EFFECT OF FASTING ON REPRODUCTIVE PERFORMANCE OF LAYING HENS

By

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Abstract: *This experiment was carried out to study the effect of restricted for times of eating feed through limiting (adlibitum, 4 and / or 8 hours fasting/day) during laying period (from 20 to 70 weeks of age) of two laying hen strains (Hisex brown and Bovans white strains) on their productive performance.*

The results revealed that fasting laying hens for about 4 or 8 hours/day during laying period decreased (P<0.05) cumulative feed intak by about 7.69% or 11.40% respectively compared to those fed adlibitum, without no successive significance decrease in cumulative feed intake by increasing fasting time from 4 to 8 hours/days. Feed deprivation for 4 to 8 hours/day improved (<0.05) cumulative feed conversion from 3 to 7 laying periods, but this improvement effect began to decrease with the progress in laying (at 8 and 9 laying period) and disappeared at the end of laying periods (from 10 to 13 laying periods).Fasting laying hens for about 4 or 8 hours/day during laying period decreased the cost of feed by about 7.68 and 11.39% and mortality rate by about 6.54% and 8.92% respectively compared to those fed adlibitum. Feed restriction had no significant effect on egg number, egg weight egg mass, hen day production and egg quality. Hisex Brown strain produced higher (P<0.01) egg number, hen day production, egg mass, feed intake and utilized feed better (P<0.05) than Bovans white strain during laying period. Hisex Brown strain produced eggs with higher quality than Bovans white strain based on yolk index and Haugh units at the first stage of egg production and yolk index, Haugh units, yolk color and shell strength at the mid stage of egg production. At the late stage of egg production (after 52 laying weeks), Hisex Broawn strain recorded lower (P<0.05) yolk color, shell strength and the eggs tended to be rounder compared to eggs produced by Bovans white strain.

INTRODUCTION

Poultry production is effected by many factors such as breed and strain of chickens used, environmental conditions in the poultry houses, management practices, feed and feeding management (Bell and Weaver, 2002). Maintaining correct body weight during laying period through controlled feeding will keep the pullets from consuming more feed than normal and getting overly heavy (Kostal et al., 1992 and Sovory et al., 1992).

The methods of food restriction classified as (a) limiting the birds time of access to food, (b) quantative food restriction, (c) the use of low energy diets and (d) dietary protein restriction (Lee et al., 1971). Quantitative feed restriction is commonly used to control growth by feeding a predetermined amount of a balanced diet. One of the problems involved in implementing a quantative feed restriction program is distributing amounts of feed rapidly so that uniform feed consumption among birds is achieved (Leeson and Summers, 1997). Therefore, the results obtained cannot to repeated under practical conditions, since the body weight, body weight gain and egg production rate and consequently their feed requirements at the same age are strongly variable. Moreover, the distribution of the daily rations is laborious and inaccurate.

MATERIALS AND METHODS

A total number of one hundred thirty five Hisex Brown (Hs) and Bovan white (BV) pullets aged 20 weeks, as commercial egg strains were used in this experiment. Sixty three birds from Hisex Brown and seventy two from Bovans white pullets were randomly divided into three groups (control and two treatments). Each group was subdivided into three replicates with 7 and 8 birds (recommended stocking rate for each strain) from Hisex and Bovans white strains respectively. Birds in each replicate were housed in wire cages of 61 × 55 × 45 cm for length, width and height respectively in a closed house system from 20 to 72 weeks of age. The first group of pullets within strain was fed *adlibitum* during the experimental period (from 20 to 72 weeks of age). However, the second and third groups within each strain were fasted for 4 (from 16.00 to 20.00 hour) and 8 (from 12.00 to 20.00 hour) respectively during the experimental period Birds were fed a layer diet (table 1) according to NRC (1994).

Birds were kept at 65% relative humidity and the temperature inside the house was adjusted to be 22 to 24 °C during the experimental period. Birds were exposed to an adequate lighting program (16 L : 8 D).and drinking water was available all the time. All hens were kept under similar adequate managerial and hygienic conditions until 72 weeks of age (end of the experiment).

Table (1) Composition and calculated analysis of the experimental diet.

Ingredients	**%**
Yellow corn	60.90
Soybean meal(44%Cp)	21.60
Corn gluten meal (60%Cp)	6.00
Vit&Min. premix*	0.30
Wheat bran	0.45
Dicalcium phosphate	1.36
Calcium carbonate	8.95
Salt	0.40
DL-methionine	0.04
Total	100
Calculated analysis:	
ME. Kcal/Kg	2766.00
Crude Protein. (%)	18.45
Crude fiber. (%)	2.68
Crude fat, (%)	2.78
Ca, (%)	3.87
P (Available, %)	0.38
Lysine, (%)	0.85
Methionine. (%)	0.40
Methionine+Cystine	0.65

*Vitamins and minerals premix provided per kilogram of the diet: Vit A. 1000 IU; D3 2000 ICU: Vit E. 10 mg; Vit K, 1mg: B1. 10 mg; B2, 5 mg; B6. 1500 mg; B12, 10mg Pantothenic acid. 10 mg; Nicotinic acid. 30 mg; Folic acid, 1mg: Biotin, 50 mcg; Chloride, 500 mg; copper. 10 mg; iron, 50 mg; Manganese, 60 mg; Zinc. 50mg, and selenium. 0.1 mg.

Egg number, hen-day production, egg weight, egg mass, egg quality, feed consumption, feed conversion, mortality rate and economic return were recorded for both two laying hen strains during the experimental period (from 20 to 72 weeks of age).

Egg quality was measured three times: nearly at 50% egg production at the peak of egg production (at 36 weeks of age) and at the end of the experimental period (at 72 weeks of age). Egg quality was measured on the same day of collection (2 strains × 3 treatments × 3 replicates × 2 eggs × 3 successive days = 108 eggs)

Data were statistically analyzed using the following model.

$$Y_{ijk} = M + \alpha_i + \beta_{\beta j} + (\alpha\ \beta)_{ij} + e_{ijk}$$

where : Y_{ijk} = the observed value of the concerned trait ijk.

M = the overall mean for the concerned trait.

α_i = the fixed effect of i^{th} strain, (i= 1 … 2)

$\beta_{\beta j}$ = the fixed effect of j^{th} treatment. (restriction level, j= 1…3)

$(\alpha \beta)_{ij}$ = the effect of interaction between i^{th} strain and j^{th}. treatment

e_{ijk} = random error.

Significant differences among treatments were performed using Turkey's HSD procedure (The Honestly Significantly Different test) at 5% level (Martin, 1995)

RESULTS AND DISCUSSION

Cumulative egg number:

Averages of cumulative egg number during all productive periods as affected by feed restriction and strain are shown in Tbles (2). Feed restriction has insignificant ($P \geq 0.05$)effect on both egg number and cumulative egg number during all productive periods. Laying hens fasted about 4 hours/day produced numerically higher cumulative egg number during the first laying periods (from 1 to 7 laying periods) than those fed *adlibitum* or those fasted 8 hours/ days. However, laying hens fasted about 8 hours/ day produced insignificantly ($P \geq 0.05$) higher cumulative egg number during laying period from 8 to 13. the insignificant effect of feed restriction on cumulative egg number, in spite of it's negative effect on feed intake table (6), may be due the higher efficiency of feed utilization with limiting eating tine table (7). The results obtained are in partial agreement with those reported by Mc Daniel and Brake, 1981: Hocking et al., 1989; Robinson et al., 1991 and Yu et al., 1992, who showed that, ad-libitum feeding during egg production reduced egg number. Hi-sex Brown strain produced higher ($P<0.05$) cumulative egg number than Bovans white strain during all productive periods. The superiority of Hi-sex Brown strain over Bovans white strain in cumulative egg number represented about 28.05% at the end of the production period which lasted 52 weeks. The difference in cumulative egg number between both strains could be attributed to their genetic variations. These results are in accordance with those reported by Renema et al., 2001; Anderson, 2002 and Vits et al., 2005, who found that, egg production of brown strain was higher than that of white strain.

