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EFFECT OF ASCORBIC ACID SUPPLEMENTATION ON PERFORMANCE OF LAYING HENS DURING HOT SUMMER MONTHS

(with 6 tables & 10 figures)

By

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تأثير اضافة فيتامين ج على كفاءة الدجاج البياض خلال شهور الصيف الحارة

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اجرى هذا البحث على ٢٠٠ من الدجاج البياض، عند عمر ٣٦ أسبوعا ومتوسط وزن ٩٥٠ر١ كجم، لدراسة تأثير اضافة فيتامين ج على كفاءة الدجاج البياض خلال شهور الصيف المرتفعة الحرارة. تم تقسيم الدجاج عشوائيا الى أربع مجموعات متساوية كل منها ٥٠ دجاجة. أضيف فيتامين ج الى عليقة الدجاج البياض بمعدلات صفر، ١٢٥، ٢٥٠، ٥٠٠ مجم/ كجم عليقة. وقد استمرت التجربة لمدة عشرة أسابيع خلال شهور الصيف المرتفعة الحرارة (من ١٥ أبريل الى ١٥ يونية) حيث تراوحت درجة الحرارة بين ٣٧ الى ٤٣ درجة مئوية (٤٠م°) داخل التجربة. تم دراسة تأثير فيتامين ج على معدلات كل من الغذاء المستهلك، انتاج البيض، وزن البيضة، حجم البيضة، الكثافة النوعية للبيضة، وزن القشرة وكفاءة التحويل الغذائى، بالاضافة الى معدلات النفوق فى مجموعات التجربة الأربع. وقد أظهرت نتائج البحث أن أضافة فيتامين ج الى عليقة الدجاج البياض أدى الى تحسن معنوى فى كل من معدل انتاج البيض، وزن البيضة، حجم البيضة، وكفاءة التحويل الغذائى خاصة عند مستوى ٢٥٠، ٥٠٠مجم/كجم، فى حين لم تتأثر كل من الكثافة النوعية للبيضة ووزن القشرة، وأنخفضت معدلات النفوق بصورة واضحة نتيجة لاضافة الفيتامين. كما اوضحت النتائج أن التغيرات فى المعدلات التى تم دراستها بدأت بعد أسبوعين من أضافة الفيتامين لعلائق الدجاج. وتخلص هذه الدراسة الى أن اضافة فيتامين ج الى العليقة تؤدى الى تحسن فى كفاءة تحويل الغذاء والتى تنعكس على كفاءة الدجاج، كما تؤدى الى خفض جوهرى فى معدلات النفوق ولهذا ينصح باضافته الى علائق الدجاج البياض خاصة فى المناطق شديدة الحرارة.

SUMMARY

Two-hundred Leghorn-selected line laying hens were used to investigate the effect of ascorbic acid (AA) supplementation on productive performance during hot summer months. Hens were similar in age (36 weeks) and weight ranged from 1.800 to 2.100 kg ,with an average of 1.950 kg . The birds divided into four equal groups. AA was added at the levels of 0, 125, 250 & 500 mg / kg diet for groups 1, 2, 3 & 4, respectively. Group 1 which fed AA-free diet was considered as control .The experiment was continued for 10 weeks during hot summer months, the temperature

measurement including shell weight and egg specific gravity. The egg specific gravity was calculated by dividing the egg weight by egg volume. The eggshells were dried overnight in an oven at 50 0C. The shells were removed from the oven, allow to cool at room temperature for 15 minutes, and weighed with shell membranes intact *(MCDANIEL et al., 1993)*. Percentage shell was calculated by dividing shell weight by egg weight and mutiplying the quotient by 100. The chemical composition of the experimental diet was determined according to AOAC (1984) for determination of the percentages of moisture, crude protien, ether-extract, crude fiber and ash, while calcium and phosphorus were determined spectrophotometry. The data statistically analysed after *SPLEGEL (1972)*.

