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Comparison of Egg Production Between Two Quail Strains and Their Reciprocal Crosses

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Abstract: Hen Day (H-D) and Hen-Housed (H-H) egg production for 135 day period compared in two quail strains and their reciprocal crosses in two separate trails. At the first trail in two hatches 180 Japanese quail (*Coturnix japanese*) and 180 Range quail (*Coturnix ypisilophorus*) were reared in two different spaces [litter with sawdust (250×200×230 cm) and one-tier cage (50×50×70 cm)]. The 130-day period production was measured from date of first egg for each female. Strain difference were not significant for H-D ($p>0.05$), but there were significant difference for H-H ($p<0.01$). Also H-D and H-H were significantly different by space of variations ($p<0.01$). Japanese quails with H-H 72.42±0.65% were significantly higher than Range quail with 62.68±1.07. At the second trail in two hatches 800 quails include four groups: 1- Japanese quails 2- Range quails 3- Hybrid 1 (R♂×C♀). 4- Hybrid 2 (C♂×R♀) were reared in four-tier cage from 28 days of age to experiment end. H-D and H-H of four groups were significantly different ($p<0.01$). Japanese quails with H-D 77.39±1.23% were the highest in four groups, but H-D between Japanese quail and H2 was not significantly different ($p>0.05$). H-D were not affected by hatch effects ($p>0.05$), but H-H at second hatch was significantly higher than first hatch. Egg weights were obtained with sample 35 eggs which randomly were selected at 70th, 115th and175th days of age production for Japanese quails, hybrid 1, hybrid 2 and Range quails 11.16±0.16, 10.92±0.17, 10.61±0.11 and 11.06±0.12 g, respectively.

Key words: *Coturnix japanese*, *Coturnix ypisilophorus*, quail, egg production and heterosis

INTRODUCTION

The modern Japanese quail is a good egg layer in its own right (Baumgartner, 1994) and it is farmed intensively for egg production, especially in Japan and in Southeast Asia (Minvielle, 1998). Studies have been published on egg production in Coturnix japanese (Bacon *et al*., 1986 Strong *et al*., 1978; Nestor *et al*., 1982, 1983, Minvielle *et al*., 1995, 2000), but reliable values of egg production in Range quail (*Coturnix ypisilophorus*) are less common (Vali *et al*., 2005 a, b). This strain is called Range quail, but is also known by other names: Brown (swamp) quail, British Range and American Range (Thear, 1998). Iran is one of the Asian countries, which commercial quail production has become more important in recent years and most of the production has been centered on the Japanese quail farm and other quail strains are less. In the present research, the aims were to study rate of laying and most of the production has been centered on the comparison between raring different conditions for egg production has become more important in recent years production in two quail strains (*Coturnix japanese* and *Coturnix ypisilophorus*) and their reciprocal crosses.

MATERIALS AND METHODS

Trial 1: In order to comparison egg production at two quail strains, Japanese quail (*Coturnix japanese*) and Range quail (*Coturnix ypisilophorus*) in different conditions raring in Iran 360 chicks were hatched from base population (base population include 500 Japanese quails and 500 Range quails, which weren't improvement). In each hatch from each strain 90 quails were kept at 1 male to 3 females ratio in two separate pens (250×200×230 cm) with the sawdust litter and 90 quails were kept at the same ratio for male and female in 10 one-tier cage (50×50×70 cm). Quail at 28 days of age until experiment end transported to the cage, but another group was kept in pens with sawdust litter from 1 day of age until experiment end. The chicks had access to continuous lighting for the first 48 h. At 2 days of age, the daily light was reduced to 15 h (6:00 AM until 9:00 PM) and maintained for the rest of the experiment. Temperature being decreased gradually from 32 to 20°C. Feed was available for *ad libitum* consumption. The crude protein content of diet was 24% until 21 days of age, 22% between days 21 and 42 and 20% after day 42; also diet contained 2650 kcal kg^{-1} metabolizable energy, 2.25% Ca and 0.43% available P. Water was available at all times. Egg production was recorded for 135 days. The 130-day period production was measured from date of first egg for each female. Hen-day (H-D) and Hen-housed (H-H) egg production for 130-day period was used for data.

