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Original Research Article

EFFICACY OF CALCIUM SUPPLEMENTATION ON GROWTH AND EGG QUALITY IN DESI LAYING HENS (*GALLUS GALLUS DOMESTICUS*)

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Abstract *This study examined the effects of Ca addition on the growth and egg quality of desi-laying hens. The study was conducted in a village located in District Muzaffargarh, Punjab, Pakistan. A total of 40 desi hens, approximately 8 weeks old, were procured from the local market which were included in the study. These hens were housed in wooden cages under uniform environmental conditions. To ensure a smooth transition, the hens were initially fed a standard diet for 10 days to acclimate them to their new cages and surroundings. Subsequently, a total of four groups (A, B, C, and D) of chickens were made, each group contained ten hens and was assigned to four different diets. These diets were randomly allotted among groups with the inclusion of Ca powder at various levels: 0%, 1%, 1.5%, and 2%. Each group received their respective diet two times daily, at 7:00 AM and 5:00 PM, along with continuous access to clean and fresh water. To assess weight gain, the hens were initially weighed, and thereafter weights were recorded weekly throughout the 42 days of research. The data revealed that the group received the diet with 2% Ca experienced the highest weight gain compared to the control group and the other two treated groups (1071.00g vs. 985.88g vs. 1028.13g vs. 1048.88g) in that order and this variation was significant (P<0.05). For feed efficiency, data on the daily amounts of feed offered refused, and consumed was collected. The results demonstrated that the group fed the 2% Ca diet exhibited better feed efficiency in comparison to the control group and other treatment groups (6.74kg vs. 7.10kg vs. 6.90kg vs. 6.78kg), and this distinction was significant (P<0.10). Likewise, the number of eggs produced and their quality were greater in the hens who received the food containing 2% Ca as compared to the control group and other treatment groups (80 vs. 75.06 vs. 76.625 vs. 78.875) and (10.383mm vs. 0.373mm vs. 0.3mm vs. 0.381mm), correspondingly. Statistics showed that these differences were different (P<0.10). In summary, the results of this study demonstrated that a linear increase in Ca addition in desi laying hens' normal diet, up to a level Of 2%, yielded better performance and to get better production from their laying hens, farmers were advised to add this amount of Ca in the feed of laying hens.*

Keywords*:* *calcium; efficacy; egg quality; Desi hens; diet, Performance*

Introduction

The impact of the Calcium and nutrient content of the diet on egg manufacture, egg quality, and tibiae mineralization, was studied in brown egg-laying hens. A boost in calcium during the pre-lay phase decreased feed intake, postponed egg production, and increased eggshell %. In this phase, the eggshell quality of hens previously fed on calcium-rich feed was better (DeJuan et al., 2023). The quality of the eggs from aged laying hens produced with 0.5% calcium butyrate or 0.5% calcium propionate dietary supplements was greater. For the growth and development of eggs, calcium is a crucial mineral, and hens that produce a lot of eggs of high quality also have a larger capacity to mobilize the calcium needed for egg formation (Song et al., 2022). Supplementing Bacillus subtitles with calcium (Ca) affects laying hens' intestinal morphology, egg production, and eggshell quality. Each egg contains about 2 g of calcium (Ca), which is stored in the eggshell gland as calcium carbonate (Bain et al., 2016). This study will enhance the understanding of how the added calcium will be beneficial for improving egg quality and growth in desi hens. Similarly, the effectiveness of calcium supplementation in feed on the growth and egg quality will be examined thoroughly in the current study. Both in the morning and in the afternoon, the control group was given a meal with a Ca content of 3.5%. Additionally, poor Ca intake in the afternoon harmed the eggshell's quality. Who found that a meal including fine limestone in the morning and a diet containing coarse limestone in the afternoon, both of which provided more than 50% of the daily

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necessary Ca consumption, was the most efficient diet? The study assessed the impact of a split feeding approach on the eggshell quality of mature laying hens between the ages of 75 and 92 weeks. The quality of eggshells may therefore be improved by increasing the supply of dietary Ca to the digestive tract during the process of eggshell development (Joshi *et al*., 2019)