Cumulative hen-day production:

Feed restriction had insignificant ($P \geq 0.05$)effect on cumulative hen-day production table(3), allover the experimental periods (from 20 to 72 weeks of age). The cumulative hen-day production fluctuated between 74.02 to 75.92%

at the end of laying period (table 3). The insignificant effect of feed restriction on cumulative hen-day production may be due to the fact that, feed restriction was not severe enough to affect egg number table, (2) and mortality rate table (11). These results are in accordance with those found by Mbugua and Cunningham (1983), Bartov et al., 1988, and Felts, 1993, who indicated that feed restriction had no adverse effect on hen-day production.

Hi-sex Brown strain was superior ($P<0.05$) in cumulative hen-day production than Bovans white strain table(3) during all laying periods from 1 to 13 laying periods). At the end of laying period, Hisex Brown strain achieved higher cumulative hen-day production by about 18.44% than Bovans white strain table (3).. The superiority of Hi-sex Brown strain over Bovans white strain in hen-day production was attributed to it's higher ($P<0.05$) cumulative egg number table (2) during production periods (from 20 to 72 weeks of age). These results are in accordance with those recorded by Renema et al., (2001) who indicated that, egg Brown strains (ISA- Brown and Shaver, 579) recorded higher ($P<0.05$) hen-day production than white egg strains (ISA- White and Shaver, 2000). Also, Anderson (2002) and Silversides et al., (2006), showed higher, hen-day production of brown strains than that of white strains. Therefore, it can be concluded that the differences in egg production do exist between different strains of brown and white laying hens and the brown egg hens perform better than white hens.

Egg Weight:

Feed restriction had insignificant effect on egg weight at various productive periods table (4). Also, the interaction between feed restriction and strain had insignificant effect on egg weight during all productive periods except at the 3rd productive period. The overall mean of egg weight were 60.48, 60.10 and 60.21g. for laying hens fed *adlibitum*, 4 or 8 hours / day respectively. Bovans white strain fasted 4 or 8 hours/day produced lighter eggs ($P<0.05$) than those fed adlibitum only at the 3rd productive periods (58.87 or 58.64 vs. 59.39 g.). the results obtained are in agreement with those reported by Georzen et al., (1996) and Sandoval and Gernat (1996) who indicated that, feed restriction during laying period had insignificant effect in egg weight.

Hi-sex Brown strain produced heavier ($P<0.01$) eggs than Bovans white strain at the 3rd and 6th laying period table (4). Generally, Hi-sex Brown hens produced insignificantly heavier eggs than Bovans white hens in most laying periods. Averages of egg weight produced by Hi-sex Brown and Bovans white strains were 60.32 and 60.22 g. respectively during overall laying periods. The average egg weight of both strains were higher in the late laying periods (from 7-13 laying periods) than in the early laying periods (from 1-6 laying periods). These results are partially agree with those recorded by Anderson (2002), who found that, brown hens produced heavier eggs than white ones (61.1 vs 58.3 g.) Also, Rizzi and Chiericato (2005) showed that, the egg weights of Hy-line Brown strain were higher ($P<0.01$) than that of Hy-line white from 24 to 43 weeks of age and the egg weight increased ($p< 0.01$) as the hens age increased . Moreover, Silversides et al., (2006) reported that ISA-brown hens produced heavier eggs than Babcock hens from 19 to 74 weeks of age.

Cumulative egg mass :

Cumulative egg mass was not significantly affected by limiting eating time during all laying period table(5). Laying hens fed *adlibitum,* fasted about 4 or 8 hours/day produced 17.40, 16.97 and 17.58 kg. egg mass respectively at the end of the experimental period (after 52 weeks laying period). The insignificant effect of feed restriction on cumulative egg mass was due to the similarity table (2) and egg weight table (4) for different treatment. Also, the effect of interaction between strain and feed restriction on cumulative egg mass was negligible. These results are in accordance with those reported by Nofal and Hassan (2004) who reported insignificant effect of feed restriction on egg mass during the first production year of Mamourah laying hens.

Hi-sex Brown strain produced higher ($P<0.05$) egg mas and cumulative egg mass tables (5) compared to Bovans white strain during all laying periods (from 1 to 13 laying periods). The superiority of Hi-sex Brown strain over Bovans white strain in cumulative egg mass after 13 laying period (end of the experimental period) represented about 27.71%. this superiority was mainly due to the higher ($P<0.05$) cumulative egg numbers produced by Hi-sex Brown strain compared to Bovans white strain table (2). These results are in agreement with those found by Grobas et al., (2001) who found that, egg mass produced by ISA-Brown was more than that from Also, Badawe et al., (2005) found that, Brown Hy-line strain produced higher egg mass than white Hy-line strain. Moreover, Wu et al. (2007) found significant differences in egg mass among eight leghorn strains during 16 weeks of production.

Cumulative feed consumption:

The results presented in table (6) indicated that, laying hens fasted 8 hours/day consumed cumulative feed ($P<0.05$) than those fed adlibitum at the 2^{nd} laying period, while those fasted for about 4 hours / day consumed intermediate amount of feed. At the 3rd laying period, birds fasted about 8 hours/day recorded the lowest feed intake (P<0.05) followed by those fasted for about 4 hours/day. During the laying periods from 4 to 13, birds fasted for about 4 to hours/day recorded lower (P<0.05) cumulative feed intake compared to those fed adlibitum. Increasing fasting time from 4 up to 8 hours/day had no more significant decreasing effect on cumulative feed intake during the previous mentioned periods. Also, there were no significant effect of the interaction between feed restriction and strain on cumulative feed intake allover laying periods from the previous mentioned results it could be concluded that, fasting laying hens for about 4 or 8 hours/day during laying period (52 weeks) decreased (p< 0.05) cumulative feed intake by about 7.69 or 11.40% respectively compared to those fed *adlibitum* without no successive significant decrease in cumulative feed intake with increasing the time of feed deprivation from 4 to 8 hours/day. These results are in agreement with those recorded by Cumingham (1984) who found that, controlled feeding programs initiated after peak egg production resulted in significant reductions in total feed usage compared to full fed white leghorn layers. Also, Hocking et al. (2002) indicated that, feed restriction decreased the average daily feed consumption in broiler breeder jemales during early lay of egg production (from 24 to 37 weeks of age). Moreover Nofal and Hassan (2004) showed that, feed restriction decreased (p< 0.01) feed intake by Mamourah laying hens during the first production year.

Hi-sex Brown strain consumed higher (P<0.05) cumulative feed than Bovans white strain at all production periods... At the end of the productive period. Hi-sex Brown strain consumed 15.29% higher cumulative feed than Bovans white strain table(6).

These results are in agreement with finding of by Mbugua and Cunningham (1983). Badawe et al.. (2005) and Al-Nasser et al.. (2006) who showed that, feed consumption of Brown egg strains were higher than that of white egg strains.

As previously mentioned Hi-sex Brown strain produced higher egg number table(2) and egg mass table (5) compared to Bovans white strain and this required more feed intake to meet the nutrients required for such productivity.

Cumulative feed conversion :

laying hens fasted for about 4 or 8 hours/day had better (P<0.05) cumulative feed conversion ratio from 3 to 7 laying periods compared to those fed *adlibitum* Table (7). At 8 and 9 laying periods, only birds fasted for about 8 hours/day showed better (p< 0.05) cumulative feed conversion ratio than those fed *adlibitum*. However, birds fasted about 4 hours/day had intermediate cumulative feed conversion ratio. The improvements in cumulative feed conversion with limiting eating time could be attributed to the lower cumulative feed intake Table (6) without no change in cumulative egg mass table (5). From these results, it could be noticed that, limiting eating time improved (P<0.05) feed utilization during early laying period (from 8-7 laying periods) but this improvement effects was progressively decreased as birds aged (from 1-9 laying periods) and became insignificant during the late laying period (from 1-13 laying periods). This improvement in cumulative feed conversion ratio resulted from fasting laying hens 4 or 8 hours/day represented 9.39% and 14.08%. 7.06% and 13.01% and 4.03% and 11.72% during the previous mentioned laying periods respectively compared to those fed *adlibitum*. These results agree with the results reported by Nofal and Hassan (2004) who showed that feed restricted laying hens had insignificantly better feed conversion ratio than those fed *adlibitum*. However Hasnath (2002) found significant improvement (P<0.05) in feed conversion ratio as a result of restricted feeding (80% of adlibitum) in Fayoumi laying hens.

