EFFECT OF DIFFERENT DIETARY PROTEIN ON EGG QUALITY TRAITS IN LAYER JAPANESE QUAILS (*Coturnix coturnix japonica*)

K.Sangilimadan[1], R.Asha Rajini[2], R.Prabakaran[3], Maqbool Ahmed[4] and M.Murugan[5]

Department of Poultry Science,
Madras Veterinary College, Chennai-600 007

Received : 21st March 2012 Accepted: 8th May 2012

ABSTRACT

A Biological experiment were conducted using Japanese quails (Coturnix coturnix japonica) from day old to thirty weeks of age and varying dietary protein regimen to study its effect on egg quality traits in requirement of layer Japanese quail reared in cages under a hot and humid tropical climate. Experiment quail chicks were fed with two levels of dietary protein 24 and 26 per cent (0-3 weeks) with 2750 Kcal ME/Kg , 20 and 22 per cent dietary protein with 2600 Kcal ME/Kg were provided to growers (4 to 6 weeks). At six weeks of age layer quails were provided with three levels of dietary protein of 16, 19 and 22 per cent with 2700 Kcal ME/Kg. The eggs collected were utilized to study external and internal egg quality traits. Protein groups of 26/22/22, 24/22/22 and 26/20/22 recorded significantly (P<0.01) highest egg weight. Dietary protein groups fed with 22 per cent protein during the growing and laying period, recorded significantly (P<0.01) higher egg weight. The various dietary protein combinations did not differ significantly in shape index, specific gravity, albumen index, yolk index, Haugh unit score, yolk colour score, shell thickness, per cent albumen and yolk. Age had significantly (P<0.05) influenced higher shape index, per cent shell and specific gravity. Individual dietary protein groups fed with 16 per cent protein during lay recorded significantly (P<0.01) higher yolk colour score and shell per cent.

1. Part of Ph.D., thesis submitted by the first author to the Tamil Nadu Veterinary and Animal Sciences University, Madhavaram Milk Colony, Chennai-600 051
2. Professor, Department of Poultry Science, Madras Veterinary College, Chennai-600 007.
3. Vice-Chancellor, Tamil Nadu Veterinary and Animal Sciences University, Madhavaram Milk Colony, Chennai-600 051.
4. Professor, Department of Animal Nutrition, Madras Veterinary College, Chennai-600 007.
5. Assistant Professor & Head, Veterinary University Training and Research Centre, Rajapalayam

INTRODUCTION

Japanese quail, a small-domesticated avian species, has assumed importance world wide as laboratory bird and is presently commercially exploited for meat and egg production. The popularity of quail eggs has increased in India due to some belief in its medicinal value. Egg weight ranges from 9 to 12 gm, with an average weight of 10g. Japanese quail egg represents about 8 per cent of the body weight of the adult quail. This is nearly one-fifth of the size of a chicken egg. It is characterized by a variety of shell colour patterns, ranging from dark brown to blue, white or speckled. Hence, the present investigation was carried to find out the effect of different dietary protein on egg quality traits in layer Japanese quails under hot and humid climatic conditions.

MATERIALS AND METHODS

An experiment was conducted using Japanese quails (*Coturnix coturnix japonica*) eggs from 7-30 weeks age, a total of 1296 eggs were collected to study the egg quality traits in layer Japanese quails fed varying protein levels.One thousand and two hundred straight run Japanese quail chicks belonging to a single hatch were reared in a brooder cum grower multi tiered cage upto six weeks of age. All the birds irrespective of the experimental groups were fed with *ad libitum* quail brooder mash containing 2750 Kcal of metabolizable energy per kilogram of feed, each treatment group of 600 birds were fed with dietary crude protein levels of 24 and 26 per cent respectively up to three weeks of age. During the growing period of 4 to 6 weeks of age, the metabolizable energy level in the feed was brought down to 2600 Kcal/kg as per the recommendations of Shrivastav and Panda (1999), while each brooding group of 600 birds were once again divided in to two sub groups with six replicate each and provided with lower dietary protein levels of 20 and 22 per cent. From each of the four treatment groups of growers, 120 female Japanese quails were randomly chosen and 40 birds from each group were provided with dietary crude protein levels of 16, 19 and 22 per cent totalling to 12 treatment groups. All the birds were provided ad *libitum* layer feed. During the laying period female Japanese quails were provided extra artificial light totalling to 16 light hours. Uniform managemental practices were adopted in all the experimental groups. The following external and internal Japanese quail egg quality parameters were studied.

