blunt and pointed ends, showing the shape indices of 77.30-79.63 with no statistical difference. Egg weight was heaviest in guinea fowl (46.65 g), followed by pheasant (25.79 g), chukar (19.16 g) and quail (10.34 g). Proportion of yolk to the total egg weight was highest in pheasant (35.7%), followed by chukar (33.9%), quail (31.4%) and guinea fowl (30.6%). Albumen content was highest in quail showing 61.2%, while pheasant, chukar and guinea fowl were in the range of 55.6~57.4%. The ratio of yolk to albumen (Y/A) was highest in pheasant (0.65), followed by chukar (0.60), guinea fowl (0.55) and quail (0.52). The portion of shell to the total egg weight was highest in guinea fowl (13.5%) and lowest in quail (7.3%). The shell thickness of the eggs was thickest in guinea fowl (462.8 μm), followed by pheasant (241.5 μm), chukar (231.8 μm) and quail (174.8 μm). The contents of moisture, crude protein, crude fat and crude ash of whole egg were in the ranges of 74.26-74.50%, 11.98-12.77%, 10.83-11.91% and 1.02-1.10%, respectively, with no statistical difference ($p>0.05$) among the species. Albumen was high in moisture (87.46-87.99%) and very low in crude fat (0.09-0.13%), which was quite different from yolk. Yolk showed relatively low level of moisture (49.71-50.42%) and high levels of fat (31.48-32.32%), crude protein (15.12-15.99%) and crude ash (1.53-1.86%). No species difference in the proximate compositions of albumen and yolk was found except in crude ash content of albumen. (*Asian-Aus. J. Anim. Sci. 2000. Vol. 13, No. 7 : 986-990*)

Key Words : Egg Quality, Pheasant, Chukar, Quail, Guinea Fowl

INTRODUCTION

Eggs are highly versatile food containing many essential nutrients as they support life during embryonic growth. Judging from the common physiological role of reproduction, eggs of most species of birds may have similarities in nutritional composition and potential food usage. However, information on egg quality characteristics and the utilization of egg for food and other purposes have been limited mostly to chicken egg.

Egg quality is compounded of those characterics of an egg that affect its acceptability to consumers (Stadelman, 1977). Among many quality characteristics, external factors including cleanliness, freshness, egg weight and shell quality are important in consumer's acceptability of shell eggs. On the other hand, interior characteristics such as yolk index, albumen index, proportions of egg components and chemical composition are also important in egg product industry as the demand of liquid egg, frozen egg, egg powder and yolk oil increases.

In the present study, the quality characteristics and composition of eggs of some wild birds, pheasant, chukar, quail and guinea fowl raised under farm condition were investigated.

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MATERIALS AND METHODS

Materials

The eggs of pheasant, chukar, quail and guinea fowl used in the study were purchased from farms near Taejon, Korea. The eggs were laid on the day of collection, and the birds had been raised under farm condition with a diet suitable for laying chicken.

Evaluation of egg quality

The weight of egg was measured after washing and drying with towel to remove contaminants from shell. Yolk was separated from albumen and the weight was measured. Shell weight was measured after removal of remaining albumen with water and subsequent drying at 105℃ for 12 hrs. The weight of albumen was calculated by subtracting the weights of yolk and shell from the weight of whole egg.

The shape of egg was estimated by the shape index (breadth/length × 100) after measuring breadth (B) and length (L) of egg using a micrometer caliper (Mitutoyo, Japan). The surface area (SA) of egg was calculated from a formula described by Carter (1975); SA $(cm^2)=4.5118\times L^{0.289}\times B^{0.3164}\times EW^{4882}$ where EW was the weight of egg. The thickness of egg shell was obtained by average measurement of three areas, blunt end, pointed end and middle part of the egg using a microdial gauge (Mitutoyo, Japan) as described by Amer (1972).

The heights of yolk and thick albumen were

measured on a glass plate with a Tri-pod micrometer (Ames S-6428, USA). Haugh unit was calculated from the measured height of thick albumen and weight of egg using the following formula proposed by Haugh (1937);

$$H.U. = 100 \log \{H - G^{0.5}(30\ W^{0.37} - 100)/100 + 1.9\}$$

H.U. = Haugh units
H = albumen height in millimeters
G = 32.2
W = weight of egg in grams

Analytical methods

Moisture content was determined by drying at 100~102℃ for 16~18 hrs as described by AOAC (1990). Crude protein was estimated by multiplying 6.25 to nitrogen content obtained through semimicro-Kjeldahl method. Crude fat and ash were analyzed by soxhlet extraction and 550℃ muffle furnace, respectively.