The results outlined in Table (7) revealed that Hi-sex Brown strain recorded better (P<0.05) cumulative feed conversion ration than Bovans white strain only at 12 and 13 productive periods. The little effect of strain on feed conversion ratio in spite of its significant effect on both egg mass Tables (5) and feed intake Tables(6) could be attributed to the fact that, as feed intake increased, egg mass also increased with the same level and vice versa. These results agree with the results outlined by Grabas et al., (2001) which reported that. ISA- Brown hens had better feed efficiency than Dekalb white strain. Also, Al-Nasser et al., (2006) found that, feed efficiency of for Brown egg strain was better than that for white egg strain.

Effect of feed restriction

Egg shape index:

Feed restriction had significant effect (P<0.05) on egg shape index only at the first stage of egg production Table (8), latter on it's effect become insignificant table (9 and 10). Laying hens fasted for about 4 hours/day laid rounder (P<0.05) eggs compared to those fasted 8 hours/day at the first stage of egg production. However, laying hens fed adlibitum laid eggs with intermediate shape index Data presented inTables (8, 9and 10) indicated that, feed restriction had no significant($p \geq 0.05$) effect on both shell strength and shell thickness. Averages of shell strength and shell thickness measured at different stages of egg production were within the normal ranges and feed restriction not deteriorated their qualityFeed restriction had significant effect (P<0.01) on shell percentage only at the first stage of egg production Table (8). Laying hens fasted 8 hours/day laid eggs with higher (P<0.05) shell percentage than those fed *adlibitum* or those fasted 4 hours/day at the first laying stage. Averages of yolk index and yolk color presented in Tables (8, 9 and 10) indicated that, feed restriction had no deleterious effect on yolk quality and the values were within the normal ranges Feed restriction had insignificant effect on Haugh Units measured at different stages of egg production and the values of Haugh Units were within the normal range Tables(8, 9 and 10). From these results, it could be concluded that, feed restriction through limiting eating time down to 16 hours/day during laying period had no pronounced effect on egg quality.

Egg quality based on yolk index, Haugh Units and shell strength was deteriorated with advancing age of birds. Albumin percentage decreased while yolk percentage increased with successive age of laying hens. However, shell percentage and shell hickness decreased with advancing age of laying hens up to the peak of egg production and remained constant later till the end of the experiment. These results agree with those reported by Hasnath (2002) who insignificant differences in egg shape index, egg shell thickness, albumen index, yolk index and Haugh Units between laying hens fed *adlibitum* and 80% of adlibitum. Also, Crouch et al., (2002) reported insignificant differences in shell percentage and shell thickness among feed restricted treatments and adlibitum control treatment in white turkey breeder hens.

Effect of strain

Strain had significant effect (p< 0.05) on egg shape index only at the latter stage of egg production Table (10). At the first and mid stages of egg production both Hi-sex Brown and Bovans white strains laid eggs with similar shape indexTables(8 and 9). However, Hi-sex Brown strain laid rounder eggs (P<0.05) compared to Bovans white strain (76.94% vs 74.13%) at the latter stage of egg productionHi-sex Brown strain laid eggs with higher (p< 0.05) shell thickness (37.7 vs 35.8 mm) but lower (p< 0.05) shell strength (2.65 vs 3.19 Wewton) compared to Bovans white strain at mid and latter stages of egg production respectively tables(9 and 10).Bovans white strain had higher (P<0.05) egg shell percentage compared to Hi-sex Brown strain (14.24% vs 13.45%) only during the first stage of egg production table (8).Hi-sex Brown strain recorded better values (P<0.05) of yolk index at the first (50.41 vs 45.79%) and mid (44.76% vs 41.98%) stages of egg production compared to Bovans white strain Tables(8 and 9). Also, Hi-sex Brown strain laid eggs with better (P<0.05) yolk color at the peak and at the end of egg production stages compared tp

Bovans white strain Tables (9 and 10 Hi-sex Brown strain recorded higher (P<0.05) Haugh Units values than Bovans white Bovans white strain at the first (89.73 vs 87.20) and mid (82.73 vs 75.08) stages of egg production Tables (8 and 9). However the effect of strain on Haugh Units became insignificant (P≥0.05)at the latter stage of egg production table (10).

From these results, it could be concluded that, the effect of strain on egg quality was evident and Hi-sex Brown strain was superior in egg quality compared to Bovans white strain based on the values of yolk index and Haugh Units at the first and mid stages of egg production, shell thickness at the mid stage and yolk color at the mid and latter stages of egg production. These results are partially agree with Leeson et al., (1997) who found significant (P<0.01) difference in egg hell quality among Babcock, Dekalb, H&W, and Shaver strains. Scott and Silversides (2000) found that, eggs produced by ISA-Brown hens had more shell and albumin than those from ISA-White hens, but less yolk. Also Badawe et al., (2005) noticed that, the albumin weight percentage of Brown Hy-line strains was significantly higher (P<0.01) than that of white Hy-line strain at 24 weeks of age. Moreover, the shape index of brown eggs was significantly higher than white eggs. However the effect of strain on yolk percentage and shell thickeness was insignificant. Hassanein and Toson (2005) found that, Hi-sex Brown eggs were superior in shape index, shell percentage, yolk index and albumin percentage than those recorded for Bovans white eggs at 26 weeks of age However, Bovans white eggs were higher in shell strength and yolk percentage than that of Hi-sex Brown eggs. Moreover, Rizzi and Chiericato (2005) showed that, the Haugh Units decreased (P<0.01) with age and the deterioration rate was more pronounced in the eggs produced by Hy-line Brown laying hens than that produced by Hy-line white strain.

Economical efficiency and mortality rate:

Feed restriction had highly significant effect (P<0.01) on total feed consumption and total feed costs, while total egg number, total egg price and the net revenue/hen were not significantly affected by feed restriction Table (11) Total feed cost (L.E./hen) was decreased (P<0.05) by feed restriction during laying period. The reduction in feed cost represented about 7.68% and 11.93% for laying hens fasted about 4 and/or 8 hours/day respectively compared to those fed *adlibitum* during the entire laying period. Increasing fasting period more than 4 hours/day insignificantly decreased total feed cost (L.E./hen) during the production period of laying hens. The reduction in total feed cost (L.E./hen) by feed restriction was a result of the negative effect of feed restriction on total feed consumption or previously mentioned. Total egg price (L.E./hen) was insignificantly affected by feed restriction. This could be attributed to the fact that, feed restriction had no significant effect on total egg number/hen during laying period. Also, the net revenue (LE)/hen) was insignificantly improved by increasing fasting period and the improvement represented about 23.28% and 49.36 for laying hens fasted 4 and 8 hours/day, respectively compared to those fed *adlibitum* during the entire laying period. The insignificant effect of feed restriction on net revenue (LE/hen) in spite of its higher effect ($p<0.001$) on feed intake and feed cost could be attributed to the higher variation among replicates withing feed restricted treatments. These results are partially agree with Mbugua and Cunningham (1983) who found that, net egg income over feed cost was significantly improved by quantative feed restriction. Also, Cunningham (1984) stated that, egg incomes over feed costs favored all controlled feeding programs initiated after peak egg production in White Leghorm layers. They demonstrated that, maximum production level do not always mean maximum returns. Olawuni et al., (1989) reported that, restricted feeding resulted in increased monetary returns compared to full feeding because the mortality was less in restricted feeding group. Tottori et al., (1997) found that economic performance was better with restricted feeding than that with full feeding as a result of improvements in viability and feed conversion ratio. Hasnath (2002) reported that, feed restriction of Fayoumi laying hens economically reduced the cost of production.

Mortality rate was progressively decreased with increasing fasting period Table (11) and it was 13.09%, 6.55% and 4.17 for laying hens fed adlibitum, fasted 4 and/or 8 hours/ day respectively during the entire laying period.