External egg quality:

The eggs were collected for 3 consecutive days during the end of each 28 days period from 7-30 weeks period and were utilized for the measurement of external and internal egg quality traits. The weight of each egg, albumen, yolk and shell were recorded to 0.01g accuracy. The length and width of the eggs was measured using dial caliper with 0.05 mm accuracy. Shape index was worked out according to the formula of Shuttz (1953).From,

the specific gravity was calculated with help of egg weight (g) and volume of egg (ml).

Specific gravity = Weight of the egg (g) / Volume of the egg (ml)

Internal egg quality

After breaking open the egg, the height of the thick albumen and yolk was measured to 0.01 mm accuracy using an "Ames tripod micrometer" and the width of the thick albumen was measured at two places using a dial caliper with 0.05 mm accuracy and their mean width was arrived at. Albumen index was calculated according to the formula of Heiman and Carver (1936). Yolk index was calculated according to the formula of Sharp and Powell (1930). A modified version of Haugh unit by Kondaiah *et al.* (1983) was used. Yolk colour was visually compared to the colour numbers in the 'Roche yolk colour fan. The shell thickness was measured at three place namely, narrow end, broad end and equatorial region of the egg by using a shell thickness measuring gauge with 0.01mm accuracy and the mean shell thickness was calculated. The per cent Albumen, yolk and shell was calculated in relation to egg weight and expressed as percentage. The egg shell percentage was calculated by using the following formula

Percentage of egg shell = Shell weight (g) / Egg weight (g) X 100

RESULT AND DISCUSSION

The effect of dietary protein levels, combinations, effect of period and effect of individual protein levels on Egg weight Shape index, Specific gravity, Albumen and Yolk index, Haugh unit score, Yolk colour, Shell thickness, Per cent Albumen, Yolk and shell are presented in Table 1,2 and 3 respectively.

External egg quality

Egg weight

The protein groups of 26/22/22, 24/22/22 and 26/20/22 recorded significantly ($P<0.01$) highest egg weight and between these three groups there was no significant difference. Between periods, the last period of 27-30 weeks, recorded significantly ($P<0.01$) the highest egg weight (12.6g).The same trend was noticed by Banja *et al.* (2006).The dietary protein groups fed 22 per cent protein during the growing and lay recorded significantly ($P<0.01$) higher egg weight. Between layer dietary proteins, as the protein level increased the egg weight also increased, this agreed with the findings of Sehu *et al. (*2005). The overall egg weight was 12.26g±0.02, this agreed with the findings of Fernando *et al*. (2008).

Shape index

The overall mean shape index was 78.61±0.08. The shape index of eggs laid by quails fed on different dietary protein levels did

not differ significantly. However, Shrivastav *et al*. (1993) found that shape index was significantly higher in birds fed with 16 per cent dietary protein. Old birds recorded significantly (P<0.05) higher shape index (Table 2). However, between these treatments there was no significance. Abaza *et al.* (2009) also had come to the same conclusion with respect to egg shape index.

Specific gravity

Various dietary protein groups did not differ significantly in specific gravity of the eggs, while between periods, highly significant (P<0.01) difference was observed, highest specific gravity was recorded in eggs laid by birds aged 7-10 and 11-14 weeks(Table2). Older birds in the last two periods laid significantly (P<0.01) eggs of low specific gravity. Individual dietary protein levels did not influence the specific gravity of the egg significantly (Table 3). The overall specific gravity was 1.083±0.002. This was similar to that recorded by Shrivastav *et al.* (1989).

