Veterinary World, EISSN: 2231-0916
Available at www.veterinaryworld.org/Vol.6/Sept-2013/2.pdf

RESEARCH ARTICLE
Open Access

Effect of egg weight on hatchability and hatchling weight in Fayoumi, Desi and crossbred (Rhode Island Red X Fayoumi) chickens

Abdul Rashid, Sohail Hassan Khan, Ghulam Abbas, Muhammad Yasin Amer, Muhammad Jameel Ahmad Khan and Naveed Iftikhar

Poultry Research Institute,
Murree Road, Shamsabad, Rawalpindi, Pakistan
Corresponding author: Sohail Hassan Khan, email:sohailhassan64@gmail.com
Received: 10-02-2013, **Revised:** 09-03-2013, **Accepted:** 11-03-2013, **Published online:** 15-06-2013

How to cite this article: Rashid A, Khan SH, Abbas G, Amer MY, Khan MJ and Iftikhar N (2013) Effect of egg weight on hatchability and hatchling weight in Fayoumi, Desi and crossbred (Rhode Island Red X Fayoumi) chickens, *Vet World* 6(9): 592-595, doi: 10.5455/vetworld.2013.592-595

Abstract

Aim: An experiment was conducted to determine the effect of egg weight on hatchability, embryonic deaths and hatchling weight of three rural breeds (Fayoumi, *Desi* and crossbred (Rhode Island Red X Fayoumi) chickens.

Materials and Methods: Three different egg weight groups classified into small: (<41g), medium (41-45g) and large (> 45g) were used in the experiment. A complete randomized design was used for the experiment. Simultaneously quadratic type equation was used to determine the egg weight for optimum hatchability and hatchling weight.

Results: Percentage hatchability of medium-sized eggs was higher ($P < 0.05$) than those in large sized eggs. Similarly, large–sized eggs had higher ($P < 0.05$) percentage hatchability than small sized eggs in all breeds. Hatchability percentage changed by ratio 0.4077 with one unit change in mean egg weight of Fayoumi. The hatchability changed by ratio 0.5488 with one unit change in egg weight of *Desi*. The hatchability changed by ratio 0.3767 with one unit change in egg weight of crossbred chickens. Mean hatchling weight in Fayoumi eggs changed by ratio of 0.6760; *Desi* eggs by ratio of 0.5955 and crossbred chicken eggs by ratio of 1.3613 with one unit change in mean egg weight. The overall mean hatchling weight as percentage of mean egg weight in case of Fayoumi was 67.10, in *Desi* 62.42 and 68.36 in case of cross birds. There was no evidence that hatchabilitypercentage increased with increase in egg weight in all the three strains of birds. Small-sized eggs had higher ($P<0.05$) embryonic deaths than those of medium and large-sized eggs in three breeds. Hatchling weight from large eggs were ($P < 0.05$) higher than those of small eggs in three breeds. Mean hatchling weight of Fayoumi changed by ratio 0.676 with one unit change in mean egg weight. In case of *Desi* chickens, mean hatchling weight changed by ratio 0.5955 with one unit change in egg weight. In case of crossbred chicken, mean hatchling weight changed by ratio 1.3613 with one unit change in egg.

Conclusion: This study revealed that medium sized eggs were more appropriate for better hatchability percentage and lower embryonic deaths in three rural breeds. However, large sized eggs were suitable for better hatchling weight.

Keywords: crossbred chicken, Desi, egg weight, Fayoumi, hatchability, hatchling weight

Introduction

The avian egg is a biological system projected to warrant the safety of the embryo and its successful hatching into a fully developed chick [1]. Effect of egg weight on hatchability is an important economic trait in domestic poultry. There are positive correlations among pre-incubation egg weight, hatchling weight and subsequent performance of different kinds of poultry [2]. The size of day old chick is directly related to the size of the hatching egg [3] and there is a progressive increase in egg production related to hatching egg weight [4].

The heritability of 55% in egg weight serves as determining factor for the strain of chickens to be reared for hatching egg production [5]. The hatchling weight is usually in the range of 62 to 78% of egg weight [6]. In case of Bob white quail, hatchling weight is on an average 72% of egg weight [7]; 63.5% in Turkeys; 57.8% in Ducks; 58.9% in Goose; 61.9% in Pheasant [8]. Hatchling weight is reported to account for 87% of egg weight at the normal time for removal from the hatcher [9]. Hatchling weight from dwarf broiler breeders is reported to be 67.3% of egg weight compared to the significantly larger chicks (68.4% of egg weight) from a standard strain [10]. The time of oviposition and age of parent have no significant effect on the egg weight: chick weight ratio when early and late hatched chicks are weighed at the same time [11]. The correlation of egg weight to hatchling weight is generally very high ranging from 0.50 to 0.95 [12] and then decreases progressively until the chick is 8 to 12 weeks of age [13].