Robinson and Sheridan (1982) reported that, all restriction regimes during rearing period tended to reduce mortality rate in the laying period. Hocking et al., (2002) stated that, conventional feed restriction decreased mortality rate in broiler breeder females compared to adlibitum feeding after the peak rate of lay. *Adlibitum* feeding post-peak was associated with higher rates of mortality to 60 weeks of age. However, Hasnath (2002) reported that, mortality of Fayoumi laying hens was not significant between adlibitum and 80% of adlibitum restricted feeding regimen. Strain had significant effect ($P<0.01$) on total feed cost, total egg price, net revenue and economical efficiency at the end of the experimental period (after 364 days laying period table (11). Hi-sex Brown strain achieved higher ($p< 0.01$) net revenue/hen over feed cost than Bovans white strain at the end of the experimental period (27.05 vs 15.52 LE). This superiority (42.62%) could be attributed to the better ($P<0.05$) feed conversion Table (7), the higher

(P<0.05) total egg number/hen. and hence to the total egg price produced by Hi-sex Brown strain compared to Bovans white strain Table (11).Luiting (1990) reported that feed expenses are the main cost in egg production. Flock (1998) reported that, the breeding goal for commercial layer is maximum egg income over feed cost, not minimum feed consumption. Mortality rate was higher for Bovans white strain than Hi-sex Brown strain Table(11). El-Sagheer and Hassanein (2006) found that, Bovan Brown strain had higher mortality rate than Hi-sex Brown strain during the period from 20 to 68 weeks of age.

Table (2): Averages ± (SE) of cumulative egg number at different period as affected by feed restriction and strain.

Classification	Productive periods (4 weeks/period)												
	0-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10	1-11	1-12	1-13
Treatment (A):	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	15.53	38.82	63.31	88.84	109.23	132.14	154.21	177.80	199.71	219.17	237.20	256.15	272.73
	±1.13	±2.61	±3.69	±4.49	±5.26	±5.56	±6.69	±7.63	±9.04	±10.32	±11.81	±13.36	±14.17
4 hours fasting	15.93	41.10	66.28	91.75	111.81	134.21	156.09	178.12	198.63	216.88	234.88	252.99	269.44
	±0.99	±1.72	±2.25	±2.75	±3.37	±4.97	±7.04	±9.28	±12.07	±14.58	±17.00	±19.34	±21.18
8 hours fasting	14.53	37.87	63.44	88.51	109.97	132.28	155.47	179.12	200.84	221.25	241.05	259.14	276.35
	±1.60	±1.58	±1.35	±1.33	±2.22	±3.23	±4.18	±5.57	±7.81	±10.38	±12.83	±15.27	±17.43
Strain (B):	*	*	**	**	**	**	**	**	**	**	**	**	**
Hisex Brown (HB)	16.84^{a}	42.08^{a}	68.09^{a}	94.41^{a}	116.8^{a}	142.15^{a}	167.55^{a}	193.31^{a}	218.47^{a}	241.79^{a}	264.42^{a}	286.76^{a}	306.41^{a}
	±1.03	±1.37	±1.39	±1.59	±1.33	±1.31	±1.42	±1.59	±1.91	±2.36	±2.59	±3.04	±3.17
Bovans White (BV)	13.82^{b}	36.45^{b}	60.59^{b}	84.98^{b}	103.79^{b}	123.60^{b}	142.96^{b}	163.38^{b}	180.98^{b}	196.41^{b}	211.00^{b}	225.43^{b}	239.28^{b}
	±0.68	±1.32	±1.89	±2.18	±2.47	±2.12	±2.63	±3.82	±5.37	±6.65	±7.98	±9.20	±10.37
Interaction (AxB)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	17.52	43.14	69.52	96.67	118.28	142.90	168.33	194.09	219.19	241.33	262.76^{a}±	285.14^{a}±	303.48
	±0.54	±2.18	±2.32	±2.29	±2.24	±2.42	±2.35	±2.70	±3.71	±4.77	4.15	3.51	±1.90
(HB) 4 hours fasting	17.52	44.28	70.09	96.19	118.23	144.23	169.95	195.37	220.56	244.18	267.23^{a}±	290.04^{a}±	310.56
	±0.96	±1.31	±2.15	±3.04	±2.71	±2.50	±2.90	±3.78	±4.34	±5.45	6.35	7.43	±7.47
8hours fasting	15.48	38.81	64.66	90.38	114.14	139.33	164.38	190.47	215.66	239.85	263.28^{a}±	285.09^{a}±	305.18
	±3.17	±2.76	±2.07	±1.87	±1.79	±1.48	±1.39	±1.55	±2.19	±3.14	4.15	5.95	±6.91
Control	13.54	34.50	57.09^{b}	81.01	100.17	121.38	140.09	161.51	180.22	197.02	211.64	227.15	241.98
	±1.46	±3.27	±4.91	±5.87	±7.16	±5.75	±4.31	±4.27	±3.92	±4.31	±5.16	±6.26	±7.40
(BV) 4 hours fasting	14.34	37.92	62.47^{ab}	87.30	105.39	124.19	142.23	160.86	176.6	189.57	202.53	215.95	228.33
	±1.19	±1.73	±2.47	±2.99	±2.87	±4.08	±6.90	±10.86	±15.10	±16.95	±18.95	±21.04	±22.28
8hours fasting	13.59	36.92	62.22^{ab}	86.64	105.8	125.22	146.56	167.77	186.02	202.65	218.81	233.19	247.52
	±1.33	±2.00	±1.81	±1.35	±2.02	±0.39	±2.49	±4.90	±8.96	±13.51	±17.66	±21.39	±25.31

Means in the same classification within each column have not the same letters are significantly differed (P<0.05).

Table (3): Averages ± (SE) of cumulative hen-day production (%) at different periods as affected by feed restriction and strain.

Classification	Productive periods (4weeks/period)												
	0-1	**1-2**	**1-3**	**1-4**	**1-5**	**1-6**	**1-7**	**1-8**	**1-9**	**1-10**	**1-11**	**1-12**	**1-13**
Treatment (A):	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	55.48	69.33	75.37	79.32	78.02	78.66	78.68	79.38	79.25	78.28	77.01	76.23	74.93
	±4.03	± 4.66	±4.40	±4.01	±3.76	±3.31	±3.41	±3.41	±3.59	±3.68	±3.83	±3.98	±3.89
4 hours fasting	56.89	73.4	78.91	81.92	79.87	79.89	79.64	79.52	78.82	77.46	76.26	75.30	74.02
	±3.53	± 3.08	±2.68	±2.46	±2.41	±2.96	±3.59	±4.14	±4.79	±5.21	±5.52	±5.76	±5.82
8 hours fasting	51.90	67.62	75.53	79.03	78.55	78.74	79.32	79.97	79.70	79.02	78.26	77.13	75.92
	±5.70	±2.82	±1.60	±1.18	±1.59	±1.92	±2.13	±2.49	±3.10	±3.71	±4.17	±4.54	±4.79
Strain (B):	*	*	**	**	**	**	**	**	**	**	**	**	**
Hisex Brown (HB)	60.15^{a}	75.14^{a}	81.06^{a}	84.30^{a}	83.49^{a}	84.62^{a}	85.49^{a}	86.30^{a}	86.69^{a}	86.35^{a}	85.85^{a}	85.34^{a}	84.18^{a}
	±3.67	± 2.44	±1.66	±1.42	±0.95	±0.78	±0.72	±0.71	±0.76	±0.84	±0.84	±0.91	±0.87
Bovans White (BV	49.36^{b}	65.09^{b}	72.13^{b}	75.88^{b}	74.13^{b}	73.57^{b}	72.94^{b}	72.94^{b}	71.82^{b}	70.15^{b}	68.51^{b}	67.09^{b}	65.74^{b}
	±2.42	± 2.35	±2.25	±1.95	±1.77	±1.26	±1.34	±1.70	±2.13	±2.38	±2.59	±2.74	±2.85
Interaction (AxB)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	62.58	77.04	82.77	86.31	84.49	85.06	85.88	86.65	86.98	86.19	85.31	84.86	83.38
	±1.92	±3.90	±2.77	±2.04	±1.60	±1.44	±1.20	±1.21	±1.47	±1.70	±1.35	±1.05	±0.52
(HB) 4 hours fasting	62.58	79.08	83.45	85.88	84.45	85.86	86.71	87.22	87.52	87.21	86.76	86.32	85.32
	±3.42	±2.34	±2.56	±2.71	±1.93	±1.49	±1.48	±1.69	±1.72	±1.95	±2.06	±2.21	±2.05
8 hours fasting	55.27	69.3	76.98	80.69^{a}	81.53	82.94	83.87	85.03	85.58	85.66	85.48	84.85	83.84
	±11.34	±4.94	±2.47	±1.67	±1.28	±0.88	±0.71	±0.69	±0.87	±1.12	±1.35	±1.77	±1.90
Control	48.37	61.61	67.96	72.33	71.55	72.25	71.48	72.10	71.52	70.36	68.71	67.60	66.48
	±5.21	±5.84	±5.84	±5.24	±5.11	±3.42	±2.20	±1.90	±1.56	±1.54	±1.67	±1.86	±2.03
(BV) 4 hours fasting	51.20	67.72	74.37	77.95	75.28	73.92	72.57	71.81	70.12	67.70	65.76	64.27	62.73
	±4.27	±3.09	±2.94	±2.67	±2.05	±2.43	±3.52	±4.85	±5.99	±6.05	±6.15	±6.26	±6.12
8 hours fasting	48.52	65.93	74.07	77.36	75.57	74.54	74.78	74.90	73.82	72.37	71.04	69.40	68.00
	±4.77	±3.57	±2.16	±1.20	±1.44	±0.24	±1.27	±2.19	±3.55	±4.82	±5.73	±6.36	±6.95