Albumen index,Yolk index and Haugh unit score

The over all mean albumen index, yolk index and Haugh unit score of the Japanese quail egg was 0.102±0.001, 0.424±0.001 and 82.20±0.05, the various dietary protein combinations and individual protein levels did not influence albumen index, yolk index and Haugh unit score significantly, the same trend was observed between the periods also. This agrees with the findings of Abaza *et al.* (2009). Quails in the age group of 7 to 10, 11 to 14 and 15 to18 weeks of age recorded significantly (P<0.01) higher yolk index. However, Shrivastav *et al.* (1993) observed that Japanese quails fed with a low dietary protein level of 16 per cent had significantly higher albumen and yolk index. Age did not have a significant effect on Albumen index and Haugh unit score. Shrivastav *et al.* (1994) also opined that age had no effect on albumen index but this was refuted by Narayanan kutty *et al.* (1989).

Internal egg quality

Yolk colour

The dietary protein groups of 24/20/16, 26/20/16, 24/22/16, 24/22/22, 26/20/22, 26/22/16 and 26/22/22 recorded significantly (P<0.01) higher yolk colour score. Individual dietary protein groups fed with 16 per cent protein during lay recorded significantly (P<0.01) higher yolk colour score this could be attributed to the higher maize levels in the feed (Table3). Eishu *et al.* (2005) also observed the same.

Shell thickness, Percent albumen, yolk and shell

The overall mean egg shell thickness was 0.207±0.00mm and the various dietary protein combinations did not have any significant effect on shell thickness, but periods exhibited highly significant (P<0.01) difference. Birds aged 7-10 weeks, recorded significantly

(P<0.01) highest egg shell thickness, however, as age advanced, a significant (P<0.01) reduction in egg shell thickness was observed (Table2). This result concurred with the findings of Kaur *et al.* (2005). The reason for poor quality shells as the bird ages is still not clearly understood. The dietary protein group did not have any significant effect on per cent albumin and Yolk. This agreed with findings of Garcia *et al*. (2005) and Abaza *et al*. (2009).Between periods there was a significant (P<0.01) difference. Layer Japanese quail aged of 27-30 weeks and 15-18 weeks recorded significantly higher (59.20±0.13) albumen per cent and Yolk percent (32.72 0.06) respectively (Table 2). This agreed with findings of Garcia *et al.* (2005) and Abaza *et al.* (2009). Layer fed with 22 per cent dietary protein laid eggs with higher per cent albumen. This agreed with findings of Garcia *et al.* (2005) and Abaza *et al.* (2009). Average percent shell in Japanese quails was 8.45± 0.01. The various dietary protein combination and individual brooder, grower and layer dietary protein levels had significantly affected shell per cent. This agreed with findings of Eishu *et al.*(2005). Irrespective of other dietary protein, birds fed with 16 per cent dietary protein during lay had significantly (P<0.01) higher per cent shell. This agreed with the findings of Shrivastav *et al*. (1993). The shell per cent ranged from 8.21± 0.04 to 8.73± 0.05. Dietary protein levels had influenced egg weights and so did age. Young birds and birds fed with lower dietary protein of 16 per cent laid smaller eggs. Smaller eggs had relatively a higher per cent of egg shell.

REFERENCES

Abaza,I.M., W.Ezzat, M.S. Shoeib, A.A. Ei-Zaiat and I.I. Hassan, 2009. Effects of Copper Sulphate on productive, reproductive performance and blood constituents of laying Japanese quail fed optimal and sub-optimal Protein.*Inter.J.Poult.Sci.,***8 (1)**: 80-89.

Bhanja, S.K., S.K.Agarwal and S.Majumdar, 2006. Effect of cage floor space on the egg production performance of Japanese quail during winter. *Indian J. Poult. Sci*., **41(2)**: 205-207.

Eishu Ri., Katsunori Sato, Takuro Oikawa, Tetsuo Kunieda and Hideji Uchida, 2005. Effects of dietary protein levels on production and characteristics of Japanese quail eggs. *J.Poult.Sci.,* **42**:130-139.

Garcia, E.A., A.A .Mendes, C.C. Pizzolante Saldanha, J.Moreira, C. Mori and A.C. Pavan, 2005. Protein, methionine plus cystine and lysine levels for Japanese quails during the production phase. *Rev.Bras.Cienc.Avic.,* **7 (1)**:1-9.

Heiman,Vand J.S.Carver,1936.The albumen index as a physical measurement of observed egg quality. *J. Poult.Sci.,* **15**:141-148

Kaur,S; Mandal, A.B; Singh, K.B and Kadam, M.M .2005.Response of Japanese quails to dietary protein quality during different phases of egg production.Indian *.J. Ani.Nutr., **22 (3)** : 206-209.*

Kondaiah,N;B.Panda and Singhal, 1983 . Internal egg quality measure of quail eggs. *Indian J. Anim. Sci.,* **53**: 1261-1264.