Trial 2: A total of 400 quails include 200 Japanese quails and 200 Range quails were randomly selected from the base population, (the base population were contained quails at 200 days of age, which they were kept as a random bred control) and were randomly divided to four groups 1-Japanese male and female quails (C♂×C♀). 2-Range male and female quails (R♂×R♀). 3-Range male quails and Japanese female quails (R♂×C♀). 4- Japanese male quails and Range female quails (C♂×R♀). These four groups were kept in separate pen at 1 male to 3 female's ratio. After 15 days when these groups were placed in pens, the fertile eggs were collected from each group and coded. The fertile eggs were set in incubator (14 days in setter and 2 days in Hatcher). Setter and Hatcher were divided into separate parts per groups according to the egg code. At each hatch 100 quails from each group (a total of 800 quails in 2 hatches) were wing banded and transferred to a litter house with 35°C temperature. Quails were kept in four-tier cage (70×65×40 cm) from 28 days until experiment end. Conditions of rearing and husbandry were according accuracy of trial 1. Egg productions in 135 day period were recorded from date of first egg for each female. Egg weights were obtained with sample 35 eggs which randomly were selected at 70, 115 and175 days of age production for each group.

Statistical Analysis: Hen-day and hen housed egg production data were analyzed using the General Linear Model (GLM) procedures of SAS (SAS Institute, 1998). In all case the means for significant (p<0.01) factors were compared by using Lsmeans (SAS Institute, 1998).

Models used were:

$$Y_{ijkl}= \mu+S_i+H_j + P_k+ (SH)_{ij} + (SP)_{ik} + (HP)_{jk} + e_{ijkl} \quad (1)$$

$$Y_{ijk}= \mu+S_i+ H_j + (SH)_{ij} + e_{ijk} \quad (2)$$

where:
Y^{ijkl} is the individual observation for trait Y.
μ is the overall mean for trait Y_{ijkl}.
S_i is the effect of the i^{th} strain.
H_j is the effect of j^{th} hatch.
P_l is the effect of the l^{th} place.
$(SH)_{ij}$, $(SP)_{il}$ and $(HP)_{jl}$ are the corresponding interaction.
e_{ijklm} is random error.

Table 1: Description of data for rate of laying for a period of 135 days in two quail strains, CO Japanese quail (*Coturnix Japanese*), RA: Range quail (*Coturnix ypisilophorus*)

Laying (%)	Space	Strain	No. Obs.	Mean	SE	SD	CV
		CO	519	67.99	0.89	20.36	29.94
	Litter	RA	431	73.33	1.84	21.02	28.66
H-D		CO	961	78.77	0.66	20.33	25.81
	Cage	RA	883	76.61	1.03	20.06	26.19
		CO	519	62.90	1.01	23.00	36.57
	Litter	RA	431	66.32	1.62	18.49	27.88
H-H		CO	961	72.75	0.65	20.13	27.67
	Cage	RA	883	62.67	0.76	14.93	23.82

H-D: Hen-Day egg production for long period, H-H: Hen-Housed egg production for long period, No. Obs: Number of Observations, Mean: average, SD: Standard Deviation, SE: Standard Error and CV: Coefficient of Variation

Table 2: Least squares mean and standard error of rate of laying (%) for a period of 135 days in two quail strains, CO Japanese quail (*Coturnix Japanese*), RA: Range quail (*Coturnix ypisilophorus*)

Source of variance			H-D(%)±SE	H-H(%)±SE
Overall mean			75.19±0.47	67.82±0.46
	CO		73.42 ± 0.55^{a}	67.69 ± 0.54^{a}
Strain	RA		74.21 ± 1.10^{a}	64.47 ± 1.08^{b}
	1		74.64 ± 0.73^{a}	66.98 ± 0.71^{a}
Hatch	2		72.99 ± 0.98^{a}	65.18 ± 0.96^{a}
		Litter	69.57 ± 1.14^{b}	64.61 ± 1.11^{b}
Space		Cage	78.05 ± 0.63^{a}	67.56 ± 0.63^{a}
Strain×space	CO	Litter	67.97 ± 0.89^{b}	62.94 ± 0.87^{b}
		Cage	78.87 ± 0.66^{a}	72.42 ± 0.65^{a}
	RA	Litter	71.18 ± 2.08^{b}	66.26 ± 2.04^{b}
		Cage	77.24 ± 1.08^{a}	62.68 ± 1.07^{b}
Strain×Hatch	CO	1	72.91 ± 0.74^{b}	69.42 ± 0.72^{a}
		2	73.93 ± 0.80^{ab}	65.95 ± 0.79^{b}
	RA	1	76.36 ± 1.25^{a}	64.54 ± 1.22^{b}
		2	72.05 ± 1.80^{b}	64.41 ± 1.76^{b}