Means in the same classification within each column have not the same letters are significantly differed (P<0.05).

Table (4): Averages ± (SE) of egg weight (g) at different periods as affected by restriction and strain.

Classification	Productive periods (4 weeks/period)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Treatment (A):	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	50.58 ±0.41	55.13 ±0.11	59.36 ±0.11	60.31 ±0.11	58.13 ±0.36	56.67 ±0.24	61.98 ±0.29	63.14 ±0.27	63.89 ±0.24	64.04 ±0.42	64.31 ±0.37	64.89 ±0.51	63.86 ±0.37
4 hours fasting	50.85 ±0.29	54.80 ±0.33	59.16 ±0.15	60.28 ±0.10	57.92 ±0.24	56.06 ±0.27	61.95 ±0.28	63.09 ±0.31	63.07 ±0.41	63.49 ±0.37	63.98 ±0.37	63.72 ±0.36	62.92 ±0.31
8 hours fasting	50.18 ±0.31	54.09 ±0.45	59.10 ±0.22	59.83 ±0.45	58.26 ±0.51	56.23 ±0.42	61.41 ±0.68	62.92 ±0.52	63.60 ±0.43	64.01 ±0.61	65.01 ±0.63	64.41 ±0.30	63.67 ±0.38
Strain (B):	NS	NS	**	NS	NS	**	NS	NS	NS	NS	NS	NS	NS
Hisex Brown (HB)	50.63 ±0.33	54.62 ±0.38	59.44^{a} ±0.08	60.42 ±0.18	58.34 ±0.33	56.80^{a} ±0.15	61.94 ±0.43	63.28 ±0.32	63.60 ±0.30	63.40 ±0.18	64.10 ±0.27	64.13 ±0.18	63.41 ±0.21
Bovans White (BV)	50.45 ±0.23	54.85 ±0.21	58.97^{b} ±0.14	59.86 ±0.24	57.87 ±0.26	55.84^{b} ±0.25	61.61 ±0.29	62.81 ±0.26	63.44 ±0.32	64.29 ±0.47	64.77 ±0.48	64.55 ±0.46	63.55 ±0.39
Interaction (AxB)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	51.26 ±0.58	55.34 ±0.14	59.32 ±0.06	60.40 ±0.03	57.86 ±0.52	56.90 ±0.31	61.75 ±0.52	63.28 ±0.45	63.64 ±0.34	63.42 ±0.20	64.11 ±0.21	64.31 ±0.32	63.42 ±0.25
(HB) 4 hours fasting	50.81 ±0.44	55.06 ±0.33	59.44 ±0.17	60.31 ±0.18	57.97 ±0.53	56.57 ±0.18	61.95 ±0.53	62.94 ±0.48	63.18 ±0.52	63.17 ±0.37	63.63 ±0.38	63.85 ±0.30	63.37 ±0.26
8 hours fasting	49.82 ±0.47	53.46 ±0.74	59.56 ±0.15	60.55 ±0.57	59.20 ±0.42	56.94 ±0.33	62.13 ±1.29	63.62 ±0.84	63.97 ±0.75	63.61 ±0.38	64.57 ±0.67	64.24 ±0.36	63.45 ±0.63
Control	49.91 ±0.19	54.92 ±0.03	59.39 ±0.25	60.22 ±0.23	58.39 ±0.57	56.45 ±0.38	62.20 ±0.30	62.99 ±0.38	64.14 ±0.33	64.65 ±0.69	64.51 ±0.78	65.47^{a} ±0.93	64.30 ±0.64
(BV) 4 hours fasting	50.90 ±0.47	54.89 ±0.66	58.87 ±0.09	60.26 ±0.11	57.88 ±0.06	55.55 ±0.24	61.95 ±0.34	63.23 ±0.46	62.95 ±0.75	63.81 ±0.68	64.33 ±0.71	63.59^{b} ±0.74	62.46 ±0.46
8 hours fasting	50.54 ±0.36	54.73 ±0.28	58.64 ±0.11	59.11 ±0.41	57.33 ±0.49	55.52 ±0.51	60.68 ±0.40	62.22 ±0.41	63.23 ±0.46	64.41 ±1.24	65.45 ±1.16	64.58^{a} ±0.53	63.89 ±0.51

Means in the same classification within each column have not the same letters are significantly differed (P<0.05).

Table (5): Averages ± (SE) of cumulative egg mass (g) as affected by feed restriction and strain.

Classification	Productive periods (4 weeks/period)												
	0-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10	1-11	1-12	1-13
Treatment (A):	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	787 ±62	2141 146±	3757 ±217	5358 ±270	6344 ±286	7490 ±323	9555 ±408	11225 ±484	12753 ±549	14018 ±590	15246 ±732	16599 ±785	17401 ±851
4 hours fasting	810 51±	2259 ±92	3922 ±142	5531 ±167	6478 ±209	7530 ±312	9669 ±439	1121 ±601	12537 ±796	13769 ±925	15023 ±1074	16129 ±1257	16974 ±1387
8 hours fasting	728 ±77	2048 ±84	3749 ±84	5296 ±102	6411 ±172	7443 ±223	9552 ±311	11276 ±398	12774 ±513	14141 ±591	15643 ±751	16675 ±940	17584 ±1082
Strain (B):	*	*	**	**	**	**	**	**	**	**	**	**	**
Hisex Brown (HB)	853^{a} ±53	2300^{a} ±82.9	4047^{a} ±82	5704^{a} ±93	681^{a} ±74	807^{a} ±80	1037^{a} ±121	1223^{a} ±104	1389^{a} ±107	1532^{a} ±143	1694^{a} ±140	18387^{a} ±156	19427^{a} ±181
Bovans White (BV)	697^{b} ±34	1998^{b} ±69	3572^{b} ±107	5086^{b} ±127	600^{b} ±136	690^{b} ±112	8805^{b} ±146	1026^{b} ±247	1118^{b} ±358	1262^{b} ±418	1366^{b} ±510	14548^{b} ±593	15212^{b} ±681
Interaction (AxB)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	899 ±38	2387 ±118	4124 ±139	5839 ±139	684 ±94	813 ±181	1039 ±230	12280 ±91	13948 ±173	15304 ±258	16847 ±301	18336 ±141	19245 ±83
(HB) 4 hours fasting	891 ±56	2438 ± 74	4167 ±139	5801 ±189	685^{a} ±218	816 ±164	1053 ±252	12301 ±322	13935 ±310	15428 ±400	17001 ±347	18515^{a} ±428	19681 ±494
8 hours fasting	768 ±153	2075 ±156.6	3851 ±117	5471 ±90	675 ±77	793 ±42	1021 ±182	12115 ±86	13792^{a} ±51	15255^{a} ±116	16994 ±133	18310^{a} ±279	19356 ±303
Control	676 ±72	1895 ±181	3389 ±283	4876 ±335	5845 ±390	6847 ±280	8714 ±270	10171 ±227	11558 ±216	12731 ±141	13646 ±175	148601 ±203	15558 ±463
(BV) 4 hours fasting	729 ±55	2079 ±70	3677 ±146	5261 ±177	6100 ±165	6900 ±251	8808 ±399	10181 ±762	11139 ±1056	12110 ±1169	13044 ±1315	13743 ±1421	14266 ±1431
8 hours fasting	687 ±68	2020 ±101	3648 ±106	5122 ±115	6067 ±154	6953 ±85	8893 ±130	10437 ±280	11757 ±526	13028 ±704	14291 ±988	15041 ±1290	15811 ±1619

Means in the same classification have not the same letters are significantly differed ($P<0.05$).