In broiler chickens, some studies showed a higher hatchability for intermediate sized eggs compared to too small or too large eggs [6, 14]. Another study with broiler chickens [15] showed that egg size typically affects hatching size in birds because the main effects of egg size lies in the mass of the residual yolk sac that the chick retains at hatching. However, there is a

paucity of information on the effect of egg size on hatchability and hatchling weight in indigenous chickens. The egg production level of indigenous hens is normally low with only 40-60 small sized eggs produced per bird per year under small holder management conditions [16]. Therefore, improving the hatchability of these eggs will help to improve the productivity of these chickens.

This study was conducted to determine any deviation in hatchling weight as percentage age of egg weight and also any effects on hatchability of eggs of rural breeds such as Fayoumi, *Desi* and crossbred (Rhode Island Red X Fayoumi) chickens.

Materials and Methods

Ethical approval: Birds were maintained according to guidelines of Institutional Ethics Committee.

In order to study effect of egg weight on hatchability and hatchling weight trials were conducted using eggs of rural breeds such as Fayoumi, *Desi* and crossbred (Rhode Island Red X Fayoumi) chicken. Three Fayoumi flocks were maintained at Breeding and Incubation Division, Poultry Research Institute, Rawalpindi, Pakistan and included in the experiments were 37 weeks, 46 weeks and 55 weeks old. The trials on Fayoumi breeding flock were conducted during October-December and March-April. The *Desi* birds included in trials were about 30 week old and crossbred chickens (RIR X Fayoumi) were about 29 week old. The trials on *Des*i and crossbred chickens were carried out during August-November. The birds included in all trials were maintained on deep litter system in open window houses. They were provided feed and water *ad libitum.* The birds were fed commercial breeder diet (16.50% CP, 2,800 kcal MEn/kg, 3.10% calcium and 0.35% available phosphorus), formulated to meet or exceed NRC [17] requirements. The eggs collected from each breeding stocks were grouped into 3 size categories as follows: small (<41g), medium (41-45g) and large (>45g), replicated three times (90 eggs/ replicate). The eggs collected from all the three breeding stocks were cleaned and fumigated and set in the incubator. On 7^{th} day of incubation, eggs were candled and infertile or clear eggs were removed. On the 18^{th} day of incubation, the eggs were candled and those with evidence of living embryos were recorded for the different egg treatments and transferred to the hatcher. The remaining eggs were candled and then broken for microscopic analysis to distinguish the eggs containing dead embryos from the infertile ones. At the end of 21^{st} day the hatch was taken out and observations with regard to number of normal chicks hatched, hatchling weight and hatchability were calculated using the formula described by Sahin and coworkers [18].

Statistical analysis : Data on hatchability, embryonic deaths and hatchling weight were determined following completely randomized design. When differences were significant, means were separated using Duncan's multiple range tests at the 0.05 level of significance [19]. The analyses were conducted using SPSS 15.0 software [20]. All comparisons were made within breeds, and the breeds were not compared with each other.

The statistical model used was:

$$Yij = ì + Ti + Óij$$

Where,

Yij= the overall observation (hatchability, embryonic deaths, hatchling weight)

ì = Population means

Ti= Effect of different egg weights (small, medium, large)

Óij= Residual error with zero mean and variance $ó^2$

The responses in optimum hatchability and hatchling weight to egg weight were modeled using following quadratic equation:

$$Y = a+b_1x+b_2x^2$$

Where, Y is optimum hatchability and hatchling weight, 'a' is intersect, b_1 and b_2 is coefficients of quadratic equation, 'x' is egg weight.

Results and Discussion

The effect of egg weight on hatchability percentage, embryonic deaths and hatchling weight are summarized in Table-1.