H-D: hen-day egg production for long period, H-H: hen-housed egg production for long period. Letter(s) $^{(a, b)}$ Means within each subclass column with different superscript are significantly different (p<0.01)

RESULTS AND DISCUSSION

Trial 1: Table 1: Description of data are showing for egg production in a period of 135 days in two strains, Japanese and Range quail according to hen day, hen housed and rearing space. Table 2 lists least squares means with standard error for H-D and H-H, by strain, hatch, space and corresponding interactions. Strain difference were not significant for H-D (p>0.05) and these results were lower than some previous studies. Nestor and Bacon (1982), reported egg production of the randomly selected females *Coturnix coturnix japonica* was recorded for 120 days 107-118 eggs. Bamgartner (1994), stated egg production one year Japanese quail were 290 eggs. Nestor *et al.* (1983) reported level of egg production of the base population (Japanese quails) was ranging from 109 to 113 egg in 120 days (the 120 day period started when approximately 50% of the hens laid their first generation and the other generations the 120-day period began with the date of first egg for

Table 3: Description of data for rate of laying for a period of 135 days in two quail strains and their reciprocal crosses, CO Japanese quail (*Coturnix Japanese*), RA: Range quail (*Coturnix ypisilophorus*), H1: hybrid 1(R♂×C♀) and H2: hybrid 2 (C♂×R♀)

Laying (%)	Groups	No. Obs.	Mean	SE	SD	CV
	CO	270	77.39	1.08	17.60	22.74
	RA	270	72.49	1.19	19.55	26.97
H-D	H1	270	71.38	1.36	22.20	31.10
	H2	270	76.51	1.32	21.53	28.15
	CO	270	66.57	1.06	17.42	26.17
	RA	270	57.74	0.94	15.42	26.71
H-H	H1	270	65.62	1.27	20.81	31.71
	H2	270	62.15	1.33	21.71	34.93

H-D: Hen-Day egg production for long period, H-H: Hen-Housed egg production for long period, No. Obs: Number of Observations, Mean: Average, SD: Standard Deviation, SE: Standard Error and CV: Coefficient of Variation

Table 4: Least squares mean and standard error of rate of laying (%) for a period of 135 days in four groups include two quail strains and their reciprocal crosses, CO: Japanese quail (*Coturnix Japanese*), period of 135 days in four groups include two quail strains and RA: Range quail (*Coturnix ypisilophorus*), H1: hybrid 1(R♂×C♀) and H2: hybrid 2 (C♂×R♀)

Source of variance			H-D (%)±SE	H-H (%)±SE
Overall mean			74.44 ± 0.62	63.02 ± 0.59
	CO		77.39 ± 1.23^{a}	66.57 ± 1.13^{a}
	RA		72.49 ± 1.23^{b}	57.74 ± 1.13^{c}
Group	H1		71.38 ± 1.23^{b}	65.61 ± 1.13^{a}
	H2		76.50 ± 1.23^{a}	62.15 ± 1.13^{b}
	1		74.76 ± 0.87^{a}	60.95 ± 0.79^{b}
Hatch	2		74.12 ± 0.87^{a}	65.08 ± 0.79^{a}
	CO	1	76.40 ± 1.74^{ac}	64.71 ± 1.59^{bcd}
		2	78.37 ± 1.74^{ab}	68.43 ± 1.59^{ac}
	RA	1	76.08 ± 1.74^{bc}	61.94 ± 1.59^{d}
Group×Hatch		2	68.90 ± 1.74^{d}	53.54 ± 1.59^{e}
	H1	1	70.69 ± 1.74^{d}	61.83 ± 1.59^{d}
		2	72.06 ± 1.74^{cd}	69.40 ± 1.59^{a}
	H2	1	75.87 ± 1.74^{ac}	55.34 ± 1.59^{e}
		2	77.13 ± 1.74^{d}	68.95 ± 1.59^{ab}

H-D: Hen-Day egg production for long period, H-H: Hen-Housed egg production for long period. Letters (a,b,c,d,e) Means within each subclass column with different superscript are significantly different ($p<0.01$)

each female. However H-D egg production this work in comparison with some reports was more. Strong *et al.* (1978), reported means 70 day egg period 58.6%±0.3. Strain differences were significant for H-H ($P<0.01$), which the reason that in H-H way measurement is with to take into consideration mortality. Bamgartner (1994), reported average annual laying intensity (per bird housed) in Estonian quail 86% with average mortality rate 7.4% for 0-412 days. Egg production were significantly by space of variations ($p<0.01$). Egg production in cage conditions showed a higher than litter conditions ($p<0.01$). These results show that cage conditions were effective for both strain and H-H Japanese quail with 72.42±0.65 percent was significantly higher than Range quail with 62.68±1.07 (Table 2).