Table (6): Averages ± (SE) of cumulative feed consumption (g/hen/period) at different periods as affected by feed restriction and strain.

Classification	Productive periods (4 weeks/period)												
	0-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10	1-11	1-12	1-13
Treatment (A):	NS	**	*	**	**	**	**	**	**	**	**	**	**
Control	2838	6367^{a}	9929^{a}	13502^{a}	17244^{a}	21139^{a}	24819^{a}	28346^{a}	31802^{a}	35198^{a}	38591^{a}	41748^{a}	44918^{a}
	±159	±240	±371	±527	±627	±649	±881	±1036	±1142	±1312	±1381	±1481	±1550
4 hours fasting	2776	5837^{ab}	8883^{b}	12089^{b}	15507^{b}	19336^{b}	22710^{b}	25878^{b}	29007^{b}	32145^{b}	35475^{b}	38495^{b}	41463^{b}
	±142	±180	±262	±396	±499	±555	±687	±812	±929	±1073	±1144	±1251	±1286
8 hours fasting	2441	5307^{b}	8175^{c}	11420^{b}	14775^{b}	18395^{b}	21651^{b}	24785^{b}	27947^{b}	31060^{b}	34117^{b}	36960^{b}	39799^{b}
	±95	±136	±219	±408	±360	±440	±628	±821	±987	±1152	±1215	±1296	±1346
Strain (B):	*	**	*	*	*	**	**	**	**	**	**	**	**
Hisex Brown (HB)	2857^{a}	6116^{a}	9541^{a}	13191^{a}	16817^{a}	20703^{a}	24576^{a}	28207^{a}	31747^{a}	35323^{a}	38723^{a}	41938^{a}	45048^{a}
	±117	±208	±322	±404	±476	±501	±577	±641	±682	±744	±784	±835	±878
Bovans White (BV)	2513^{b}	5558^{b}	8450^{b}	11483^{b}	14866^{b}	18544^{b}	21544^{b}	24465^{b}	27423^{b}	30279^{b}	33399^{b}	36197^{b}	39072^{b}
	±96	±171	±241	±306	±354	±408	±459	±521	±581	±612	±668	±710	±761
Interaction (AxB)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	3069	6788	10702'	14634	18546	22478	26697	30563	34277	38062	41591	44962	48269
	±193	±172	±145	±215	±94	±193	±216	±342	±192	±339	±388	±360	±374
(HB) 4 hours fasting	2965	5996	9325	12731	16451	20380^{b}	24075	27551	30922	34399	37874	41131	44191
	±194	±308	±193	±378	±194	±266	±220	±233	±369	±403	±357	±457	±338
8 hours fasting	2536	5565	8596	12208	15454	19251^{b}	22956	26508^{b}	30041	33508^{b}	36703^{b}	39722	42685
	±97	±108	±198	±371	±421	±468	±460	±572	±639	±731	±769	±818	±802
Control	2607	5946	9155	12370	15941	19800	22942	26128	29327	32333	35591	38534	41567
	±188	±284	±266	±252	±511	±525	±555	±578	±601	±542	±617	±705	±805
(BV) 4 hours fasting	2587	5678	8441	11446	14563	18293	21344	24205	27092	29892	33075	35858	38735
	±163	±204	±332	±479	±560	±617	±668	±664	±717	±718	±815	±818	±842
8 hours fasting	2346	5049	7753	10631	14095	17539	20345	23062	25852	28612	31531	34198	36913
	±163	±122	±154	±268	±102	±131	±235	±279	±277	±329	±325	±319	±294

Means in the same classification within each column have not the same letters are significantly differed ($P<0.05$).

Table (7): Averages ± (SE) of cumulative feed conversion at different periods as affected by feed restriction and strain.

Classification	Productive periods (4 weeks/period)												
	0-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10	1-11	1-12	1-13
Treatment (A):	NS	NS	**	**	**	**	**	**	*	NS	NS	NS	NS
Control	3.66 ±0.20	3.13 ±0.21	2.85^{a} ±0.14	2.68^{a} ±0.10	2.78^{a} ±0.11	2.79^{a} ±0.08	2.77^{a} ±0.07	2.72^{a} ±0.06	2.69^{a} ±0.06	2.70 ±0.06	2.72 ±0.07	2.71 ±0.07	2.73 ±0.08
4 hours fasting	3.46 ±0.15	2.68 ±0.11	2.42^{b} ±0.06	2.32^{b} ±0.07	2.43^{b} ±0.05	2.51^{b} ±0.05	2.51^{b} ±0.06	2.49^{ab} ±0.08	2.50^{ab} ±0.11	2.53 ±0.13	2.57 ±0.15	2.59 ±0.16	2.62 ±0.17
8 hours fasting	3.54 ±0.38	2.69 ±0.12	2.34^{b} ±0.07	2.28^{b} ±0.07	2.36^{b} ±0.03	2.40^{b} ±0.03	2.38^{b} ±0.05	2.35^{b} ±0.06	2.34^{b} ±0.07	2.36 ±0.09	2.37 ±0.11	2.39 ±0.13	2.41 ±0.14
Strain (B):	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	*
Hisex Brown (HB)	3.45 ±0.24	2.76 ±0.10	2.53 ±0.08	2.46 ±0.07	2.52 ±0.07	2.51 ±0.06	2.50 ±0.06	2.46 ±0.06	2.43 ±0.05	2.43 ±0.06	2.42 ±0.06	2.41^{b} ±0.05	2.42^{b} ±0.05
Bovans White (BV)	3.65 ±0.17	2.91 ±0.17	2.54 ±0.13	2.40 ±0.10	2.53 ±0.10	2.62 ±0.08	2.61 ±0.08	2.57 ±0.09	2.59 ±0.10	2.62 ±0.11	2.68 ±0.12	2.71^{a} ±0.12	2.75^{a} ±0.13
Interaction (AxB)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	3.41 ±0.14	2.94 ±0.12	2.76 ±0.07	2.65 ± 0.05	2.74 ± 0.05	2.70 ±0.03	2.69 ±0.05	2.65 ±0.04	2.61 ±0.04	2.62 ±0.06	2.61 ±0.05	2.59 ±0.04	2.61 ±0.02
(HB) 4 hours fasting	3.35 ±0.32	2.55 ±0.19	2.40 ±0.13	2.34 ± 0.15	2.45 ± 0.10	2.45 ±0.10	2.43 ±0.09	2.39 ±0.08	2.36 ±0.09	2.36 ±0.08	2.36 ±0.08	2.35 ±0.08	2.35 ±0.08
8 hours fasting	3.59 ±0.73	2.79 ±0.17	2.42 ±0.09	2.39 ± 0.08	2.37 ± 0.06	2.38 ±0.06	2.39 ±0.06	2.35 ±0.06	2.33 ±0.06	2.32 ±0.05	2.30 ±0.04	2.29 ±0.02	2.29 ±0.02
Control	3.91 ±0.34	3.32 ±0.40	2.94 ±0.29	2.71 ± 0.21	2.81 ± 0.23	2.88 ±0.15	2.85 ±0.12	2.78 ±0.10	2.77 ±0.10	2.77 ±0.09	2.83 ±0.10	2.83 ±0.11	2.85 ±0.12
(BV) 4 hours fasting	3.56 ±0.05	2.81 ±0.09	2.44 ±0.06	2.30 ±0.04	2.42 ± 0.03	2.57^{b} ±0.03	2.60 ±0.07	2.59 ±0.14	2.64 ±0.19	2.70 ±0.22	2.79 ±0.24	2.83 ±0.26	2.88 ±0.26
8 hours fasting	3.48 ±0.44	2.59 ±0.18	2.25 ±0.08	2.18 ±0.07	2.35 ± 0.03	2.41 ±0.04	2.38 ±0.09	2.34 ±0.12	2.36 ±0.16	2.39 ±0.20	2.44 ±0.24	2.48 ±0.26	2.52 ±0.29

Means in the same classification within each column have not the same letters are significantly differed ($P<0.05$).