Narayanan kutty., K. A.Jalaludeen and A.Ramakrishnan, 1989. Effect of age on quality characteristics of Japanese quail eggs. *Cheiron,* **18(2)**: 97-98.

Sehu,A., O.Cengiz and S.Cakir, 2005. The effects of diets including different energy and protein levels on egg production and quality in quail. *Indian Vet. J.*, **82**: 1291-1294.

Sharp,P.Fand C.K.Powell,1930.Decrease in internal quality of hens egg during storage as indicated by the yolk. *Ind.Eng.Chem.,* **22**: 909-910.

Shrivastav,A.K., B. Panda and N. Darsan, 1989. Calcium and Phosphorus requirements of laying Japanese quail. *Indian J.Poult.Sci.,* **24 (1)**: 27-34.

Shrivastav, A.K., M.V.L.N. Raju and T.S. Johri, 1993. Effect of varied dietary protein on certain production and reproduction traits in breeding Japanese quail. *Indian J.Poult.Sci.,* **28 (1)**: 20-25.

Shrivastava,S.K, ,S.D.Ahuja, R.P.Singh and U.K.Bandyopadhyay, 1994. Influence of rearing mixed and separate sexes of Japanese quail on egg production and egg quality. *Indian J.Poult.Sci.,* **29 (2)** : 151-156.

Shuttz.P.T;1953. Analysis of egg shape in Chicken. *Biometrics*, **9** : 336.

Table-1.Protein combination effect on various egg quality traits in layer Japanese quail (*Coturnix coturnix japonica*)