Trial 2: Table 3 description of data are showing for egg production in a period of 135 days in two quail strains and their reciprocal crosses according to hen day, hen housed. Table 4 lists least squares means with standard error for H-D and H-H, by group, hatch and corresponding interactions. Groups difference were significantly different for H-D and H-H ($p>0.01$).

H-D and H-H of four groups were significantly different ($p<0.01$). Japanese quail, were the highest in four groups, but H-D between Japanese quail and H2 were not significantly different ($p>0.05$). H-D between H1 and H2 were significantly different ($p<0.01$), however H-H of H1 were significantly ($p<0.01$) higher than H2. Results obtained for H-D and H-H were difference from the previous studies. Minvielle *et al.* (2000a), reported average 65 days in purebreds AA, BB, DD and EE 44.2, 49.3, 51.5 and 55.1 respectively and crossbred types, AB, DE 56.1 and 56.9 respectively, which were lower than results these study. Also, total egg numbers after 13 months in laying test for these purebreds foregoing 247, 255, 301 and 282 and for crossbred foregoing 314 and 327 eggs. Minvielle *et al.* (2000), reported mean egg number for hen housed egg production with standard deviation at purebred line AA, BB, DD and EE after 397 days 245.4±113.5, 255.5±90.1, 312.1±93.0 and 283.1±90.2, respectively and for their crossbred AB, BA, DE and ED 314.3±89.0, 308.9±90.0, 322.5±91.2 and 332.7±84.1, respectively. H-D were not affected by hatch effects ($p>0.05$), but H-H at the second hatch were significantly higher than first hatch, my be reason that more mortality.

Table 5: Description of data for egg weight (g) in four quail groups, CO: Japanese quail (*Coturnix Japanese*), RA: Range quail (*Coturnix ypisilophorus*), H1: hybrid 1 and H2: hybrid 2

Group	No. Obs.	Min	Mean	Max	SE	SD	CV
CO	94	7.94	11.16	13.87	0.12	1.20	10.76
H1	93	7.88	10.92	13.90	0.11	1.08	9.89
H2	96	7.30	10.61	13.29	0.11	1.03	9.74
RA	94	7.35	11.07	13.37	0.12	1.21	10.91

No. Obs: number of observations, min: minimum, Mean: average, max: maximum, SE: standard error, SD: standard deviation and CV: coefficient of variation.

Table 6: Least squares mean and standard error of egg weight (g) at 70th, 115th and 175th days of ages in four quail groups CO: Japanese quail (*Coturnix Japanese*), RA: Range quail (*Coturnix ypisilophorus*), H1: hybrid 1(R♂×C♀) and H2: hybrid 2 (C♂×R♀)

Source of variance		Egg weight(g)±SE
Overall mean		10.94 ± 0.06
	CO	11.16 ± 0.11^{a}
	H1	10.92 ± 0.17^{a}
Group	H2	10.61 ± 0.11^{b}
	RA	11.06 ± 0.11^{a}
	70	10.74 ± 0.98^{b}
Age (day)	115	10.87 ± 0.10^{b}
	175	11.19 ± 0.09^{a}

Letter(s) (a,b) Means within each subclass column with different superscript are significantly different ($p<0.01$)

Table 5 description of data is showing for egg weight at 70th, 115th and 175th days of ages in four quail groups. Change in egg weight paralleled those of increase ages

(Table 6). Egg weight at 175 days of age were significantly different from the other ages ($p<0.01$), but there were not any significant difference at 70 and 115 days of ages ($p>0.05$). Egg weight of Japanese quail with 11.16±0.11 g, was heaviest than other groups and there was significant difference from H2 with egg weight 10.61±0.11 g,. Nestor and Bacon (1982), reported change in egg weight paralleled those of adult body weight. Minvielle *et al.* (2000a) also reported egg weight after six months in four purebred and their reciprocal crosses, which there were significantly different among groups.

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