Table (8): Averages ± (SE) of egg quality at 50% of egg production as affected by feed restriction and strain.

Classification	Characters of egg quality									
	Average egg weight	Shape index %	Shell Strength (Newton)	Shell Thickness (mm)	Shell %	Albumin %	Yolk %	Yolk Index %	Yolk Color	Haugh Unit
Treatment (A):		*	NS	NS	**	NS	NS	NS	NS	NS
Control	53.79	77.48^{ab}±0.46	4.11± .12	0.397± .007	13.64^{b}±0.14	63.15±0.32	23.21±0.22	49.29±1.20	5.63±0.35	87.82±1.00
4 hours fasting	54.11	78.60^{a}±0.74	3.92±0.17	0.400± .008	13.71^{b}±0.23	62.78±0.58	23.51±0.40	48.42±0.94	5.83±0.38	88.45±1.19
8 hours fasting	53.42	74.78^{b}±1.36	3.79±0.14	0.403±0.008	14.18^{a}±0.22	62.07±0.77	23.75±0.81	46.57±1.47	6.40±0.15	89.13±0.78
Strain (B):		NS	NS	NS	**	NS	NS	**	NS	*
Hisex Brown (HB)	54.20	77.24±1.20	3.97± 0.12	0.402± .007	13.45^{b}±0.09	63.32±0.38	23.23±0.32	50.41^{a}±0.64	6.02±0.37	89.73^{a}±0.58
Bovans White (BV)	53.35	76.67±0.51	3.91± 0.12	0.398± .006	14.24^{a}±0.14	62.01±0.48	23.76±0.50	45.79^{b}±0.67	5.89±0.09	87.20^{b}±0.77
Interaction (AxB)		NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	53.93	77.95±0.72	4.13±0.24	0.402±0.015	13.37±0.09	63.79±0.16	22.84±0.21	51.84±0.57	5.50±0.77	89.60±0.53
(HB) 4 hours fasting	54.35	79.86 ±0.51	3.91±0.22	0.406±0.016	13.23±0.04	63.90 ±0.29	22.87±0.34	50.24±0.78	5.94±0.83	90.23±1.06
8 hours fasting	54.31	73.91 ±2.71	3.89±0.25	0.398±0.008	13.75±0.10	62.28±0.89	23.97±0.82	49.13±1.47	6.63±0.17	89.34±1.57
Control	53.64	77.01±0.55	4.08 ±0.10	0.391±0.001	13.91±0.14	62.50±0.28	23.59±0.26	46.74±0.63	5.77±0.05	86.04±1.23
(BV) 4 hours fasting	53.87	77.33 ±0.93	3.94±0.32	0.394±0.008	14.18 ±0.22	61.66±0.58	24.16±0.53	46.61±0.70	5.72±0.06	86.66±1.66
8 hours fasting	52.53	75.66 ±1.10	3.69±0.15	0.407±0.016	14.6 ±0.19	61.85±1.45	23.53±1.60	44.01±1.46	6.17±0.17	88.91±0.73

Means in the same classification within each column have not the same letters are significantly differed (P<0.05).

Table (9): Averages ± (SE) of egg quality at the peak of egg production as affected by feed restriction **and strain**.

Classification	Characters of egg quality									
	Average egg weight	Shape Index %	Shell Strength (Newton)	Shell Thickness (mm)	Shell %	Albumin %	Yolk %	Yolk Index %	Yolk Color	Haugh Unit
Treatment (A)		NS	NS	NS	NS	NS		NS	NS	NS
Control	59.42	78.14±0.90	3.18±0.13	0.372 ±0.007	12.48±0.21	62.11±0.46	25.42±0.34	43.72 ±0.63	5.14 ±0.30	76.36 ±3.06
4 hoursfasting	60.26	74.98±1.49	3.26±0.08	0.364 ±0.005	12.27±0.25	62.71±0.40	25.02±0.24	42.43 ±0.58	5.29 ±0.34	82.30 ±2.63
8 hours asting	60.62	75.69±1.55	3.03±0.24	0.368 ±0.010	12.17±0.29	61.74±0.54	26.09±0.54	43.97 ±1.32	5.43 ±0.28	78.06 ±2.46
Strain (B)		NS	NS	NS		NS		**	**	*
Hisex Brown (HB)	60.73	76.38±1.61	3.24±0.15	0.377^{a}±0.005	12.37±0.18	62.26±0.35	25.37±0.37	44.76^{a}±0.71	5.90 ±0.12	82.73^{a} ±1.68
Bovans White (BV)	59.48	76.16±0.36	3.08±0.11	0.358^{b}±0.005	12.24±0.22	62.11±0.44	25.65±0.31	41.98^{b}±0.40	4.67^{b}±0.12	75.08^{b} ±2.10
Interaction (AxB)		NS	NS	*	NS	NS	NS	*	NS	NS
Control	59.65	79.83±0.74	3.23±0.29	0.384 ±0.007	12.44±0.40	62.18±0.54	25.39±0.21	44.81^{ab}±0.59	5.78±0.15	82.28 ±2.97
(HB) 4 hours fasting	60.08	74.5 ±3.26	3.29±0.08	0.363^{a}±0.007	12.63±0.19	62.47±0.29	24.91±0.27	42.73^{b}±1.25	5.94±0.34	84.34±3.84
8 hours fasting	62.44	74.79±3.29	3.19±0.41	0.384 ±0.004	12.04±0.31	62.14±1.02	25.82±1.16	46.75^{a}±0.37	5.97±0.14	81.57^{a}±2.88
Control	59.20	76.45±0.82	3.13±0.05	0.359±0.005	12.52±0.23	62.04±0.86	25.45±0.73	42.63^{b}±0.68	4.50±0.17	70.44±1.74
(BV) 4 hours fasting	60.44	75.45±0.44	3.23±0.15	0.364^{ab}±0.008	11.91±0.38	62.96±0.81	25.14±0.46	42.13^{b}±0.24	4.63±0.19	80.26±3.97
8 hours fasting	58.80	76.59±0.57	2.88±0.31	0.351^{b}±0.013	12.3 ±0.56	61.3 ±0.50	26.3 ±0.19	41.18^{b}±0.93	4.88±0.25	74.55±3.12

Means in the same classification within each column have not the same letters are significantly differed ($P<0.05$).

Table (10): Averages ± (SE) of egg quality at the end of the experimental period as affected by feed restriction and strain.

