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INFLUENCE OF EGG WEIGHT ON EGG QUALITY PARAMETERS AND GROWTH TRAITS IN RING NECKED PHEASANTS (*PHASIANUS COLCHICUS*) IN CAPTIVITY

S. Ashraf[1], A. Javid[1], M. Ashraf[2], M. Akram[3], S. Malik[1], Irfan[1] and M. Altaf[1]

[1]Department of Wildlife and Ecology, University of Veterinary and Animal Sciences, Lahore
[2]Department of Fisheries and Aquaculture, University of Veterinary and Animal Sciences, Lahore
[3]Department of Poultry Production, University of Veterinary and Animal Sciences, Lahore
Corresponding Author E-mail: sanaashrafdr@gmail.com

ABSTRACT

To study the influence of egg weight on internal and external quality egg parameters and biometrical traits of hatched chicks, a total of 450 eggs of ring necked pheasants (*Phasianus colchicums)* were collected. These eggs were weighed and classified as light (20.0-26.0g), medium (27.0-32.0g) and heavy (33.0-40.0g) egg weight categories. Egg length, breadth, egg volume and surface area varied significantly ($P<0.05$) between all the three egg weight categories. Out of total 450 eggs, 150 eggs (50 from each of the egg weight category) were selected for the evaluation of internal egg quality parameters. Significantly higher albumen and yolk weight were recorded in heavy weight egg category while non-significant influence of egg weight was observed on shell and membrane thickness, yolk percentage, yolk index, yolk pH and albumen pH of the egg. Out of the remaining 300 eggs kept in the incubator, 142 hatched successfully. Forty chicks from each of the egg weight category were selected and chick weight, wing length and wingspan were taken at the time of hatching and thereafter increase in these parameters were noted on weekly basis. The effect of egg weight on chick weight, live weight gain, wing length and wingspan was significant ($P<0.05$). Our studies revealed that egg weight has strong influence on external and internal characteristics of the eggs and the growth parameters in *P. colchicus* chicks.

Key words: Galliformes, Egg geometry, Haugh unit, Chick weight, Wingspan.

INTRODUCTION

Eggs provide nutrition and protection to the developing chicks, therefore the egg quality is of immense importance for the hatchlings. A positive correlation has been observed between egg weight, hatched chick weight, chick growth and its biometric traits in many of the bird species (Wilson, 1991). Hearn (1986) suggested that if eggs are separated by their weight and size in hatchery, and the hatched chicks reared separately, the slaughtering age variability would be reduced and the growth of each group would be optimized. The yolk (30-33%), albumen (60%) and the shell (9-12%) are the main components of an egg (Stadelman, 1995). Egg size affects the proportions of components of the hatching egg and the reduction in the proportion of yolk could be a disadvantage for developing embryos in eggs with small yolks. Similarly, shell quality plays significant role in gas exchange and moisture loss during incubation (Wangensteen *et al*., 1971) while poor shell quality may lead to the higher egg moisture loss and low hatchability (Reis *et al*., 1997; Peebles *et al*., 2001; Narushin and Romanov, 2002).

The strength of the egg is dependent not only on thickness of shell but also on its construction material and the egg breaking strength (Solomon, 1991; Roberts and Brackpool, 1995; Nys *et al*., 1999). In cases, where shell weight and thickness are good but shell breaking strength is poor, the explanation lies with the ultrastructure of the shell, or how well the shell has been constructed. Techniques, such as the measurement of dynamic stiffness of egg shell are being developed and compared with traditional measurements of egg shell strength (de Ketelaere *et al*., 2002).

The quality of the newly hatched chick is a major factor in determining its livability, growth and health. Sklan *et al*. (2003) considered chick weight as an accurate predictor of final body weight whereas for others this has not been the case (Gardiner, 1973; Shanawany, 1987). Most of the old breeder flocks lay heavier eggs and as a result heavier chicks are produced (Suarez *et al*., 1997; O’Dea *et al*., 2004). However, higher percentage of chicks with low quality scores was reported in older (45-wk) than in younger (35-wk) flocks (Tona *et al*., 2004). Poor chick quality, as reflected by a high number of culled chicks, has been associated with heavier than average egg weight for a particular flock age (Kumpula and Fasenko, 2004; Lawrence *et al*., 2004).