RESULTS

Effect of the four experimental diets on performance of the laying hens during the experimental period (10 weeks) are shown in tables from 1 to 6 and depictured in figures from 1 to 10.

Table 1 displays the average daily and comulative feed intake by hen for the experimental groups. The data indicated that AA supplementation significantly increased the daily feed intake in comparison with the non-supplemented group. The differences in feed intake between the AA-supplemented groups are not significant. As it is shown from the table and figure 1, the control, on the average, consumed daily amount of 118.04 g diet / hen .This amount increased by about 6.95 (5.89 %), 11.85 (10.4 %) & 13.02 g (11.03 %) for groups 2, 3 & 4, respectively and by 0.486 (0.06 %) , 0.829 (0.10 %) and 0.905 g (0.11 %) along the experimental period (10 weeks) as the level of the vitamin increased . The results also cleared that the 125 - ppm AA begin to act and effect on the feed intake at the second week of the experiment , while at both 250- and 500-ppm significantly increased the daily feed intake from the first week. Concering the comulative feed intake the statistical analysis demonstrated that there was no significant differences between the different groups including the control.

Table 2 illustrates the number and percentage of egg produced / hen. The data cleared that supplementation of the basal diet with AA significantly improved the egg production. The improvement become clear at the 5 th week with both levels of 125- & 250-ppm and at the 3rd week with 500-ppm . Statistical analysis showed no significant differences between the AA supplemented groups. The average percentage of egg produced / hen were 55.74 , 62.87 , 65.67 and 66.78 % for groups 1, 2, 3 & 4 , respectively along the whole period (10 weeks)

Average egg weight , egg volume and specific gravity in the four groups are presented in table 3. The data displayed that the egg weight of the 125-ppm AA group did not differ from the control, while it was significantly affected by AA supplementation at the levels of 250 -& 500 ·ppm. The average egg weights during the 10 weeks period were 58.65, 59.67, 63.93 and 64.50 g for groups 1, 2, 3 & 4 , respectively (figure 2) . Statistical analysis revealed a significant differences between all experimental groups except between group 1&2.

Concering egg volume, the results appeared that addition of AA at the level of 125-ppm had no significant effect on it. On the contrary, the higher doses increased it significantly (figure 5). The average egg volumes attained along the experimental period were 55.18, 56.10, 60.10 & 60.63. The results cleared that the effect of the 250-& 500-ppm levels on egg weight and volume become significant after two weeks from its feeding . Table 3 also shows no effect for the level of vitamin on specific gravity of eggs (figure 6).

Table 4 shows the quality of eggshell (weight and percentage). The results indicated that the shell weight did not affected by AA supplementation along the experiment (figure 7).

The feed efficiency which recorded with the four groups during 10 weeks are presented in table 5. The data displayed that the feed efficiency was highly affected by dietary AA supplementation specialy at 250- and 500-ppm (figure 8). Mortality in the four groups along the 10 weeks is also presented in table 5 , as shown in the table and figure 9 it reached 28&12 % for groups 1&2, respectively , with the superiorety of the group fed 250- ppm AA at 39 - week age, while the high level AA-group (500- ppm) completely cancelled the lethal effect associated with high temperature at 41-46 weeks age. The data also indicated that AA supplementation reduced the rate of mortality after two weeks from the experiment.

Table 6 shows the feed cost / kg egg mass produced and the net egg income in the four groups. The obtained data cleared that supplementation the basal diet with AA markedly increased the net egg income. This is true inspite the relative high cost of the supplemented.

DISCUSSION

A flock of Leghorn-selected line hens was raised by Vet. Med., Assuit University for egg production. A problem appeared in the flock with beginning the hot summer months . The problem was dropping in egg production and high mortality, the problem become more and severe with the elevation of temperature . Various examinations performed attribute the problem to heat stress as the environmental temperature become very high in this region. So, the idea of the present work was initiated . As this trial is may throw light on the benefits resulting from AA supplementation to the basal diet of the birds to overcome this crisis .