Though larger eggs from three breeds tended to record higher hatchability, these differences were not statistically significant. Larger sample sizes are needed to test if these tendencies are significant. Percentage hatchability of medium-sized eggs was higher than those in large sized eggs. Similarly, large–sized eggs had higher percentage hatchability than small sized eggs in all breeds. The current findings are supported by some workers [21-23], who reported that intermediate sized eggs of ostrich and chickens had higher hatchability. These results are divergent to the observations made by some workers [24,25], who found that hatchability of eggs of ostrich, New Hampshire and Rhode Island Red breeds decreased with increasing egg weight. Similarly, another study showed that large sized eggs of indigenous Venda chickens had higher hatchability than medium and small sized eggs [26]. Researchers also found negative correlations between egg weight and hatchability in crossbred chickens [3]. As indicated, in their studies heavier eggs resulted in lower hatchability as in the current study. The reason for such differences in hatchability might be due to breed differences.

The analysis of data for ascertaining the effect of egg weight on hatchability showed that hatchability percentage changed by ratio 0.4077 with one unit change in mean egg weight of Fayoumi in given set of data (Table-2). The hatchability changed by ratio 0.5488 with one unit change in egg weight of *Desi* which is similar to what was observed in case of Fayoumi eggs (Table-2). There was, however, no evidence that hatchability would increase with increase in egg weight. The hatchability changed by ratio 0.3767 with

Table-1. Effect of egg weight on hatchability, embryonic deaths and hatchling weight in Fayoumi, *Desi* and crossbred (RIR X Fayoumi) chickens

Type of breeding stock	Egg groups*	No. of eggs set	Hatchability (%)	Embryonic deaths (%)	Hatchling weight (g)
Fayoumi	Small	270	59.90	40[a]	23.69[b]
	Medium	270	65.10	31[b]	26.54[ab]
	Large	270	61.46	18[c]	29.43[a]
Desi	Small	270	48.63	35[a]	23.14[b]
	Medium	270	58.31	27[b]	29.00[a]
	Large	270	55.20	14[c]	30.00[a]
Crossbred	Small	270	73.33	24[a]	27.63[c]
	Medium	270	77.41	15[b]	30.70[bc]
	Large	270	77.04	05[c]	39.20[a]

[a, b, c, ab, bc] means with different superscripts within coloumn for the same breed, differ significantly ($P < 0.05$)
* Small: <41g; Medium: 41-45g; Large: > 45g

Table-2. Regression analysis showing mean hatchability and hatchling weight and as affected by mean egg weight (independent variable)

Type of birds	Dependent variable	Regression line	Value of slope at 95% confidence level	Significance($p \leq 0.05$) t-Test	T. Tab
Fayoumi	Mean Hatchability (%)	Yi= 59.7459 + 0.4077 Xi	-0.23 to 1.04	2.7697	2.920
Fayoumi	Mean hatchling weight (gm)	Yi=-0.2040 + 0.6760 Xi	0.57 to 0.78	28.1728	2.920
Desi	Mean Hatchability (%)	Yi= 28.2355 + 0.5488 Xi	-2.0247 to 3.1224	0.9176	4.303
Desi	Mean hatchling weight (gm)	Yi= 1.3007 + 0.5955 Xi	-0.7398 to 1.9308	1.9188	4.303
Crossbred chicken	Mean Hatchability (%)	Yi= 44.3212 + 0.3767 Xi	-6.5130 to 7.2665	0.6948	12.706
Crossbred chicken	Mean hatchling weight (gm)	Yi=-31.9261 + 1.3613 Xi	-6.1145 to 8.8372	1.9188	12.706

one unit change in egg weight of crossbred chickens, but there was no any significant relation of chick weight with egg weight; as was also observed in Fayoumi and *Desi* eggs, which implied that hatchability was mainly also affected by other factors than egg weight.

Small-sized eggs had higher ($P<0.05$) embryonic deaths than those of medium and large-sized eggs in three breeds (Table-1). These results are in agreement with the findings of some workers, who found that embryonic mortality rate in rock partridge and turkey was decreased as the egg weight increases [27, 28]. This might be due to heavy eggs having more sufficient nutrients to support embryos compared to lighter eggs.

In three breeds, hatchling weight from large eggs were ($P < 0.05$) higher than those of small eggs. The overall mean weight in Fayoumi eggs was 40.0 g which produced chicks whose average weight was found to be 26.55 g which was 66.37% of egg weight. In case of *Desi* chickens mean egg weight was 45.0 g which produced chicks weighing 27.38 g on an average which was 61.00% of egg weight and in case of crossbred eggs weighed on mean 46.00 gm with chicks weighing 32.51 gm on an average which was 70.67% of egg weight. The hatchling weight in all the three rural breeds was found between 61 to 70% of egg weight which is in agreement with commercial stocks as reported by some workers [6, 8, 10, 12].