Pheasant farming industry is flourishing in many parts of the world and the quality of eggs is considered the backbone for successful pheasant farming (Sogut *et al*., 2001). Moreover, the growth of chicks is directly linked with external and internal quality traits of eggs (Altinel *et al*., 1996). Pheasants belong to the avian order Galliformes and are Asian in their native distribution, except Congo peafowl. They are considered one of the favorite game birds for a large number of hunters, not only for their meat characterized by low fat and high essential fatty acids and amino acids content which make it of a higher quality compared to broilers, ducks and geese, but for hunting characteristics as well (Tucak *et al*., 2004; Adamski and Kuzniacka, 2006; Strakova *et al*., 2006). In Asia they are valuable source of cultural traditions, visible in art, religion, and folklore of different ethnic groups (Mcgowan, 1995). Pheasant species are also used as a biological indicator to monitor the health of the ecosystem and other associated wildlife species (Malik, 2003).

Current knowledge on the ecology, social behavior and biology of pheasants is minimal and there are opportunities for research and studies for biologists and avian scientists. Answering questions regarding their production, growth traits, nutrition, behavior, ecology and population biology would help to develop a better understanding among managers, students and the general public (Hill and Robertson, 1988; Robertson *et al*., 1993a and b). The present study was therefore planned to find the influence of egg weight with egg quality traits and growth parameters in *P. colchicus* in captivity.

MATERIALS AND METHODS

Present study was planned to determine the relationship of egg weight with egg quality characteristics and growth traits in ring necked pheasants. Eggs of the ring necked pheasant were collected from Captive Breeding Facilities, Department of Wildlife and Ecology, Ravi Campus, University of Veterinary and Animal Sciences, Lahore. The collected eggs were weighed and classified into light (20 to 26 g), medium (27 to 32g) and heavy (33 to 40g) weight egg categories. A total of 450 eggs, 150 eggs for each category were selected.

External and internal egg quality parameters: The external egg quality parameters viz. egg weight was taken by digital weighing balance measuring up to 0.1 g, egg length and egg breadth were taken by ordinary vernier caliper measuring up to 0.01cm while egg volume, shape index and egg surface area were calculated by using following formulae;

Egg volume (cm^3) = $V = K_V LB2$ (Narushin, 1997)
Where;
Kv = Coefficient for volume calculation= $k_V = 0.496$
L = Length of egg in cm
B = Breadth of egg in cm

Shape index (%) = Egg breadth/egg length x 100 (Parmar *et al.*, 2006; Monira *et al.*, 2003)

Egg surface area (cm^2) = $k (\pi LB^2/6)^{0.67}$ (Etches, 1996)
Where;
k = constant
L = Egg length in cm
B = Egg breadth in cm

For internal quality parameters, 50 eggs from each egg weight category were broken in glass plate and after five minutes long and short diameters and height of both albumen and yolk were measured with vernier caliper while albumin index and yolk index were calculated using following formulae following (Abu Tabeekh, 2011);

Albumen index (%) = Albumen height /albumen diameter x 100

Yolk index (%) = Yolk height /yolk diameter x100

The yolks and albumins were separated and were weighed using digital weighing balance. Yolk and albumin pH were recorded using digital pH meter (HI 98107 pHep®).

Shells of the broken eggs were washed with tap water, air dried and weighed. Then stubby diameter, sharp diameter and equator diameter of shell with membranes were determined by vernier caliper. Shell membrane was then removed and its stubby diameter, sharp diameter and equator diameter were recorded accordingly.

Shell thickness, shell membrane thickness, shell ratio, yolk ratio, albumen ratio and Haugh unit were calculated using following formulae (Kirikci *et al*., 2003; Abu Tabeekh, 2011);

Shell thickness (mm) = (sharp point thickness + equator thickness + stubby thickness)/3
Shell membrane thickness (mm) = (sharp point membrane+ equator membrane+ stubby membrane)/3
Haugh Unit = 100 x log (Albumen weight + 7.57 - 1.7 x egg weight x 0.37)
Shell ratio (%) = Shell weight/ total egg weight x 100
Albumin ratio (%) = Albumin weight/ total egg weight x 100
Yolk ratio (%) = Yolk weight/ total egg weight x 100

Growth and egg weight relationship: To investigate the relationship of egg weight with growth traits in pheasants; 100 eggs from each of the three egg weight categories were selected and incubated in Victoria incubators (Italian made) under standard conditions of incubation as described by North and Bell (1990). The eggs were then transferred to hatching machine for three days. A temperature of 36.5 °C and relative humidity of 85 % was provided for the eggs at hatching period.