By reviewing the performance data concerning egg production for the four groups (table 2), the obtained data confirmed that AA supplementation improved the daily egg production (figure 3). This improvement become significant after 4 weeks with 125- and 250-ppm levels but more early with 500-ppm level (after two weeks) . The beneficial effect of AA on egg production recorded in the present study agreed with the findings of *PEREK and KENDLER, 1963; KECHICK and SAKES, 1974 ; PEEBLE and BRAKES, 1985 ; BELL and MARIAN, 1987 and ALI et al. , 1992* who reported that AA supplementation increased egg production for hens reared under hot environmental condition .

The number of eggs produced is not a precise determinant for production efficiency, but the mass. For considering the egg mass, egg weight was recorded and displayed in table 3. from the table it was cleared that, egg weight increases by AA supplementation specially at 250- & 500- ppm levels (figure 4). This coincides with that reported by *PEREK and KENDLER, 1962 ; El-BOUSHY and VAN ALBADA, 1970 and CHEN and NOCKELS, 1973*, while that result is not in coincidence with the previous findings with *THORNTON and MORENG, 1958, ; PEPPER et al., 1961 ; HEYWANG et al., 1964 ; PEEBLE and BRAKE, 1985 and ALI et al., 1992* who mentioned that AA has no beneficial effect on egg weight.

ALI et al., (1992) found that AA supplementation to the diet at the levels of 50 and 100 mg / kg diet did not affect the egg volume. This is true only with the level 125 (Table 3). On the contrary , AA supplemented at the levels 250- and 500 -ppm signicantly increased the egg volume (figure 5) .This means that the level of 125-ppm is not sufficient to affect the egg volume.

Regarding eggshell weight, the data presented in table 4 cleared that laying hens supplemented with AA produced eggs similar to that of the control (figure 7). This findings comes in line with that of *HEYMANG and KEMMRER, 1955* ; Perek and Kendler, *1963 ; PEEBLE and BRAKE, 1985 and ALI et al., 1992* who reported that AA supplementation did not affect the weight of eggshell . In the contrarly, *PEREK and KENDLER, 1962; El-BOUSHY and VAN ALBADA, 1970 and CHEN and NOCKELS, 1973* found that AA addition increased the weight of eggshell in Leghorn and L.S.L.strains.

Concerning the specific gravity, the obtained results indicated that the specific gravity of eggs produced by hens did not affected by AA supplementation. This is in accordance with that reported by *ALI et al. ,1992* and disagreed with *PEEBLE and BRAKE, 1985* who demonstrated that supplementation the laying diet with AA increased the specific gravity of eggs.

The current experiment indicated that AA had a positive effect in neutralizing the negative effect caused by heat. This is clear in the reduction of mortality rate from 28 to 12 % to reach 0.0 % at the 6 th week of its feeding with the 500-ppm level. Moreover, the obtained results revealed that addition of AA increased the daily feed intake / hen. This means that AA improved the palatability of the basal diet which agreed with that reported by *PEEBLE and BRAKE (1985)*.

Collectively, it is of interest to point out that AA supplementation highly improved egg production, egg weight, egg volume, egg mass, feed effeciency beside the significant reduction in mortality rate . These findings may be attributed to many causes as shown by many authores. Firstly, activation of thyroid gland *(BERG and BEARS, 1951)*. Secondly, supplying the hens with their needs from AA in which their synthesis is impaired *(THORNTON, 1961)*.Thirdly, the level 15.46 % dietary protein with absence of vitamin C may be insufficient to overcome the depressant effect associated with high temperature (*THORNTON, 1960 ; CHEN and NOCKELS, 1973)*.

Unequivocably, the above-cited findings amply confirmed the importance of AA in diets of laying hens reared under high climatic temperature and dietary supplementation with AA may be of practical value to raise the validity of birds and to minimize the depressant effect associated with heat stress.