The data obtained of Fayoumi breeding stock was subjected to statistical analysis and it was found that mean hatchling weight had linear relationship with egg weight (Table 2). The regression analysis indicated that mean hatchling weight changed by ratio 0.676 with one unit change in mean egg weight in given set of data. The analysis further showed that there was strong evidence that hatchling weight increased with increase in egg weight. The statistical analysis of data collected in case of *Desi* breeding stock was found to be similar to that of Fayoumi stock so far regression of mean hatchling weight on mean egg weight is concerned. In case of *Desi* chickens, mean hatchling weight changed by ratio 0.5955 with one unit change in egg weight but there was no any significant relation of hatchling weight with egg weight, which is contrary to that Fayoumi chicken. In case of crossbred chicken, mean hatchling weight changed by ratio 1.3613 with one unit change in egg weight but there was no any significant relation of chick weight with egg weight as was also observed in *Desi* chickens. The positive correlation between egg weight and the weight of chick hatched from it was reported by Garip and Dere [29] for Japenese quail, Çağlayan and coworkers [27] for rock partridges, Raju and coworkers [30] for chicken and Saatc and coworkers [31] for geese. The positive correlation found between egg weight and the hatching weight indicated the advantage of initial bigger size egg at the time of setting. The hatchling weight as function of egg weight was found to be consistent regardless of strain difference. The results suggest selection of hatching eggs of proper size to produce quality chicks of better livability.

Conclusions

This study showed that medium-sized eggs were more suitable for good hatchability and lower embryonic mortality in three rural breeds. However, large sized eggs were suitable for better hatchling weight.

Authors' contributions

AR, GA and MYA- Substantial contribution to conception and design of study. SHK- Acquisition of data and drafted the manuscript, MJK and NI- analyzed and

interpreted the results, revised manuscript critically for important intellectual content. All authors read and approved the final manuscript.

Acknowledgements

The authors are thankful to the authorities of Livestock and Dairy Development Department, Lahore, Punjab, Pakistan for providing financial assistance to carry out this investigation.

Competing interests

The authors declare that they have no competing interests.