Materials and methods

Forty (40) desi hens of approximately 8 weeks of age were purchased from the local market, of almost equal size and weight. The hens were weighed individually. All the hens were kept in wooden cages in the same environmental conditions. After 10 days the hens were divided into four groups A (control), B, C and D, Ten (10) hens in each group. The hens in group A (control) were fed prepared feed without the addition of Ca; group B received prepared feed containing 1% Ca powder; group C received prepared feed containing 1.5% Ca powder; and group D received prepared feed containing 2% Ca powder. Each group received a weighed quantity of feed twice daily at 7:00 am and 5:00 pm. To protect the hens from diseases, all necessary vaccines were administered by the local veterinarian. To determine the feed efficiency for each group, daily data on feed consumption and rejection was noted daily. To observe the weight gain for each group, the weekly weight of each hen was also recorded. Weakly egg production of each group was also recorded/counted. The texture of each layed egg from all hens was observed to determine the quality of the eggs. Similarly, the weights of the eggs produced for each group were also recorded. The research lasted for eight weeks. The feed formula used for different groups was as under in table 1.

Table 1. The Feed Ingredients, their Percentage and Proportion of Calcium to be used in the Diets

Sr. No	Ingredients	Group A	Group B	Group C	Group D
1.	Maize grain	15%	15%	15%	**15%**
2.	Maize gluten	20%	20%	20%	**20%**
3.	Rice grain	17%	16%	15.5%	**15%**
4.	Soybean meal	15%	15%	15%	**15%**
5.	Rice polish	20%	20%	20%	**20%**
6.	Fish meal	12%	12%	12%	**12%**
7.	DCP (Di Calcium Phosphate)	0%	1%	1.5%	**2%**
8.	Salt	1%	1%	1%	**1%**
	Total	**100%**	**100%**	**100%**	**100%**

Results and discussion

Weight Gain

The data of overall average weekly weight gain (g) in hens during 8 weeks of an experiment is shown in table 2. The body weight of hens of D group was the highest compared to group A (control) and the other two groups B and C (1071.000g vs 985.875g vs 1028.125g vs 1048.875g) respectively (Figure 1). This difference was statistically significant ($P<0.05$) among all of them. A significant difference ($P<0.05$) was also observed among treated groups (Table 3). The result indicated that the feed with the addition of 2% calcium (group D) was most successful ($P<0.05$) in increasing the weight gain in hens during the whole period of experiments followed by the hens fed the ration with the addition of 1.5% calcium (group C). However, the hens fed the ration with the addition of 1% of calcium (group B) showed better results ($P<0.05$) compared to the ration fed to the hens without the addition of calcium (control group A). Although there was a substantial increase in the weight of hens of all four groups the results indicated that the linear increase of calcium addition in the feed of hens can result in gaining more body weight which can be successfully used up to 2% by the farmers at their farms(Bar, 2009; Chang et al., 2019).

Table 2. The tabulated data showing the group-wise weekly Weight Gain (gm) in hens

Research Period	A (Control)	B	C	D
IST WEEK	904	904	905	906
2ND WEEK	920	941	947	955
3RD WEEK	945	976	987	1001
4TH WEEK	970	1010	1029	1049
5TH WEEK	995	1047	1069	1095
6TH WEEK	1020	1074	1109	1140
7TH WEEK	1050	1111	1149	1185
8TH WEEK	1083	1162	1196	1237
TOTALL WEIGHT	7887	8225	8391	8568
AVERAGEWEIGHT	985.875	1028.125	1048.875	1071

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Figure 1. Representing the overall growth performance in Group A, B, C and D

