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ORIGINAL RESEARCH

Effect of Vitamin Supplementation on Egg Production, Egg Quality, and Mortality of Sasso Chickens

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Introduction: Ethiopia has a huge poultry population that plays a role in rural development. However, feed shortage is a major problem. Vitamin supplementation in feed formulation is crucial to improve the productivity of poultry. The objective of this study was to evaluate extra doses of vitamin supplements in quality egg production.

Methods: This experimental study was conducted on Sasso Ruby T chickens aged 22 weeks. The experimental and control groups each contained 60 hens. For the study group, extra doses of vitamins were added to the drinking water. Weekly observation was carried out for 3 months for a total of 12 observations. The effect of extra doses of vitamins on layers in terms of mortality, egg production, egg size, egg-specific gravity, and eggshell thickness was analyzed using SPSS 20 with *t*-tests.

Results: Significant changes were observed for mortality ($P<0.05$), with mean mortality of 0.25±0.45 and 0.66±0.65 and general mortality of 5% and 13% in the study and control groups, respectively. Average egg production per week in the study group (279.5 ±3.80) was significantly ($P<0.05$) higher than the control group (256±4.81). However, no significant difference ($P>0.05$) was found for egg size between the groups: study group 59.99±0.92 g and control group 59.34±0.95 g. There was no significant variation ($P>0.05$) in average egg-specific gravity: study group $1.068\pm5.33\times10^{-3}$ and control group $1.061\pm5.33\times10^{-3}$. Average eggshell thickness was significantly greater ($P<0.05$) in the study group(0.36±0.048 mm) than the control group (0.32±0.04 mm).

Conclusion: We identified that extra vitamin supplements for layer chickens is very important to increase profitability in the poultry industry by decreasing mortality and increasing egg production.

Keywords: egg production, egg quality, layer mortality, vitamin powder

Introduction

Ethiopia has a massive poultry population, which is distributed:[1] It constitutes 60% of the total chicken population of East Africa and is estimated to be 60.4 million. With regard to breed, 94.3%, 3.21% and 2.49% of the population represent indigenous, hybrid, and exotic chickens, respectively.[2,3] Despite the large scale of poultry production in the country, as well as regions, their contributions to economies are disproportional. This is mainly due to poor management and disease constraints. The high incidence of disease driving high morbidity and mortality is the principal constraint that hinders chicken productivity in Ethiopia. Although it is understood that diseases cause great losses, few have been studied in the Amhara region.[1,4]

Poultry are domestic birds that are a primary supplier of meat and eggs, as well as raw materials for industries (feathers, waste products), and are a source of income and employment.[5] Poultry production systems come in three major categories: backyard, semi-intensive, and intensive (in-cage) rearing.[6] The major costs incurred in intensive rearing are feed and feed-related, which account for 60%–70% of total expenses.[4] Therefore, proper utilization of feed is highly recommended, since it determines the profitability and sustainability of a farm. Moreover, the type and amount of rations given should be safe for production and growth.[7]

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Chickens should have sufficient vitamin accessibility. Chicks should be fed starter rations from 0 to 8 weeks of age, pullets grower rations from 8 to 18 weeks, and layer hens vitamin-supplemented layer rations from 18 weeks - onward.[4] Provision of balanced rations plays a great role in the profitability of the poultry industry. Major indices for measuring the profitability of layer hens in a poultry enterprise are total number of eggs of good quality and low mortality.[5]

For the egg industry worldwide, the production of good-quality eggs is critical to the economic viability of the industry. Problems with egg quality currently cost the industry many of millions of dollars per year. Therefore, it is of great importance to understand the factors that affect egg quality.[4,8] Currently in Burji district, there are >380,000 chickens, 35% in urban areas and 65% in rural areas. The commonest poultry reared are Sasso Ruby T44, ducks, Bovans Brown, and white leghorn. Of these breeds, Ruby T44s are one of the fastest-growing populations.[6,9]

However, there has been no well-documented research on the use of vitamin-supplemented feed for chickens in the study area. Therefore, the objective of this study was to identify the effect of vitamins on layers' health status, production capability, and egg quality (EW, ESG, and EST) in Ruby T44 layers, as well as whether vitamin powder in drinking water in addition to standard vitamin premix in ration is beneficial or a waste of money.

Methods

Study Area

This study was conducted in Soyama, Burji, southern Ethiopia. Ecologically, the area lies in moderate wetland ecosystem and has bimodal rainfall. There are two rainy season: heavy rain from April to June and light rain from September to November, with a mean annual rainfall of about 800–1,194 mm.

Study Population

This study was conducted on 120 Sasso layer chickens 22 weeks old that were randomly selected from the study farm. The chickens were divided randomly into an experimental group (n=60) and control group (n=60). Both groups had similar body weight and body condition. Simple random sampling was used to select the hens.