References

1. Reijrink, I.A.M., Meijerhof, R., Kemp, B., Graat, E.A.M and van den Brand, H. (2009) Influence of prestorage incubation on embryonic development, hatchability, and chick quality. *Poultry Science* 88: 2649–2660.
2. Wondmeneh, E., Dawud, I. and Adey. (2011) Comparative evaluation of fertility and hatchability of Horro, Fayoumi, Lohmann Silver and Potchefstroom Koekoek breeds of chicken. *Asian Journal of Poultry Science* 5: 124-129.
3. Farooq, M., Aneela, K., Durrani, F.R., Muqarrab, A.K., Chand, N. and Khurshid, A (2001) Egg and shell weight, hatching and production performance of Japanese broiler quail. *Sarhad Journal of Agriculture* 17: 289-293.
4. Alabi, O.J, Ngambi, J.W. and Norris, D. (2012) Effect of egg weight on physical egg parameters and hatchability of indigenous Venda chickens. *Asian Journal of Animal and Veterinary Advances* 7: 166-172.
5. North, M.O and Bell, D.D. (1990) Gentic Management In: Commercial chicken Production. An Avi Book Published by Van Nostrand Reinhold, New York.
6. Wilson, H.R. (1991) Interrelationships of egg size, chick sixze, post hatching growth and hatchability. *World's Poultry Science Journal* 47(1): 1-20.
7. Newsted, J.L., Katherine, K.C., Susan, A.B., John, L.B., Sean, G., John, P.G. (2007) Effects of perfluorooctane sulfonate on mallard and northern bobwhite quail exposed chronically via the diet. *Environmental Toxicology and Pharmacology* 23: 1-9.
8. Shanawany, M. M. (1987) Hatching weight in relation to egg weight in domestic birds. *World's Poultry Science Journal* 43: 107-115.
9. Tullet, S.G. and Burton, F.G. (1982) Factors affecting the weight and water status of the chick at hatch. *British Poultry Science* 23: 361-369.
10. Whiting, T.S. and Pesti, G.M. (1983) Effects of the dwarfing gene (dw) on egg weight, chick weight and chick weight: Egg weight ration in a commercial broiler strain *Poultry Science* 62: 2297-2302.
11. Yannakopoulos, A.L. (1988) Lack of effect of Oviposition time and parental age on chick weight when egg weight remains constant, *British Poultry Science* 29: 431-434.
12. Yannakopoulos, A.L. and Tserveri Gousi A.S. (1987) Relationship of parents age, hatching egg weight and shell quality to day old chick weight as influenced by oviposition time. *Poultry Science* 66: 829-833.
13. Pinchasov, Y. (1991) Relationship between the weight of hatching eggs and subsequent early performance of broiler chicks. *British Poultry Science* 32(1):109-15.
14. Kalita, N. (1994) Effect of egg weight, storage period and position of egg on hatchability. *Indian Journal of Poultry Science* 29 (3): 281-283.
15. Abiola, S.S. (1999) Effects of turning frequency of hen's egg in electric table-type incubator on weight losses, hatchability and mortality. *Nigeria Agriculture Journal* 30: 77-82.
16. Grobbelaar, J.A.N., Sutherland, B. and Molalakgotla, N.M. (2010) Egg production potentials of certain indigenous chicken breeds from South Africa. *Animal Genetics Resources* 46: 25-32.
17. National Research Council (NRC). (1994) Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press, Washington, DC.
18. Sahin, E.H., Sengor, E., Cetingul, I.S. and Yardimci, M. (2009) Relationship between pre-incubation egg parameters from old breeder hens, egg hatchability and chick weight. *Journal of Animal and Veterinary Advances* 8: 115-119.
19. Steel, R.G.D. and Torrie, J.H. (1984) Principles and procedures of statistics, international student Edn, Tokyo (Japan): McGraw Hill.
20. SPSS Inc. (2010) Manual del Usuario de SPSS Base 15.0. SPSS Inc., Chicago, IL.
21. Gonzalez, A., Satterlee, D.G., Moharer, F. and Cadd, G.G. (1999) Factors Affecting Ostrich Egg Hatchability. *Poultry Science* 78:1257–1262.
22. Kingori, A.M., Tuitoek, J.K., Muiruri, H.K. and Wachira, A.M. (2010) Effect of Dietary Crude Protein Levels on Egg Production, Hatchability and Post-Hatch Offspring Performance of Indigenous Chickens. *International Journal of Poultry Science* 9 (4): 324-329.
23. Alabi, O.J., Ng'ambi, J.W., Norris, D. and Mabelebele, M. (2012) Effect of egg weight on hatchability and subsequent performance of Potchefstroom Koekoek chicks. *Asian Journal of Animal and Veterinary Advances* 7(8): 718-725.
24. Deeming, D.C. (1995) Factors affecting hatchability during commercial incubation of Ostrich (*Struthio camelus)* eggs. *British Poultry Science* 36(1): 51-65.
25. De Witt, F. and Schwalbach, L.M.J. (2004) The effect of egg weight on the hatchability and growth performance of New Hampshire and Rhode Island Red chicks. *South African Journal of Animal Science* 34(6): 62-64.
26. Mbajiorgu, C.A. (2011) Effect of hatching egg size on hatchability and chick hatch- weight of indigenous Venda chickens. *Indian Journal of Animal Research* 45(4): 300-304.
27. Çaðlayan, T., Garip, M., Kýrýkçý, K. and Günlü, A. (2009) Effect of egg weight on chick weight, egg weight loss and hatchability in rock partridges (*A. graeca*). *Italian Journal of Animal Science* 8: 567-574.
28. Anandh, M.A., Jagatheesan, P.N.R., Kumar, P.S., Rajarajan, G. and Paramasivam, A**.** (2012) Effect of egg weight on egg traits and hatching performance of Turkey (*Meleagris gallopavo*) eggs. *Iranian Journal of Applied Animal Science* 2(4): 391-395.
29. Garip, M. and Dere, S. (2011) The effect of storage period and temperature on weight loss in quail eggs and the hatching weight of quail chicks. *Journal of Animal and Veterinary Advances* 10(18): 2363-2367.
30. Raju, M.V.L.N., Chawak, M.M., Praharaj, N.K., Rao, S.V.R. and Mishra S.K. (1997) Interrelationship among egg weight, hatchability, chick weight, post-hatch performance and rearing method in broiler breeders. *Indian Journal of Animal Sciences* 67: 48-50.
31. Saatcü, M., Kirmizibayrak, T., Aksoy, A.R., Tülkü, M. (2005) Egg Weight, Shape Index and Hatching Weight and Interrelationships among These Traits in Native Turkish Geese with Different Coloured Feathers. *Turkish Journal of Veterinary and Animal Sciences* 29: 353-357.

****