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Table 1 : Average feed intake per hen during 10 weeks

Flock	AA,ppm							
	0 #		125		250		500	
age (weeks)	DFI g	CFI kg	DFI g	CFI kg	DFI g	CFI kg	DFI g	CFI kg
36-37	118.76	0.831	120.16	0.841	121.14*	0.848	121.88*	0.847
37-38	115.66	1.641	122.14*	1.696	119.26	1.683	120.66*	1.692
38-39	116.22	2.455	121.65*	2.548	125.33**	2.560	126.44**	2.577
39-40	119.33	3.290	120.98	3.395	124.86**	3.434	125.66**	3.457
40-41	118.66	4.121	124.77**	4.268	130.88**	4.350	130.66**	4.372
41-42	117.44	4.943	125.48**	5.146	135.22**	5.297	136.33**	5.326
42-43	119.22	5.778	128.22**	6.044	135.66**	6.247	136.43**	6.281
43-44	115.77	6.588	128.66**	6.945	136.11**	7.200	135.98**	7.233
44-45	118.65	7.419	128.81**	7.817	135.55**	8.149	138.33**	8.201
45-46	120.66	8.264	129.00**	8.750	134.87**	9.093	138.22**	9.169
Mean	118.04		124.99		129.89		131.22	

Ascorbic acid produced by Kahira Pharmaceutical & Chemical Industries Co. ,Cairo, Egypt.

DFI = daily feed intake .

CFI = comulative feed intake: No significant differences between the different groups.

considerd as control group.

*significant at (P< 0.05) . ** significant at (P< 0.01).

No significant differences between groups 2 & 3 2 &4 and 3 & 4.

Table 2 : Percentage and number of egg produced / hen during the experiment (10 weeks).

Flock age (weeks)	AA ppm							
	0#		125		250		500	
	%	No.	%	No.	%	No.	%	No.
36-37	55.10±0.42	3.86±0.06	56.25±3.11	3.94±0.20	57.14±3.31	4.00±0.33	58.00±3.41	4.06±0.22
37-38	55.32±0.33	3.87±0.05	59.57±2.99	4.17±0.22	59.57±3.52	4.17±0.31	60.42±3.50	4.23±0.23
38-39	57.78±0.23	4.04±0.06	59.57±3.40	4.17±0.24	61.70±3.41	4.32±0.34	63.83±3.56*	4.47±0.25
39-40	55.56±0.24	3.89±0.5	60.00±3.50	4.20±0.24	63.83±3.44	4.40±0.36	65.96±3.88**	4.62±0.30
40-41	54.55±0.46	3.82±0.05	64.44±3.60**	4.50±0.33	65.96±4.10**	4.62±0.38	67.39±3.66**	4.72±0.35
41-42	56.10±0.42	3.93±0.06	64.44±3.66**	4.50±0.43	68.02±4.33**	4.77±0.39	69.57±3.89**	4.87±0.35
42-43	56.10±0.36	3.93±0.04	66.67±3.65**	4.67±0.35	69.57±4.32**	4.87±0.35	69.57±3.94**	4.87±0.36
43-44	56.41±0.52	3.95±0.04	65.91±3.61**	4.61±0.41	69.57±4.41**	4.87±0.38	69.56±4.22**	4.87±0.34
44-45	55.26±0.51	3.87±0.04	65.91±3.66**	4.61±0.35	69.57±4.44**	4.87±0.40	71.74±4.53**	5.02±0.37
45-46	55.56±0.53	3.89±0.05	65.91±2.33**	4.61±0.41	71.74±4.55**	5.02±0.45	71.74±4.55**	5.02±0.41
Mean	55.74±0.45	3.91±0.05	62.87±2.30	65.67±0.30	65.67±4.11	4.60±0.36	66.78±3.88	4.67±0.31

± SD. # considered as control .

* significant at (P< 0.05) ** significant at (P< 0.01).

No significant differences between all AA-supplemented groups.