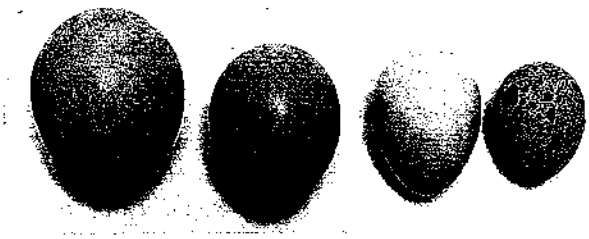
Statistical analysis

Results were analyzed by analysis of variance (ANOVA), and means were compared by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Egg shape

In general eggs of birds have oval shape with small difference among species. In spite of its small difference the shape of egg has been considered as an important factor to characterize species of birds. In this study the eggs of pheasant, chukar, quail and guinea fowl showed similar ovalish conical shape with blunt and pointed ends (figure 1), hence they were almost indistinctive with eyesight as far as the shape was concerned solely without respect to size and color.



Guinea fowl Pheasant Chukar Quail

Figure 1. Photograph of typical eggs of pheasant, chukar, quail and guinea fowl

The shape of egg can be expressed numerically by the shape index (breadth/length × 100). The shape indices of pheasant, chukar, quail and guinea fowl eggs showed the range from 77.30 to 79.63 with no statistical difference (table 1), which was larger than that of standard egg of chicken (Gallus domesticus) (0.74) (Powrie, 1977). The shape indices of present study were also higher than that of egg of 500 day old Ogol fowl (72.60) reported by Baek (1990) in which the shape index value decreased with the age of bird. The shape index value of pheasant egg (79.63) observed in the present study is slightly lower than the value of 80.24 reported by Tserveni-Gousi and Yannakopoulos (1990) who suggested a positive relationship between the shape index and hatch weight of chick with correlation coefficient of 0.72.

Table 1. Egg shape of pheasant, chukar, quail and guinea fowl[1]

Species	n	Breadth (B) (mm)	Length (L) (mm)	B/L × 100
Pheasant	15	33.65 ± 0.93[b]	42.30 ± 1.57[b]	79.63 ± 2.78[a]
Chukar	11	30.21 ± 0.43[c]	39.23 ± 1.85[c]	77.30 ± 3.32[a]
Quail	25	24.62 ± 0.96[d]	31.30 ± 1.05[d]	78.93 ± 3.75[a]
Guinea fowl	12	40.18 ± 0.77[a]	50.53 ± 1.25[a]	79.57 ± 2.71[a]

[1] Mean ± Standard deviation. Means in the same column not sharing a common superscript letter(s) are significantly different ($p<0.05$).

Table 2. Weight of egg components of pheasant, chukar, quail and guinea fowl (g)[1]

Species	Whole	Yolk	Albumen	Shell
Pheasant	25.79 ± 2.17[b]	9.31 ± 1.05[b]	14.34 ± 1.10[b]	2.22 ± 0.39[b]
Chukar	19.16 ± 1.17[c]	6.52 ± 0.95[c]	10.97 ± 0.61[c]	1.67 ± 0.22[c]
Quail	10.34 ± 0.93[d]	3.25 ± 0.40[d]	6.33 ± 0.59[d]	0.76 ± 0.01[d]
Guinea fowl	46.65 ± 1.79[a]	14.26 ± 0.74[a]	26.08 ± 0.92[a]	6.31 ± 0.65[a]

[1] Mean ± Standard deviation, n=as in table 1. Means in the same column not sharing a common superscript letter(s) differ significantly ($p<0.05$).

Weights of egg and egg components

The weights of egg and egg components are shown in table 2. Guinea fowl had the highest egg weight, followed by pheasant, chukar and quail. The egg weights of guinea fowl and pheasant observed in this study differed from the report by Romanoff and Romanoff (1949) in which those were 40 and 32, respectively. The weights of yolk, albumen and shell were also different among species and showed the same trend as the whole egg weight.

Proportions of yolk, albumen and shell to the weight of whole egg are shown in table 3. Pheasant had the largest proportion of yolk (35.7%), followed by chukar, quail and guinea fowl. Portion of albumen to the total egg weight was highest in quail showing 61.2%, while pheasant, chukar and guinea fowl were in the range of 55.6~57.4%. The portion of shell to the total egg weight was highest in guinea fowl, lowest in quail, and similar in pheasant and chukar.

Quail egg was characterized to be high in albumen (61.2%) and low in yolk content (31.4%). The proportional parts of quail egg observed in the present study were similar to the reports of Imai et al. (1986) and Beev (1975). In the reports of Imai et al. (1986) and Beev (1975), the egg of Japanese quail was composed of 31.14 and 32.06% of yolk, 58.35 and 58.45% of albumen, and 10.5 and 9.53% of shell, respectively.