Productive Parameters	Protein combination (%)												
	24/20/16	24/20/19	24/20/22	24/22/16	24/22/19	24/22/22	26/20/16	26/20/19	26/20/22	26/22/16	26/22/19	26/22/22	Mean ± S.E
Egg wt (g)**	12.06 ^{d} ± 0.06	12.25 ^{bcd} ± 0.05	12.33 ^{abc} ± 0.06	12.09 ^{d} ± 0.06	12.30 ^{abc} ± 0.06	12.39 ^{abc} ± 0.06	12.07 ^{d} ± 0.04	12.27 ^{bc} ± 0.05	12.38 ^{ab} ± 0.06	12.13 ^{ed} ± 0.05	12.38 ^{abc} ± 0.05	12.49 ^{a} ± 0.04	12.26 ± 0.02
Shape index ^{NS}	78.29 ± 0.33	78.93 ± 0.23	78.11 ± 0.30	78.87 ± 0.26	78.86 ± 0.27	78.76 ± 0.29	78.25 ± 0.27	78.23 ± 0.28	78.54 ± 0.25	78.15 ± 0.33	78.57 ± 0.28	78.57 ± 0.26	78.61 ± 0.08
Specific gravity ^{NS}	1.085 ± 0.007	1.075 ±0.008	1.084 ± 0.007	1.079 ± 0.006	1.088 ± 0.006	1.084 ± 0.007	1.078 ± 0.004	1.082 ± 0.006	1.084 ± 0.007	1.076 ± 0.006	1.090 ± 0.008	1.095 ± 0.009	1.083 ± 0.002
Albumen index ^{NS}	0.102 ± 0.001	0.101 ±0.001	0.102 ± 0.001	0.103 ± 0.001	0.102 ± 0.001	0.101 ± 0.001	0.103 ± 0.001	0.101 ± 0.001	0.102 ± 0.001	0.103 ± 0.001	0.102 ± 0.001	0.102 ± 0.001	0.102 ± 0.001
Yolk index ^{NS}	0.421 ± 0.003	0.420 ± 0.003	0.424 ± 0.003	0.422 ± 0.003	0.425 ± 0.003	0.423 ±0.003	0.422 ± 0.002	0.425 ± 0.003	0.423 ± 0.003	0.422 ± 0.003	0.422 ± 0.003	0.420 ± 0.003	0.424 ±0.001
HU Score ^{NS}	82.15 ± 0.12	82.61 ±0.14	82.35 ± 0.15	82.08 ± 0.21	82.28 ± 0.14	82.29 ± 0.13	82.28 ± 0.14	82.25 ± 0.16	81.99 ± 0.25	82.13 ± 0.22	82.14 ± 0.16	82.30 ±0.16	82.20 ± 0.05
Yolk colour score**	5.55 ^{a} ± 0.10	5.11 ^{c} ±0.09	5.33b ^{c} ± 0.10	5.50 ^{ab} ± 0.10	5.15 ^{c} ± 0.10	5.31 ^{abc} ± 0.10	5.51 $^{a\,b}$ ± 0.09	5.20 ^{c} ± 0.09	5.31 ^{abc} ± 0.09	5.44 ^{abc} ± 0.08	5.19 ^{c} ± 0.09	5.28 ^{abc} ± 0.09	5.32 ± 0.03
Shell thickness ^{NS}	0.209 ± 0.002	0.206 ±0.001	0.209 ± 0.002	0.205 ± 0.002	0.204 ± 0.001	0.207 ± 0.002	0.206 ± 0.001	0.206 ± 0.002	0.206 ± 0.002	0.208 ± 0.002	0.208 ± 0.001	0.210 ± 0.002	0.207 ± 0.000
Percent albumen ^{NS}	58.84 ± 0.10	58.99 ±0.15	59.05 ± 0.12	58.86 ± 0.16	59.01 ± 0.15	59.12 ± 0.12	58.81 ± 0.12	58.93 ± 0.13	59.00 ± 0.11	58.79 ± 0.10	58.92 ± 0.13	59.04 ±0.16	58.95 ± 0.04
Percent yolk ^{NS}	32.34 ± 0.10	32.45 ±0.14	32.46 ± 0.10	32.38 ± 0.15	32.50 ± 0.14	32.61 ± 0.11	32.46 ± 0.11	32.58 ± 0.12	32.67 ± 0.11	32.50 ± 0.09	32.66 ± 0.12	32.65 ±0.16	32.52 ± 0.04
Percent Shell**	8.73 ^{a} ± 0.05	8.50 ^{ab} ± 0.05	8.38 ^{b} ± 0.05	8.69 ^{a} ± 0.05	8.41 ^{b} ± 0.05	8.18 ^{c} ±0.04	8.66 ^{a} ± 0.05	8.44 ^{b} ± 0.05	8.21 ^{c} ± 0.04	8.66 ^{a} ± 0.05	8.33 ^{bc} ± 0.04	8.22 ^{c} ±0.04	8.45 ± 0.01

- Mean for levels bearing different superscript with different column differ significantly (P<0.01) *- Mean for levels bearing different superscript with different column differ significantly (P<0.05), NS-Not Significantly (P>0.05)

Table-2. Age on protein effect of different egg quality traits of layer Japanese quail (*Coturnix coturnix japonica*)

Productive Parameters	Age (Weeks)					
	7-10	**11-14**	**15-18**	**19-22**	**23-26**	**27-30**
Egg weight(g) **	11.96^{d} ±0.04	12.21^{cd}± 0.04	12.08^{c}± 0.04	12.27^{c}± 0.04	12.42^{b}± 0.03	12.64^{a} ± 0.04
Shape index **	79.00^{a}± 0.19	79.14± 0.21^{a}	78.67^{ab}±0.20	78.29^{bc} ± 0.17	78.86^{ab}±0.18	77.70^{c}± 0.19
Specefic gravity**	1.171^{a}± 0.007	1.082^{ab}±0.004	1.071^{bc}± 0.003	1.066^{c}± 0.002	1.059^{d}± 0.002	1.052^{d}± 0.002
Albumen index ^{NS}	0.102 ± 0.001	0.103±0.001	0.101± 0.001	0.102 ± 0.001	0.103 ± 0.001	0.102 ± 0.001
Yolk index **	0.425±0.002^{ab}	0.428±0.002^{a}	0.426±0.002^{ab}	0.417±0.002^{c}	0.418±0.002^{c}	0.421±0.002^{bc}
HU Score ^{NS}	82.35 ± 0.14	82.28± 0.12	82.33 ± 0.11	82.29 ± 0.09	82.14 ± 0.12	82.03 ± 0.14
Yolk colourscore ^{NS}	5.25 ± 0.08	5.30 ± 0.07	5.23 ±0.07	5.42 ± 0.06	5.33 ± 0.06	5.44 ± 0.05
Shellthickness **	0.217^{a}± 0.001	0.211^{b}±0.001	0.208^{b}± 0.001	0.206^{c}±0.001	0.201^{d}± 0.001	0.197^{d} ± 0.001
Percent albumen **	58.97^{b} ± 0.05	58.89^{bcd}±0.05	58.77^{d} ± 0.07	58.81^{bc}± 0.05	59.04^{ab} ± 0.14	59.20^{a} ± 0.13
Per cent yolk*	32.44^{bc}± 0.04	32.64^{ab}± 0.04	32.73^{a} ± 0.06	32.55^{abc}±0.04	32.41^{c} ± 0.13	32.36^{c} ± 0.14
Per cent Shell*	8.54 ^{a} ± 0.04	8.41^{bc} ± 0.03	8.44 ^{bc} ± 0.04	8.46^{abc} ± 0.03	8.49^{ab}± 0.04	8.38 ^{c} ± 0.04