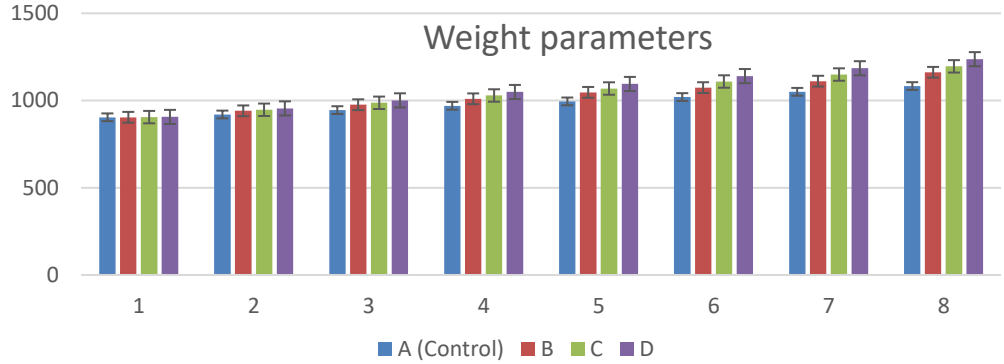

Table 3. Showing the statistical analysis of ANOVA of weight between Control and other treated groups

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	31517.34	3	10505.78	1.205578	0.003589	2.946685
Within Groups	244000.6	28	8714.308			
Total	275518	31				

Feed Efficiency

The data of the overall average weekly FCR in hens during 8 weeks of the experiment is shown in the table 4. The FCR of D group was the highest compared to group A (control) and the other two groups B and C (7.50 vs 6.74 vs 6.88 vs 6.90) respectively (Figure 2). This difference was statistically significant (P<0.10) among all of them. A significant difference (P<0.10) was also observed among treated groups (Table 5). The result indicated that the feed with the addition of 2% calcium (group D) was most successful (P<0.10) in increasing the FCR in hens during the whole period of experiments followed by the hens fed the ration with the addition of 1.5% calcium (group C). However, the hens fed the ration with the addition of 1% of calcium (group B) showed better results (P<0.10) compared to the ration fed to the hens without the addition of calcium (control group A). Although there was a substantial increase in FCR of hens of all four groups the results indicated that the linear increase of calcium addition in the feed of hens can result in greater the FCR which can be successfully used up to 2% by the farmers at their farms (Dastar et al., 2016; drMatos, 2008; Benavides-Rayes et al., 2019; Bara et al., 2012; Deobald et al., 2023; Drabik et al., 2021).

Table 4. Showing the weekly Contrast Tests of FCR between treatments and control groups

FCR in (Kg)	A(CONTROL)	B	C	D
1WEEK	6.65	6.65	6.66	6.65
2WEEK	6.82	6.75	6.71	6.68
3WEEK	6.93	6.81	6.74	6.71
4WEEK	7.13	6.83	6.79	6.73
5WEEK	7.19	6.92	6.82	6.75
6WEEK	7.32	7.01	6.83	6.78
7WEEK	7.33	7.09	6.85	6.81
8WEEK	7.45	7.21	6.88	6.83
TOTALL	56.82 kg	55.27 kg	54.28 kg	53.94 kg
AVERAGE	7.1025 kg	6.90875 kg	6.785 kg	6.7425 kg

Figure 2. Comparison of FCR between control and treated group after 1 to 8 weeks.

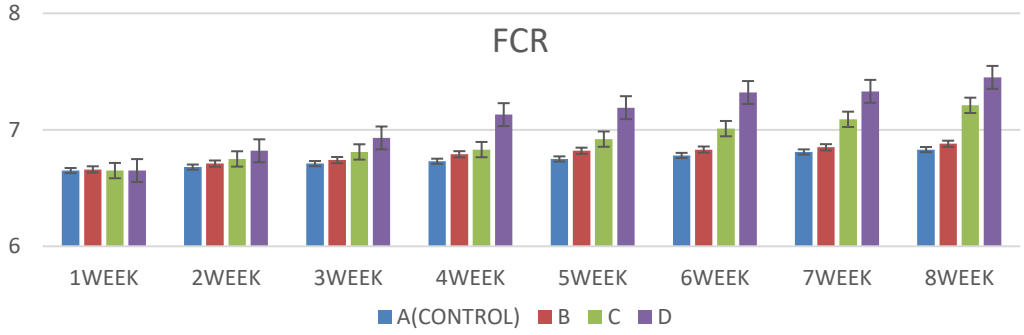

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Table 5. Showing the statistical analysis of ANOVA EQ between treatments and control groups