Table 3 : Egg weight , egg volume and egg specific gravity in the four groups.

Flock age (weeks)	Egg weight, g				Egg volume				Specific gravity			
	AA				AA				AA			
	0#	125	250	500	0	125	250	500	0	125	250	500
36-37	59.37±1.31	59.33±0.90	58.72±2.56	58.37±2.11	55.90±0.88	55.81±.88	55.19±2.11	54.86±2.33	1.062	1.063	1.064	1.064
37-38	57.13±1.23	58.58±0.92	58.03±2.43	57.06±2.50	53.69±0.89	55.06±0.89	54.49±2.33	53.63±2.44	1.064	1.064	1.065	1.064
38-39	55.73±1.34	59.19±0.94	59.74±2.45*	63.70±2.53**	52.48±0.90	55.68±0.91	56.20±2.34*	59.92±2.45**	1.062	1.063	1.063	1.063
39-40	59.83±1.29	60.56±0.95	62.90±2.55	64.15±3.56**	56.28±0.99	56.92±.96	59.12±2.42*	60.23±2.56**	1.063	1.064	1.064	1.065
40-41	60.43±1.56	60.14±0.94	66.58±2.88**	66.86±3.67**	56.96±1.00	56.47±0.96	62.58±2.46**	62.90±2.54**	1.061	1.065	1.064	1.063
41-42	58.65±1.56	58.30±0.96	68.00±2.68**	67.58±3.69**	55.12±1.11	54.84±.98	63.85±2.77**	63.52±2.66**	1.064	1.063	1.065	1.064
42-43	59.52±1.56	61.83±0.98	67.01±2.72**	67.16±3.70**	56.05±1.13	58.06±0.99	62.98±2.87**	63.18±2.71**	1.062	1.065	1.064	1.063
43-44	56.86±1.65	58.79±0.99	67.47±3.15**	67.63±4.11**	53.44±1.33	55.31±1.10	63.47±3.33**	63.62±2.88**	1.064	1.063	1.063	1.063
44-45	58.98±1.55	60.88±1.33	66.28±3.80**	66.49±4.23*8	55.33±1.50	57.22±1.14	62.41±3.56**	62.43±3.11**	1.066	1.064	1.062	1.065
45-46	60.00±1.60	59.13±1.19	64.61±3.89*	65.98±3.53**	56.55±1.61	55.63±1.16	60.67±3.60*	62.01±3.55*	1.061	1.063	1.065	1.064
Mean	58.65±1.49	59.67±1.10	63.93±2.99	64.50±3.12	55.18±0.99	56.10±0.99	60.10±2.66	60.63±2.95	1.063	1.064	1.064	1.064

The control group. ± SD.

* significant at (P< 0.05). ** significant at (P< 0.01).

Concerning egg weight , significant differences between all groups except 1&2.

Concerning egg volume , significant differences between all groups except 1&2 and 3&4.

Concerning egg specific gravity , no significant differences between all groups.

Table 4 : Eggshell weight (g) and percentage during the experimental period.

Flock age (weeks)	AA ppm							
	0		125		250		500	
	Weight	%	Weight	%	Weight	%	Weight	%
36-37	5.13±0.05	8.64	5.30±0.12	8.93	5.44±0.18	9.26	5.34±0.31	9.15
37-38	5.40±0.06	9.45	5.25±0.15	8.96	5.46±0.19	9.41	5.45±0.34	9.55
38-39	5.23±0.06	9.38	5.31±0.16	8.97	5.47±0.19	9.16	5.48±0.41	8.60
39-40	5.51±0.06	9.21	5.40±0.17	8.92	5.48±0.99	8.71	5.46±0.39	8.51
40-41	5.31±0.06	8.79	5.31±0.16	8.83	6.21±0.10	9.33	6.22±0.41	9.30
41-42	5.41±0.08	9.24	5.35±0.18	9.18	5.80±0.12	8.53	6.45±0.38	9.54
42-43	5.33±0.09	8.95	5.40±0.18	8.73	5.90±0.12	8.80	6.11±0.44	9.10
43-44	5.41±0.09	9.51	5.35±0.19	9.10	5.96±0.14	8.83	6.20±0.41	9.17
44-45	5.34±0.10	9.05	5.42±0.20	8.90	5.98±0.15	9.02	5.90±0.45	8.87
45-46	5.26±0.11	8.77	5.41±0.29	9.15	5.9±0.16	9.27	5.96±0.46	9.03
Mean	5.33±0.08	9.10	5.35±0.14	8.97	5.77±0.15	9.03	5.86±0.41	9.08