After completion of hatching, 40 chicks for each of the egg weight categories were selected and tagged individually. Chick weight, wing length and wingspan of day-old chicks were recorded at the start of experiment and thereafter subsequent increase in body weight; wing length and wingspan were recorded on weekly basis.

Statistical analysis: The data thus obtained were subjected to statistical software SAS 9.1 and Analysis of Variance (ANOVA) was applied to find out the influence of egg weight on egg quality parameters and growth traits following Steel *et al.* (1997).

RESULTS AND DISCUSSION

Two important products of poultry industry are the eggs and meat. Production of meat is linked with quality of eggs as breeding eggs have significant influence on economic breeding and continuity of flock (Sogut *et al*., 2001; Altinel *et al*., 1996; McDaniel *et al*., 1979). During present study, a total of 450 eggs of ring necked pheasants (*Phasianus colchicus)* were taken and the effect of egg weight on egg quality characteristics and growth traits was determined. The egg weight in *P. colchicus* varied from minimum 20g to maximum 40g with an average of 26.94±5.37g. Average egg length of all the 450 eggs was 4.19±0.20cm, average width 3.36±0.18cm, egg volume 23.10±3.639cm^3, egg surface area 80.80±12.728cm^2 while shape index was 80.11±2.93%. Song *et al*. (2000) documented average egg weight in *P. colchicus* as 25.79±2.17g, egg length 4.23±1.57cm, egg breadth 3.36±0.93cm and egg surface area as 47.31±9.12cm^2 while according to Demirel and Kirikci (2009) average egg weight in *P. colchicus* varies from 28.10g to 33.6g. Kirikci *et al*. (2005) recorded egg surface area ranging from 77.87 to 81.24cm^2.

Egg length and breadth varied significantly between heavy, medium and light weight eggs during present study. Our findings are in line with Bell and Weaver (2002) who reported that heavier strains laid eggs with higher length and breadth. Chick weight is dependent on egg geometry, shell quality (Narushin, 2001; 2005) and egg interior quality (Narushin and Romanov, 2002; Narushin, 2005). During present study, significantly higher values for shape index (81.22 ± 3.37 %) were observed for medium weight egg category while the same was lowest for heavy weight category. Significantly, higher egg volume (26.10 ± 4.16 cm^3) and egg surface area (91.30 ± 14.58 cm^2) were observed in heavy egg weight category followed by medium and light ones. According to Song *et al*. (2000) all the bird species have ovalish conical shaped eggs with pointed and blunt ends, however, egg volume and shape index are influenced by age and strain of the laying hens (Rayan *et al*., 2010; Esen *et al*., 2010; Ali *et al*., 2012).

Internal egg quality parameters of 150 eggs, 50 from each of the egg weight categories were also analyzed and it was observed that the shell percentage (13.54±0.54%) was higher in medium weight egg category followed by light and heavy weight egg categories (Table 1). These values were higher than 8.7±0.94% documented by Song *et al*. (2000). Hussnain *et al*. (2012) documented increase in shell percentage with increase in age. Average yolk weight of all 150 eggs was 9.19±1.16g and albumen weight was 11.72±1.05g. Our findings are in line with the results of Song *et al*. (2000) who recorded yolk weight 9.31±1.05g and albumen weight 14.34± 1.05g.

During present study, significantly higher albumen (12.66±0.28g) and yolk (10.08±0.31g) weight was observed in heavy egg weight category as compared to medium and light weight categories. Similar findings were observed by Birkhead and Nettleship (1984) who reported increase in amount of yolk with increase in egg weight. The yolk percentage 38.55±3.44% and the albumen percentage 49.30±3.97% recorded during present study were higher than the percentages i.e. 35.7±2.34% and 55.6±2.55%, respectively documented by Song *et al*. (2000).

During present study non-significant differences in yolk index and yolk percentage were recorded in all the three egg weight categories. Birkhead and Nettleship (1984) reported that absolute amount of yolk increased with egg size and further explained that egg weight and chick weight is correlated. The values of yolk index and yolk percentage recorded during present study are lower than the values given by Kirikci *et al*. (2005).

During present study, higher albumen index (2.94±0.04%) was observed in light weight egg category while the same was lowest in medium weight egg category. Average albumen index value 2.82±0.33% was recorded during present study and was greater than albumen index value1.47-0.37% recorded by Kirikci *et al*. (2005). The values of shell thickness 3.62±0.45mm recorded during present study were higher than the values 0.241±.035mm documented by Song *et al*. (2000). Similarly, shell weight 3.00±0.58g recorded during present study was slightly higher than 2.22±0.39g, the value reported by Song *et al*. (2000) while the membrane thickness was recorded 0.003±0.0007mm.