The ratio of yolk to albumen (Y/A) was highest in pheasant, followed by chukar, guinea fowl and quail. The Y/A known to influence the quality of egg product appears to vary with many factors, such as weight of egg, age of layer and genetic factors. Cotterill et al. (1962) found that among the eggs from hens with same flock age, small eggs had higher yolk portion than larger eggs. Similar results were obtained by AL-Rawi and Amer (1972), in which the portion of yolk increased as the weight of egg decreased.

However, the negative effect of egg weight on yolk portion or Y/A was not applicable to the present results where the portion of yolk and Y/A were not high in quail egg which had lowest egg weight. In a study of eggs of quail, duck and mallard, Ricklefs (1977) also found no negative correlation between weight of egg and yolk portion or Y/A. In addition, the difference of Y/A between guinea fowl and goose egg was very small (0.65 vs 0.61) in spite of big difference in the weight of egg (40 g vs 200 g). Therefore, the negative correlation between weight of egg and yolk portion or Y/A appears not to be true in different species of birds. Tolman and Yao (1960), on the other hand, found a difference in yolk size among crossbred chickens, suggesting that genetic factor would also be involved in the Y/A of eggs.

Shell thickness

The shell thickness of the eggs of pheasant, chukar, quail and guinea fowl are shown in table 4. The egg shell was thickest in guinea fowl (462.8 μm), followed by pheasant (241.5 μm), chukar (231.8 μm) and quail (174.8 μm).

The shell thickness of pheasant egg observed in the present study was somewhat thinner than those reported by Tserveni-Gousi and Yannakopoulos (1990) (272 μm) and Asmundson and Baker (1940) (260 μm). On the other hand shell thickness of quail egg was found to be close to those reported by Ha (1980) (156~171 μm) and Nagarajan et al. (1991) (160 μm).

Table 4. Egg shell characteristics of four species of poultry[1]

Species	Shell thickness (μm)	Surface area (cm^2)
Pheasant	241.5 ± 35.0^{b}	47.31 ± 9.12^{b}
Chukar	231.8 ± 31.7^{b}	40.16 ± 1.87^{c}
Quail	174.8 ± 15.5^{c}	25.97 ± 1.50^{d}
Guinea fowl	462.8 ± 39.1^{a}	73.13 ± 1.90^{a}

[1] Mean ± Standard deviation, n=as in table 1. Means in the same column not sharing a common superscript letter(s) are significantly different ($p<0.05$).

Interior egg quality

The yolk index, albumen height and Haugh unit of the eggs of pheasant, chukar, quail and guinea fowl are shown in table 5. Yolk index of guinea fowl egg was 0.53, and those of pheasant, chukar and quail were in the range of 0.46-0.48. Albumen height was highest in the egg of guinea fowl (5.74 mm), followed by pheasant (4.46 mm), chukar (4.04 mm) and quail (3.50 mm). Haugh unit, however, was highest in the

Table 3. Proportion of egg components to the weight of whole eggs (%)[1]

Species	Yolk	Albumen	Shell	Y/A
Pheasant	35.7 ± 2.34^{a}	55.6 ± 2.55^{b}	8.7 ± 0.94^{b}	0.65 ± 0.07^{a}
Chukar	33.9 ± 3.60^{ab}	57.4 ± 3.87^{b}	8.7 ± 0.72^{b}	0.60 ± 0.10^{a}
Quail	31.4 ± 1.98^{b}	61.2 ± 2.32^{a}	7.3 ± 0.69^{c}	0.52 ± 0.05^{b}
Guinea fowl	30.6 ± 0.75^{b}	55.9 ± 1.54^{b}	13.5 ± 1.07^{a}	0.55 ± 0.02^{ab}

[1] Mean ± Standard deviation, n=as in table 1. Means in the same column not sharing a common superscript letter(s) are significantly different ($p<0.05$).

egg of quail (84.19), and lowest in pheasant (79.64).

The values on yolk index, albumen height and Haugh unit of quail egg obtained in the present study were slightly lower than those of Japanese quail reported by Imai et al. (1986) where the values were 0.52, 3.96 mm and 88.4, respectively. There is no clear explanation for the discrepancy at this point, but it might be due to variations in strain, stocking density, seasonal factor, feed and the age of birds (Nagarajan et al., 1991; Tanabe and Ogawa, 1975; Izat, 1986).