± SD. No significant differences btween all groups.

Table 5 : Feed efficiency and mortality in the four groups.

Flock age (weeks)	AA ppm											
	0#			125			250			500		
	FE	Mortality		FE	Mortality		FE	Mortality		FE	Mortality	
		No.	%		No.	%		No.	%		No.	%
36-37	3.63	1	2	3.60	2	4	3.61	1	2	3.60	0	0
37-38	3.66	2	4.08	3.50	1	2.08	3.45	2	4	3.50	2	4
38-39	3.61	2	4.26	3.45	0	0	3.40	0	0	3.11	1	2
39-40	3.59	0	0.00	3.33	2	4.26	3.11	0	0	2.97	0	0
40-41	3.60	1	2.22	3.22	0	0	2.98	0	0	2.90	1	2
41-42	3.58	3	6.82	3.34	0	0	2.92	0	0	2.90	0	0
42-43	3.57	0	0.00	3.11	0	0	2.91	1	2	2.92	0	0
43-44	3.61	2	4.88	3.32	1	2.22	2.90	0	0	2.89	0	0
44-45	3.64	1	2.56	3.21	0	0	2.94	0	0	2.90	0	0
45-46	3.62	2	5.26	3.31	0	0	2.88	0	0	2.92	0	0
	3.611	14	28	3.338	6	12	3.082	4	8	3.031	4	8

The control group.

Regarding the mortality, a significant ($P < 0.01$)differences between all groups except group 3 & 4.

Table 6: The feeding cost /kg egg mass produced and the net egg income .

Groups	Total feed cost hen*	Egg mass hen	Egg income hen**	Net egg income hen #
	LE	kg	LE	LE
1	4.958	2.291	6.873	1.915
2	5.350	2.621	7.863	2.513
3	5.681	2.950	8.850	3.169
4	5.951	3.025	9.075	3.124

* Total feed cost /hen included the cost of vitamin added.

The selling price for an kg layer diet in Assiut was 0.60 LE.

** The selling price for an kg eggs in Assiut was 3.00 LE.

The difference between egg income and feed cost.

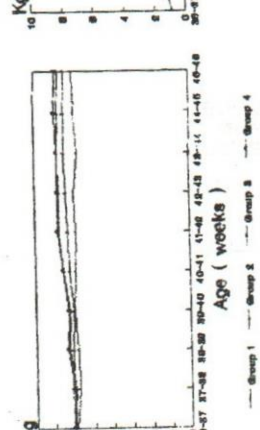

Fig.1:Average daily feed intake /hen

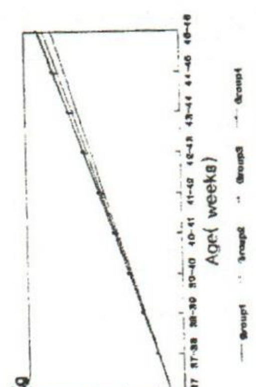

Fig.2: Comulative feed intake/hen

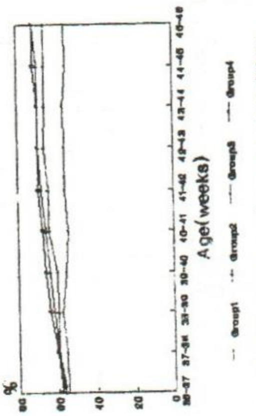

Fig.3:Percentage of egg produced/hen

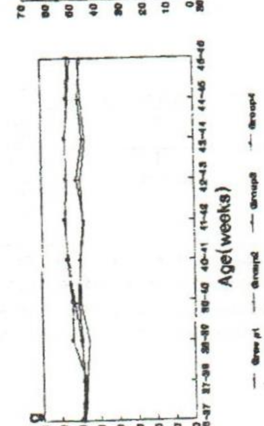

Fig.4:Average egg weight.