During present study significantly lower shell weight 2.50±0.15g was observed in light weight egg category while shell and membrane thickness showed non-significant differences in all the three egg weight categories.Similarly, non-significant differences in albumen pH were observed in all the three egg weight categories while significantly higher yolk pH (5.56±0.10) was observed in medium weight egg category. Average Haugh unit values 89.95±4.28 recorded during present study were higher than the values 79.64±1.23 noted by Song *et al*. (2000).Significantly, lower Haugh unit (87.15±1.49%) was observed in heavy weight egg category. Silversides and Villeneuve (1994) and Silversides and Scott (2001) reported that Haugh unit is affected by the age of bird. Similarly, albumen quality is the upshot of number of nutritional factors but Williams (1992) reported dissimilar results and explained that bird nutrition did not affect albumen quality.

Chicks, which are the products of pheasant breeding, are very valuable and it is recommended to hatch all eggs. Therefore, it is important to have an in-depth understanding of all the factors affecting the hatchability performance of pheasants. Among these factors, egg weight and storage period are especially important for decreasing labor needs and obtaining chicks in sufficient numbers and of same standards (Caglayan *et al*., 2009). Duringpresent study out of total 300 eggs reserved for hatching purposes 141 were successfully hatched. The average egg weight was 29.95g while average chick weight was 15.16gandthe hatchability percentage was 47%. In domestic fowls positive correlation existed between egg weight and hatched chick weight (Wilson, 1991) and heavy weight chicks got high value nutrition reserve that way they show high live rate (O'Connor, 1984). During present study, chick weight varied significantly between all the three egg weight categories and the chick weight at hatching in light, medium and heavy egg groups was determined as 19.5 g, 21.8 g and 22.6 g, respectively. Ipek and Dikmen (2007) documented that a significant ($P<0.01$) relation exists between egg weight and the chick hatch weight and live weight. Chick weight in ring necked pheasants from day old chick to 3-month stage varied significantly between heavy, medium and light weight egg categories (Table 2).

Increase in chick weight in heavy weight egg groups ranged from 11.4g to 102.7g during 2nd and 9th weeks, respectively. Similarly increase in chick weight in medium category was minimum 8.75g during 2nd week and maximum 82.1g during 12th week. Overall minimum increase in chick weight was observed during 1st week and maximum during 8th week of chick age (Table 3). Increase in chick weight in light weight egg category ranged from 6.88g during 2nd week to 68.6g during 9th week of its growth. During present study it was determined that hatching chick weight increases with increasing egg weight (Table 2). Caglayan and Inal (2006) reported increasing chick weight with increasing egg weight for quails and Ipek and Dikmen (2007) documented the same for pheasants.

Increase in wing length varied significantly between heavy, medium and light weight egg categories from day old chick to 3-month stage. Day old chick wing length ranged from 4.13 ± 0.122cm in light weight category to 5.39 ± 0.110 cm in heavy weight category. Increase in wing length in heavy weight egg groups ranged from 0.76 cm to 4.15 during 12th week and 2nd week, respectively. Similarly increase in wing length in medium weight egg groups was minimum 1.34cm during 12th week and maximum 3.32cm during 2nd week. Increase in wing length in light weight egg category ranged from 1.42cm during 2nd week to 3.09cm during 8th week of its growth. In all the three egg weight categories the increase in wing length ranged from 0.76cm to 4.15cm in heavy weight category during 12th and 2nd week, respectively. Overall minimum increase in wing length was observed during 12th week and maximum during 2nd week of chick age. Day old chick the average wing length ranged from 17.15cm to18.20cm in light weight category, 17.70cm to 20.01cm in medium weight category and 20.26cm to 20.51cm.Wing length is the second element of the species and gives indications on the quality of flight. At the game pheasants released, their flight affects the beauty and excitement of the game. Delacour (1977) reported that cheer males have wing lengths of 23.5-27.0cm while females have wing lengths of 22.5-24.5 cm. According to Popescu-Micloşanu *et al*. (2011) wing length is the second element of the species and gives indications on the quality of flight. At the game pheasants released, their flight affects the beauty and excitement of the game. Wing length of females ranged between 17.1 and 22.8 cm, averaging 19.71.0.180 cm. The coefficient of variation was 8.21%. Male pheasants that year had wing length between 22.2 and 24.8 cm, averaging 23.45 0.145 cm.