Classification	Characters of egg quality									
	Average egg weight	Shape Index	Shell strength (Newton)	Shell thickness (mm)	Shell %	Albumin %	Yolk %	Yolk % Index	Yolk color	Haugh Unit
Treatment (A):		NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	65.92	73.55 ±2.00	2.89 ±0.26	0.386±0.009	12.70±0.61	58.54±1.34	28.76±0.74	37.42 ±1.40	6.60 ±0.16	72.96 ±2.41
4 hours fasting	65.42	76.88 ±0.72	3.05 ±0.17	0.367±0.010	12.84±0.43	58.36 ±1.28	28.81±0.99	41.76 ±2.96	6.65 ±0.27	66.00 ±5.30
8 hours fasting	65.89	76.18 ±0.45	2.83 ±0.19	0.372±0.008	12.66±0.60	59.13 ±0.50	28.21±0.49	37.28 ±1.30	6.72 ±0.10	69.52 ±2.15
Strain (B):		*	*	NS	NS	NS	NS	NS	*	NS
Hisex Brown (HB)	64.93	76.94^{a}±0.46	2.65^{b}±0.13	0.373±0.006	12.52±0.37	58.49 ±0.76	29.00±0.47	40.18 ±2.20	6.87^{a}±0.13	69.21 ±1.35
Bovans White (BV)	66.56	74.13^{b}±1.33	3.19^{a}±0.14	0.377±0.009	12.95±0.48	58.87 ±0.98	28.19±0.70	37.46 ±0.97	6.44^{b}±0.13	69.78 ±4.03
Interaction (AxB)		NS	NS	NS	NS	NS	NS	NS	NS	NS
Control	65.50	76.37±0.53	2.56 ±0.24	0.379±0.006	12.33±0.68	59.21±1.58	28.47±0.90	35.52±2.00	6.86±0.15	69.54±2.98
(HB) 4 hours fasting	62.61	77.70±1.32	2.87 ±0.21	0.366±0.014	13.23±0.80	56.32±0.87	30.45±0.28	45.29 ±5.43	7.08 ±0.30	69.77 ±1.03
8 hours fasting	66.67	76.74 ±0.26	2.53 ±0.28	0.373±0.014	12.00±0.42	59.93 ±0.31	28.07±0.34	39.74 ±0.65	6.67^{a} ±0.19	68.32 ±3.35
Control	66.33	70.73±3.42	3.22±0.41	0.393±0.017	13.08±1.13	57.87±2.45	29.06±1.36	39.32 ±1.48	6.33 ±0.17	76.38±2.93
(BV) 4 hours fasting	68.22	76.05±0.40	3.22 ±0.26	0.367±0.017	12.44±0.35	60.40±1.81	27.16±1.46	38.24 ±1.33	6.22 ±0.29	62.23±11.18
8 hours fasting	65.11	75.61±0.79	3.13 ±0.07	0.371±0.013	13.33±1.08	58.34±0.71	28.34±1.03	34.82 ±1.39	6.78 ±0.11	70.72 ±3.23

Means in the same classification within each column have not the same letters are significantly differed ($P<0.05$).

Table (11): Economical efficiency and mortality rate as affected by feed restriction and strain.

Classification	Total Feed Consumption (Kg)	Total Feed Costs (LE.)	Total Egg Number per hen/364 days	Total Egg Price (LE.)	Net Revenue per hen (LE.)	Relative Economical Efficiency (%)	Mortality (%)
Treatment (A):	**	**	NS	NS	NS		
Control	$44.92^{a}\pm 1.55$	$64.68^{a}\pm 2.23$	272.73±14.17	81.82±4.25	17.14 ±2.44	100.00	13.09
4 hours fasting	$41.46^{b}\pm 1.29$	$59.71^{b}\pm 1.85$	269.44 ±21.18	80.83± 6.35	21.13 ±4.62	123.28	6.55
8 hours fasting	$39.80^{b}\pm 1.35$	$57.31^{b}\pm 1.94$	276.35 ±17.43	82.91± 5.23	25.60 ±4.08	149.36	4.17
Strain (B):	**	**	**	**	**		
Hisex Brown (HB)	$45.05^{a}\pm 0.88$	$64.87^{a}\pm 1.26$	$306.41^{a}\pm 3.17$	$91.92^{a}\pm 0.95$	$27.05^{a}\pm 1.58$	100.00	4.76
Bovans White (BV)	$39.07^{b}\pm 0.76$	$56.26^{b}\pm 1.10$	$239.28^{b}\pm 10.37$	$71.78^{b}\pm 3.11$	$15.52^{b}\pm 3.24$	57.38	11.11
Interaction (AxB)	NS	NS	NS	NS	NS		
Control	48.27± 0.37	69.51± 0.54	303.48 ± 1.90	91.04±0.57	21.54 ±0.50	100.00	9.52
(HB) 4 hours fasting	44.19 ± 0.34	63.64 ± 0.49	310.56 ±7.47	93.17±2.24	29.53±2.45	137.09	4.76
8 hours fasting	42.69 ± 0.80	61.47 ± 1.16	305.18 ±6.91	91.56±2.07	$30.09^{a}\pm 0.92$	139.69	0.00
Control	41.57 ± 0.80	59.86 ± 1.16	241.98 ±7.40	72.59±2.22	12.74 ± 3.17	100.00	16.67
(BV) 4 hours fasting	38.74 ± 0.84	55.78 ± 1.21	228.33 ±22.28	68.50±6.69	12.72 ±5.49	99.84	8.33
8 hours fasting	36.91 ± 0.29	53.16 ± 0.42	247.52 ±25.31	74.26±7.59	21.10 ±7.88	165.62	8.33

Means in the same classification have not the same letters are significantly differed ($P<0.05$).
Price of 1 egg, 2004 = 0.30 LE.   Price of 1kg of laying diet, 2004 = 1.44 LE.

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الملخص العربي

تأثير عدد ساعات تناول الغذاء علي الآداء الإنتاجي للدجاج البياض

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أجريت هذه الدراسة لمعرفة تأثيرعدد ساعات تناول الغذاء علي الأداء الإنتاجي للدجاج البياض (سلالة الهايسكس البني، و سلالة البوفانز الأبيض)عند عمر ٢٠ أسبوع حتى ٧٠ أسبوع . غذيت المجموعة الأولى من الطيور حتي الشبع، وصومت المجموعة الثانية لمدة ٤ ساعات في اليوم، والمجموعة الثالثة لمدة ٨ ساعات في اليوم

ولخصت النتائج الى الاتى

- أدى منع الغذاء لمدة ٤ أو ٨ ساعات في اليوم إلى انخفاض معنوى(معنوية >٠.٠٥) فى معدل العلف الماكول التراكمى بحوالى ٧.٦٩% او ١١.٤٠% على التوالى مقارنة بالمجموعة التى غذيت حتى الشبع مع عدم انخفاض معنوى واضح فى معدل العلف الماكول التراكمي مع زيادة عدد ساعات التصويم من ٤ الى ٨ ساعات .
- أدى منع الغذاء لمدة ٤ أو ٨ ساعات في اليوم إلي تحسين معنوى(معنوية >٠.٠٥) لمعدل التحويل الغذائى التراكمي في الدورات الإنتاجية من ٣ إلي ٧، لكن هذا التحسن بدأ في التناقص مع التقدم في موسم وضع البيض (عند الفترتين الإنتاجيتين ٨ و ٩)، ثم اختفى هذا التحسن في نهاية فترة الإنتاج (في الفترات الإنتاجية من ١٠ إلي١٣).
- أدى تصويم الطيور حوالي ٤ أو ٨ ساعات في اليوم خلال فترة الإنتاج؛ إلي نقص تكلفة الغذاء بحوالي ٧.٦٨ و١١.٣٩ ٪ بالترتيب و كذلك الى خفض معدل النفوق بحوالى ٦.٥٤% و ٨.٩٢% على التوالى مقارنة بالطيور التي غذيت حتي الشبع.
- كان تأثير تحديد الغذاء غير معنوي على كل من عدد البيض و وزن البيض و كتلة البيض و معدل إنتاج البيض اليومى و جودة البيض
- تفوقت سلالة الهايسكس البني علي سلالة البوفانز الأبيض بدرجة معنوية (معنوية >٠.٠١)في عدد البيض و كتلة البيض و معدل إنتاج و كمية العلف الماكول و كذلك استفادت من العلف افضل بدرجة معنوية (معنوية >٠.٠٥) خلال فترة التجربة.
- تفوقت سلالة الهايسكس البني علي سلالة البوفانز الأبيض في جودة البيض معتمدة على دليل الصفار ووحدات ارتفاع البياض فى المرحلة الاولى من الانتاج و على دليل الصفار ووحدات ارتفاع البياض و لون الصفار و قوة صلابة القشرة فى المرحلة المتوسطة من الانتاج فى الملرحلة المتاخرة من النتاج (بعد ٥٢ اسبوع انتاجى) سجلت سلالة الهايسكس البنيانخفاض معنوى(معنوية >٠.٠٥) فى لون الصفارو قوة صلابة القشرةو البيض يميل ان يكون فى محيط مقارنة البيض المنتج من سلالة البوفانز الأبيض .