Source of Variation	*SS*	*d.f*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.000585	3	0.000195	2.475845	0.082042	2.946685
Within Groups	0.002206	28	7.88E-05			
Total	0.002792	31				

Egg Production

The data of overall average weekly egg production in hens during 8 weeks of the experiment is shown in the table 6. The egg production of D group was the highest compared to group A (control) and the other two groups B and C (80 vs 75.06 vs 76.625 vs 78.875) respectively (Figure 3). This difference was statistically significant (P<0.05) among all of them. A significant difference (P<0.05) was also observed among treated groups (Table 7). The result indicated that the feed with the addition of 2% calcium (group D) was most successful (P<0.05) in increasing the egg production in hens during the whole period of experiments followed by the hens fed the ration with the addition of 1.5% calcium (group C). However, the hens fed the ration with the addition of 1% of calcium (group B) showed better results (P<0.05) compared to the ration fed to the hens without the addition of calcium (control group A). Although there was a substantial increase in egg production of hens of all four groups the results indicated that the linear increase of calcium addition in the feed of hens can result in greater egg production which can be successfully used up to 2% by the farmers at their farms (Bora-Molina et al., 2020; Couvreur et al., 1979).

Table 6. showing the Contrast Tests of Egg Production (No) between treatments and control groups

No. of Eggs	**A**	**B**	**C**	**D**
1WEEK	71	71	70	71
2WEEK	72	73	75	74
3WEEK	73.5	74	76	77
4WEEK	74	75	77	79
5WEEK	75	77	81	82
6WEEK	76	79	83	84
7WEEK	78	81	84	86
8WEEK	81	83	85	87
TOTALL	600.5	613	631	640
AVERAGE	75.0625	76.625	78.875	80

Figure 3. Comparison of egg production between control and treated group after 1 to 8 weeks

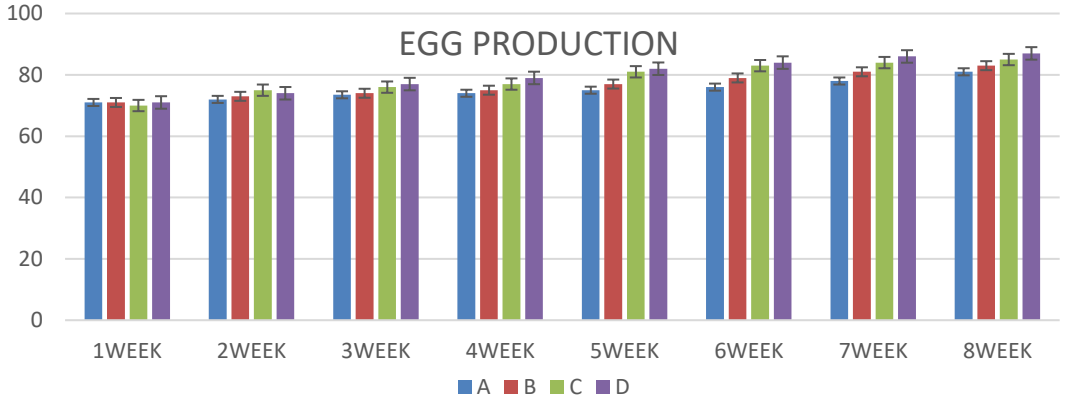

Table 7. Showing the statistical analysis of ANOVA EP between treatments and control groups

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	118.1484	3	39.38281	1.787317	0.002459	2.946685
Within Groups	616.9688	28	22.0346			
Total	735.1172	31				