Increase in wingspan in heavy weight egg groups ranged from 1.92cm to 8.98cm during 12thweek and 2nd weeks, respectively. Similarly increase in wingspan in medium category was minimum 2.42cm during 11thweek and maximum 7.35cm during 2ndweek. Increase in wingspan in light weight egg category ranged from 2.32cm during 3rd week to 2.32cm during 11th week of its growth. In all the three egg weight categories the increase in wingspan ranged from 1.92cm in heavy weight category to 8.98cm in heavy weight category during 12th and 2nd week, respectively. Gorecki *et al*. (2012) observed overall minimum increase in wingspan during 11th week and maximum during 5th week of chick age.

During present study mean average body weight in female chicks varied from minimum 11.7g of day-old chick to 589g at the age of 12th week. Minimum average increase in body weight 9.11g was observed after 2nd week while maximum 83.22g after 9th week. Similarly, maximum increase in wing length was recorded 3.45cm during 2nd week of age while minimum 1.81cm during 10th week and maximum increase in wingspan 7.31cm was observed during 2nd week and minimum 2.22cm during 10th week of age (Table 3). In male chicks mean average body weight varied from minimum 10.3g of day-old chick to 647g after 12th week. Minimum average increase in body weight 8.94g was observed during 2nd week while maximum 83.55g during 9th week. Increase in wing length was minimum 1.12cm during 12th week and maximum 3.27cm during 5th week. Similarly, the increase in wingspan was minimum 2.07cm observed during 11th week and maximum 7.51cm during 5th week. Non-significant variations in average increase in body weight, wing length and wingspan was observed from 1st to 12th week of age among male and female pheasant chicks. Dietary protein and mineral deficiencies hinder the growth of the growing chicks. According to Baker (1993) the sex of the properly fed pheasant chicks can be determined during 8th week of the age. However, during present study the sex of the chicks was prominent after 11th week which may be attributed to the lower dietary proteins.

It can be concluded from present study that chick weight is directly linked with the weight of the eggs as heavier eggs provide more nutrients to the growing chicks. It was further observed that the chicks from heavier eggs show relatively better growth patterns than the chicks from lighter eggs.

Table1. Influence of egg weight on internal and external qualities of egg in ring necked pheasants

Parameters	Egg weight category			Combined
	Heavy	Medium	Light	
External egg quality parameters				
Egg weight (g)	36.18 ± 2.46^{a}	26.88 ± 1.29^{b}	22.86 ± 1.61^{c}	26.94±5.37
Egg length (cm)	4.37 ± 0.20^{a}	4.20 ± 0.12^{b}	4.09 ± 0.18^{c}	4.19±0.20
Egg breadth (cm)	3.48 ± 0.19^{a}	3.41 ± 0.14^{b}	3.25 ± 0.14^{c}	3.36±0.18
Egg volume (cm^3)	26.10 ± 4.16^{a}	23.96 ± 2.38^{b}	21.14 ± 2.93^{c}	23.10±3.64
Egg surface area (cm^2)	91.30 ± 14.58^{a}	83.81 ± 8.33^{b}	73.96 ± 10.24^{c}	80.80±12.73
Shape index (%)	79.68 ± 2.24^{b}	81.22 ± 3.37^{a}	79.53 ± 2.77^{a}	80.11±2.93
Internal egg quality parameters				
Shell ratio (%)	12.50±0.50^{ab}	13.54±0.54^{a}	11.62± 0.68^{b}	12.53±0.57
Albumen ratio (%)	48.71±1.09^{ab}	47.91± 0.81^{b}	51.28±1.32^{a}	49.30±3.97
Yolk ratio (%)	38.78±1.20 ^{a}	38.54±0.90 ^{a}	38.33±0.93 ^{a}	38.55±3.44
Albumen Index (%)	2.66± 0.14^{b}	2.86±0.05^{ab}	2.94± 0.04^{a}	2.82±0.33
Yolk Index (%)	32.26± 0.87^{a}	33.43± 1.02^{a}	31.13± 0.71^{a}	32.27±0.86
Haugh unit	87.15±1.49^{b}	90.95±0.93^{a}	91.73±0.80^{a}	89.95±4.28
Shell weight (g)	3.25 ± 0.13^{a}	3.25 ± 0.13^{a}	2.50 ± 0.15^{b}	3.00±0.58
Shell thickness (mm)	3.72 ± 0.12^{a}	3.52 ± 0.13^{a}	3.63± 0.13^{a}	3.62±0.45
Membrane thickness (mm)	0.002 ± 0.0001^{a}	0.003 ± 0.0002^{a}	0.002 ± 0.0002^{a}	0.003±0.001
Albumin weight (g)	12.66 ± 0.28^{a}	11.50 ± 0.19^{b}	11.00 ± 0.21^{b}	11.72±1.05
Yolk weight (g)	10.08 ± 0.31^{a}	9.25 ± 0.21^{b}	8.25 ± 0.25^{c}	9.19±1.16
Albumin pH	8.04 ± 0.07^{a}	7.97 ± 0.13^{a}	8.07 ± 0.09^{a}	8.03±0.09
Yolk pH	5.54 ± 0.09^{ab}	5.56 ± 0.10^{a}	5.30 ± 0.06^{b}	5.46±0.083