- Mean for levels bearing different superscript with different column differ significantly (P<0.01) *-** Mean for levels bearing different superscript with different column differ significantly (P<0.05), NS-Not Significantly (P>0.05)

Table 3.Individual protein effect on different egg quality traits of layer Japanese quail
(*Coturnix coturnix japonica*)

Productive Parameters	Individual protein effect						
	Brooder (CP %)		Grower(CP %)		Layer(CP %)		
	24	26	20	22	16	19	22
Egg weight(g) **	12.24 ± 0.02	12.29 ± 0.02	12.23b ± 0.02	12.30 a ± 0.02	12.09 b ± 0.03	12.30 a ± 0.03	12.39 a ± 0.03
Shape index NS	78.67 ± 0.11	78.55 ± 0.11	78.59 ± 0.11	78.63 ± 0.11	78.64 ± 0.15	78.65 ± 0.13	78.54 ± 0.14
Specefic gravityNS	1.083± 0.002	1.084± 0.003	1.081 ± 0.003	1.085 ± 0.003	1.082 ± 0.003	1.084 ± 0.004	1.085 ± 0.004
Albumen index NS	0.102 ± 0.000	0.102 ± 0.000	0.102 ± 0.000	0.102 ± 0.000	0.103 ± 0.000	0.102 ± 0.000	0.102 ± 0.000
Yolk index NS	0.422 ± 0.001	0.422 ± 0.001	0.422 ± 0.001	0.422 ± 0.001	0.422 ± 0.001	0.423 ± 0.001	0.422 ± 0.001
HU Score NS	82.29± 0.06	82.18 ± 0.08	82.27 ± 0.07	82.20 ± 0.07	82.18 ± 0.08	82.30 ± 0.08	82.23 ± 0.09
Yolk colour score**	5.33 ± 0.01	5.32 ± 0.05	5.34 ± 0.07	5.31 ± 0.06	5.50a ± 0.02	5.16b ± 0.02	5.31b ± 0.01
Shell thickness NS	0.207 ± 0.000	0.205 ± 0.001	0.206 ± 0.001	0.205 ± 0.001	0.205 ± 0.001	0.205 ± 0.001	0.205 ± 0.001
Percent albumen *	58.98 ± 0.05	58.92 ± 0.05	58.94 ± 0.05	58.95 ± 0.06	58.83c ± 0.06	58.96b ± 0.07	59.05a ± 0.06
Per cent yolk NS	32.46 ± 0.05	32.59 ± 0.05	32.49 ± 0.05	32.55 ± 0.05	32.42 ± 0.06	32.55 ± 0.07	32.60 ± 0.06
Per cent Shell**	8.48a ± 0.02	8.42b ± 0.02	8.49a ± 0.02	8.42b ± 0.02	8.69a ± 0.03	8.42b ± 0.02	8.25b ± 0.02

- Mean for levels bearing different superscript with different column differ significantly (P<0.01) *- Mean for levels bearing different superscript with different column differ significantly (P<0.05), NS-Not Significantly (P>0.05)