Egg quality

The data on the total average weekly egg quality in hens during 8 weeks of the experiment is shown in the table 8. The egg quality of D group was the highest (more thickness) compared to group A (control) and the other two groups B and C (0.383 vs 0.373 vs 0.3 vs 0.381) respectively (Figure 4). This difference was statistically significant (P<0.10)

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among all of them. A significant difference (P<0.10) was also observed among treated groups (Table 9). The result indicated that the feed with the addition of 2% calcium (group D) was most successful (P<0.10) in increasing the egg quality (Thickness) in hens during the whole period of experiments followed by the hens fed the ration with the addition of 1.5% calcium (group C). However, the hens fed the ration with the addition of 1% of calcium (group B) showed better results (P<0.10) compared to the ration fed to the hens without the addition of calcium (control group A). Although there was a substantial increase in egg quality of hens of all four groups the results indicated that the linear increase of calcium addition in the feed of hens can result in greater egg production which can be successfully used up to 2% by the farmers at their farms (Attia et al., 2020; An et al., 2016; Abdikari et al., 2020).

Table 8. showing the Contrast Tests of Egg Quality/thickness in mm between treatments and control groups

No of weeks	Egg shell (Shell thickness, mm)			
	A	B	C	D
1WEEK	0.363	0.362	0.365	0.365
2WEEK	0.365	0.366	0.373	0.379
3WEEK	0.367	0.369	0.379	0.381
4WEEK	0.371	0.372	0.383	0.384
5WEEK	0.374	0.375	0.387	0.389
6WEEK	0.377	0.382	0.381	0.384
7WEEK	0.382	0.388	0.388	0.392
8WEEK	0.385	0.387	0.389	0.396
TOTALL	3.357	3.376125	3.425625	3.45375
AVERAGE	0.373	0.375125	0.380625	0.38375

Figure 4. Comparison of egg quality between control and treated group after 1 to 8 weeks.

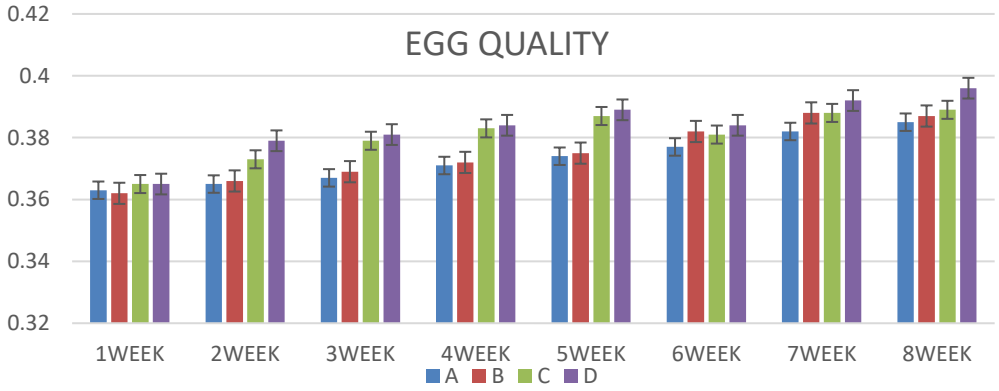

Table 9. Showing the statistical analysis of ANOVA Egg Quality (shell thickness) between treatments and control groups

Source of Variation	*SS*	*d.f*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.000585	3	0.000195	2.475845	0.082042	2.946685
Within Groups	0.002206	28	7.88E-05			
Total	0.002792	31				

Conclusion

This study was conducted on desi-laying hens to determine the efficacy of Ca on their growth rate and egg quality which was conducted in a village in District Muzaffargarh Punjab, Pakistan. Overall the results of this study indicated that the linear increase of Ca in the normal diet of laying hens up to the level of 2% showed the best performance in desi-laying hens and the farmer was advised to use this level of Ca for feeding laying hens to get better production from them.

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Declaration

Ethics Approval and Consent to Participate

Not applicable.

Consent for Publication

The study was approved by authors.

Funding Statement

Not applicable

Conflict of Interest

There is no conflict of interest among the authors regarding this case study.

Authors Contribution

All authors contributed equally.

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