Means with similar letters in a row are statistically different non-significantly

Table 2. Relationship of egg weight with wing length and wingspan of ring necked pheasants

Egg weight categories	Egg weight	Egg length	Egg width	1st week			12th week		
				Chick weight	Wing length	Wingspan	Chick weight	Wing length	Wingspan
Light weight	23.88± 2.14^{c}	4.02± 0.04 ^{b}	3.15± 0.03^{c}	12.76± 0.46^{c}	4.13± 0.12^{c}	9.31± 0.16^{c}	473.60± 8.43^{c}	29.98± 0.12 ^{c}	63.65± 0.12^{b}
Medium weight	29.50± 2.06^{b}	4.31± 0.06^{a}	3.31± 0.05^{b}	15.01± 0.49^{b}	4.78± 0.13^{b}	10.23± 0.18^{b}	529.10± 14.24^{b}	30.56± 0.27 ^{b}	63.74± 0.32^{b}
Heavy weight	36.50± 1.86^{a}	4.39± 0.07^{a}	3.50± 0.06^{a}	17.72± 0.34^{a}	5.39± 0.11^{a}	11.54± 0.42^{a}	612.40± 8.13^{a}	31.66± 0.16 ^{a}	66.05± 0.37^{a}

Means with similar letters in a column are statistically non-significantly different

Table 3. Comparison of mean average weight, wing length and wingspan between male and female ring-necked pheasants from 1st to 12th week of age

Parameters	Chick weight		Wing length		Wingspan	
Chick age	Male	Female	Male	Female	Male	Female
1st week	14.8±0.58[a]	15.7±0.68[a]	4.6±0.14[a]	5.0±0.18[a]	10.2±0.28[a]	10.6±0.40[a]
2nd week	23.7±1.05[a]	24.8±1.40[a]	7.8±0.35[a]	8.4±0.43[a]	17.0±0.68[a]	17.9±0.85[a]
3rd week	35.8±1.16[a]	36.8±1.58[a]	10.2±0.25[a]	10.4±0.34[a]	22.1±0.42[a]	22.4±0.57[a]
4th week	52.6±1.90[a]	55.0±2.63[a]	11.9±0.26[a]	12.4±0.46[a]	25.6±0.56[a]	26.5±0.92[a]
5th week	85.7±4.08[a]	87.2±5.21[a]	15.2±0.37[a]	15.3±0.39[a]	33.1±0.70[a]	33.3±0.70[a]
6th week	142.4±6.85[a]	144.1±7.92[a]	18.3±0.54[a]	18.5±0.59[a]	39.5±1.21[a]	39.8±1.32[a]
7th week	196.6±8.00[a]	199.0±9.86[a]	20.9±0.48[a]	21.5±0.59[a]	45.9±0.88[a]	46.6±1.05[a]
8th week	266.6±10.45[a]	268.5±12.30[a]	24.1±0.50a	24.2±0.64[a]	51.7±0.93[a]	51.9±1.19[a]
9th week	350.1±13.82[a]	351.8±16.46[a]	26.3±0.37[a]	26.3±0.37[a]	56.3±0.78[a]	56.6±0.85[a]
10th week	405.4±17.81[a]	401.0±16.15[a]	27.7±0.30[a]	27.5±0.27[a]	59.3±0.59[a]	58.8±0.63[a]
11th week	469.8±18.22[a]	462.9±14.04[a]	29.5±0.32[a]	29.5±0.25[a]	61.4±0.63[a]	61.7±0.53[a]
12th week	539.3±17.57[a]	536.7±14.32[a]	30.7±0.26[a]	30.8±0.14[a]	64.6±0.38[a]	64.2±0.29[a]

Means with similar letters in a row are statistically non-significant.

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