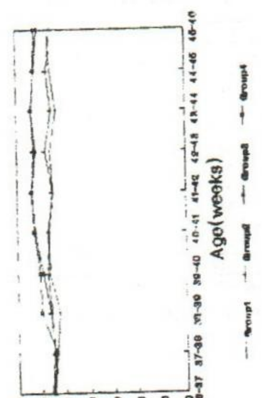

Fig.5:Average egg volume.

Fig.6:Average egg spesific gravity

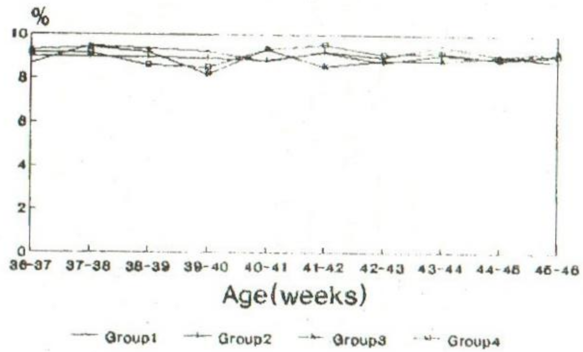

Fig.7:Average percentage of egg shell.

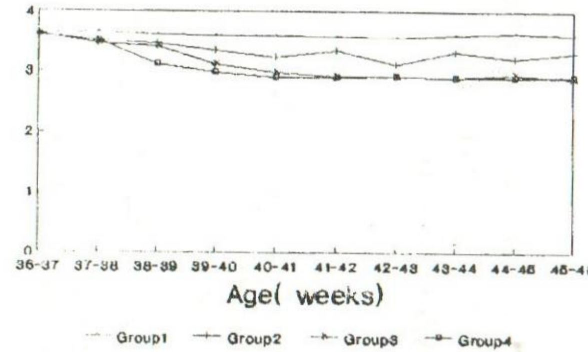

Fig.8:Feed efficiency in the four groups

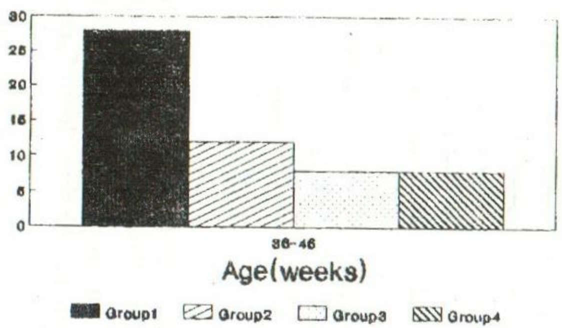

Fig.9: Mortality % during the experiment(10 weeks).

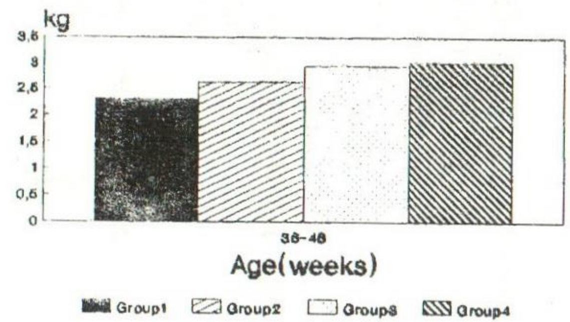

Fig.10:Egg mass/hen during the experimen(10 weeks).