Procedure

The control group had access to clean tap water and commercial layer rations. The experimental group were provided with clean drinking water diluted with vitamin powder (100 g contained vitamin A 6,000,000 IU, vitamin D 1,000,000 IU, vitamin E 2,000 IU, vitamin K 1,000 mg, vitamin B 2,000 mg, and vitamin C 20,000 mg) at 3 g per 5 L and commercial layer rations. Both groups were kept in different rooms of equal size (4×4 m) with identical design, ventilation systems (closed to the west and east, open to north and south). On the chicken house floor, there was a box layer which used to keep the chicken away from the ground. The deep letter was put on the box layer.

Both groups were fed equal layer rations formulated, with 125 g per day for each chicken. In the control group, each drank 230–250 mL clean tap water and in the experimental group each drank 230–250 mL diluted with with vitamin powder at a ratio of 0.25 g per 250 mL water. Twelve observations were made throughout the study period, with one observation per week. As indicated in Table 1 each observations mortality Mortality, egg production, and egg quality were recorded carefully.

Data Analysis

Data were put into a Microsoft Excel worksheet and analyzed using SPSS 20. Differences between the groups were determined using *t*-tests, and $P<0.05$ was considered statistically significant.

Results

Mortality

Throughout the study period, average mortality was recorded once per week. As shown in Table 2, the decrease in mortality in the study group compared to the control group was significant ($P<0.05$): 5% (three of 60) in the study group and 13% (eight of 60) in the control group.

Table 1 Commercial ration formulations for starters, growers, and layers

Ingredient	Starter composition in 100 kg, %	Grower composition in 100 kg, %	Layer composition in 100 kg, %
Maize	45.9	52.9	50.4
Wheat bran	7.5	7.5	7.5
Dried and ground trifolium	2	2	2
Ground bone and meat	4	4	4
Noug-seed cake	37	30	30
Limestone	1	1	4.5
Ground bone	2	2	1
Salt	0.35	0.35	0.35
Vitamin and mineral mix	0.25	0.25	0.25

Notes: Vitamin powder (100 g) contains vitamin A 6,000,000 IU, vitamin D 1,000,000 IU, vitamin E 2,000 IU, vitamin K 1,000 mg, vitamin B 2,000 mg, and vitamin C 20,000 mg.
Abbreviations: IU, International unit; KGkg, kilogram; mg, milligram; vit, vVitamin.

Table 2 Effect of supplementary vitamin powder in drinking water on layer mortality

	Observation	Mean	SE	SD	95% CI
Study group	12	0.25	0.13	0.45	0–0.5
Control group	12	0.66	0.18	0.65	0.3–1.02
Difference (*df*)	–	0.41	–	–	–

Notes: t_{cal}=1.86; *df*=22; $t_{critical}$=1.77.

Egg Production

Egg production is indicated in Table 3. At the end of each week, the number of eggs laid was counted. There was a significant increase in eggs laids in the study group compared to the control group (P<0.05), with average egg production per week in the control group of 279.5±3.80 and in the experimental group 256±4.81.

Egg Weight

At the end of every week, 20 eggs were taken randomly and each weighed by a digital electronic balance. As shown in Table 4, there was no significant difference in mean egg weight between the study group (59.99±0.92 g) and control group (59.34±0.95 g). This meant that the extra vitamin powder in the drinking water did not bring about a change in egg weight.

Egg-Specific Gravity (ESG)

At the end of every week, the ESG of each of the 20 eggs taken randomly was measured by flotation in saline water Table 5. The dependent variable was ESG and the independent variable vitamin powder. The difference between the

Table 3 Effect of supplementary vitamin powder in drinking water on egg production

	Observation	Mean	SE	SD	95% CI
Study group	12	279.5	1.09	3.80	277.35–281.65
Control group	12	256	1.39	4.81	253.28–258.72
Difference (*df*)	–	0.41	–	–	–

Notes: t_{cal}=13.72; *df*=22; t_{table}=1.77. There was a significant increase in the study group compared to the control group (P<0.05) in average egg production per week (279.5±3.80).

Table 4 Effect of supplementary vitamin powder in drinking water on egg weight

	Observation	Mean	SE	SD	95% CI
Study group	12	59.99	0.26	0.92	59.47–60.51
Control group	12	59.34	0.27	0.95	58.80–59.87
Combined	24	59.66	0.19	0.93	59.29–60.03
Difference (*df*)	–	0.65	–	–	–

Notes: t_{cal}=1.70; *df*=22; t_{table}=1.77.