Table 5. Interior quaility of eggs of pheasant, chukar, quail and guinea fowl[1]

Species	Yolk index	Albumen height (mm)	Haugh unit
Pheasant	0.46 ± 0.03^{b}	4.46 ± 0.15^{b}	79.64 ± 1.23^{b}
Chukar	0.48 ± 0.02^{b}	4.04 ± 0.40^{b}	80.27 ± 2.02^{b}
Quail	0.46 ± 0.05^{b}	3.50 ± 0.67^{b}	84.19 ± 4.91^{a}
Guinea fowl	0.53 ± 0.03^{a}	5.74 ± 0.42^{a}	80.87 ± 3.14^{ab}

[1] Mean ± Standard deviation, n=as in table 1. Means in the same column not sharing a common superscript letter(s) are significantly different ($p<0.05$).

Chemical composition

Chemical composition of pheasant, chukar, quail and guinea fowl eggs are shown in table 6. The contents of moisture, crude protein, crude fat and crude ash of whole egg were in the ranges of 74.26-74.50, 11.98-12.77, 10.83-11.91 and 1.02-1.10%, respectively, with no statistical difference ($p>0.05$) among the species. The proximate compositions were more or less similar to those of chicken egg (USDA, 1983) where the moisture, protein, fat and ash contents were 74.57%, 12.14%, 11.5% and 0.94%, respectively.

As shown in table 7, albumen was characterized to have high content of moisture (87.46-87.99%) and very low content of crude fat (0.09-0.13%), which was quite different from yolk. Compared with albumen, yolk showed relatively low level of moisture (49.71-50.42%) and high levels of fat (31.48-32.32%), crude protein (15.12-15.99%) and crude ash (1.53-1.86%) (table 8). No species difference in the proximate compositions of albumen and yolk was found except in crude ash of egg albumen. The proximate compositions of albumen and yolk of quail egg in the present study were similar to those of Japanese quail reported by Imai et al. (1986).

Table 6. Chemical composition of eggs of pheasant, chukar, quail and guinea fowl (%)[1]

Species	Moisture	Crude protein	Crude fat	Crude ash
Pheasant	74.27 ± 0.59^{a}	12.77 ± 0.56^{a}	10.90 ± 0.72^{a}	1.06 ± 0.18^{a}
Chukar	74.50 ± 0.73^{a}	12.60 ± 0.72^{a}	11.00 ± 0.46^{a}	1.02 ± 0.10^{a}
Quail	74.26 ± 0.45^{a}	11.98 ± 0.58^{a}	11.91 ± 0.65^{a}	1.04 ± 0.12^{a}
Guinea fowl	74.47 ± 0.43^{a}	12.77 ± 0.38^{a}	10.83 ± 0.75^{a}	1.10 ± 0.18^{a}

[1] Mean ± Standard deviation, n=as in table 1. Means in the same column do not differ significantly ($p>0.05$).

Table 7. Chemical composition of egg albumen of pheasant, chukar, quail and guinea fowl (%)[1]

Species	Moisture	Crude protein	Crude fat	Crude ash
Pheasant	87.99 ± 0.52^{a}	10.20 ± 0.43^{a}	0.10 ± 0.03^{a}	0.83 ± 0.11^{ab}
Chukar	87.85 ± 0.61^{a}	10.15 ± 0.44^{a}	0.12 ± 0.05^{a}	0.82 ± 0.07^{ab}
Quail	87.82 ± 0.55^{a}	10.39 ± 0.50^{a}	0.09 ± 0.03^{a}	1.00 ± 0.11^{a}
Guinea fowl	87.46 ± 0.84^{a}	10.61 ± 0.56^{a}	0.13 ± 0.04^{a}	0.79 ± 0.10^{b}

[1] Mean ± Standard deviation, n=as in table 1. Means in the same column not sharing a common superscript letter(s) are significantly different ($p<0.05$).

Table 8. Chemical composition of egg yolk of pheasant, chukar, quail and guinea fowl (%)[1]

Species	Moisture	Crude protein	Crude fat	Crude ash
Pheasant	50.42 ± 1.47^{a}	15.49 ± 0.68^{a}	31.71 ± 1.26^{a}	1.53 ± 0.21^{a}
Chukar	50.37 ± 1.03^{a}	15.12 ± 0.65^{a}	32.32 ± 0.95^{a}	1.57 ± 0.41^{a}
Quail	49.71 ± 0.55^{a}	15.99 ± 0.19^{a}	31.48 ± 0.76^{a}	1.79 ± 0.38^{a}
Guinea fowl	49.80 ± 1.11^{a}	15.74 ± 0.55^{a}	31.91 ± 0.90^{a}	1.86 ± 0.35^{a}

[1] Mean ± Standard deviation, n=as in table 1. All proximate components in the same column show nonsignificant difference ($p>0.05$).

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