Table 5 Effect of supplementary vitaminpowder in drinking water on egg-specific gravity

	Observation	Mean	SE	SD	95% CI
Study group	12	1.068	1.54×10^{-3}	5.33×10^{-3}	1.064–1.071
Control group	12	1.061	1.75×10^{-3}	6.06×10^{-3}	1.057–1.068
Combined	24	1.065	1.39×10^{-3}	6.83×10^{-3}	1.061–1.068
Difference (*df*)	–	0.007	–	–	–

Notes: t_{cal}=1.54; *df*=22; t_{table}=1.77.

groups was not significant: $1.068\pm5.33\times10^{-3}$ in the study group and $1.061\pm5.33\times10^{-3}$ in the control group, showing that extra vitamin powder in the drinking water did not bring about a change in ESG.

Eggshell Thickness (EST)

At the end of every week, the EST of each of the 20 eggs taken randomly was measured by flotation in saline water (Table 6). The dependent variable was EST and the independent variable vitamin powder. There was a significant increase in EST ($P<0.05$), with average EST in the study group 0.36±0.048 mm and the control group 0.32±0.040 mm. This meant that extra vitamin powder in the drinking water enhanced EST.

Discussion

This study revealed that extra vitamin powder of 0.25 g per 250 mL water result in a significant decrease in Sasso layer mortality compared to those getting vitamin premix in feed rations only. A similar study showed that the effect of feeding different vitamin mixtures in addition to standard vitamins on chick mortality and acute death syndrome[10] decreased mortality rates. Egg quality is influenced by diet variation and storage duration, hence the need to further explore the role of additives in enhancing egg quality.[4] In this study, extra vitamin powder in drinking water enhanced egg production significantly compared to vitamin premix in feed rations only. This result agreed with

Table 6 Effect of supplementary vitamin powder in drinking water on EST

	Observation	Mean	SE	SD	95% CI
Study group	12	0.36	0.0138	0.048	0.33–0.38
Control group	12	0.32	0.0115	0.040	0.29–0.34
Combined	24	0.34	0.0094	0.046	0.31–0.36
Difference (*df*)	–	0.007	–	–	–

Notes: t_{cal}=7.08; *df*=22; t_{table}=1.77.

a study on the influence of high dietary vitamin E and vitamin C supplementation on egg production and plasma characteristics in hens.[10,11]

Extra vitamin powder in drinking water enhanced EST, similar to previous research[4] on the effect of adding vitamins and minerals in powder form on egg production and egg quality and on the effects of two supplemental vitamin premixes on egg quality of Isa Brown layer chickens.[12] Vitamin supplementation is fundamental to improving the health of layers. During high egg production, chickens are exposed to stress, so extra vitamins are helpful in controlling disease via increased immunostatus.[4,12] There were no statistically significant differences in egg weight or ESG between the groups. This finding is in agreement with past research[13] on the effect of adding vitamins and minerals in powder form on egg production and egg quality.

Conclusion

This study identified that vitamin supplementation is very important, as it increases the health status and profitability of poultry by decreasing layer mortality and increasing egg production. Egg weight showed a significant change; however, ESG and EST showed no variation. EST is directly related to breakage resistance, meaning that the extra vitamin powder also enhanced eggshell strength.

- For poultry production, vitamin supplements are very important to enhance egg-laying performance and quality.
- Feeding poultry rations with vitamin premix and drinking water with vitamin powder will decrease mortality. Therefore, it is advisable that vitamin-rich rations and vitamins diluted in water be used in order to make poultry healthier.
- In general, vitamin supplementation in drinking water in addition to feed rations is very important to increase the productivity and profitability of poultry farms.

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Ethics

This research was conducted in accordance with University of Gondar animal research and ethics guidelines. The University of Gondar Research Ethics and Review Committee approved the study protocol (CVMAS 44/2021), and informed verbal consent was obtained from the poultry farm.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. Fentie T, Abebe B, Kassa, T. Small-scale family poultry production in north Gondar: characteristics, productivity and constraints, Livestock. *Res Rural Dev.* 2013;25(9).
2. Alemneh T, Getabalew M. Exotic chicken production performance, status and challenges in Ethiopia. *Int J Vet Sci*. 2019;5:2640–7604.
3. Desalegn J. *Epidemiology of Village Chicken Diseases: a Longitudinal Study on the Magnitude and Determinants of Morbidity and Mortality- The Case of Newcastle and Infectious Bursal Disease* [MSc Thesis]. Ethiopia: Addis Ababa University; 2015.
4. Balogun AA, Odunsi AA. Effects of two supplemental proprietary vitamin-mineral premixes, blend of phyto-additives and storage duration on egg quality of Isa Brown layer chickens. *Nigerian J Anim Sci*. 2020;22(2):296–305. (ISSN:1119-4308).
5. Fisseha M, Abera M, Tadelle D. Assessment of village chicken production system and evaluation of the productive and reproductive performance of local chicken ecotype in Bure district, North West Ethiopia. *Afr J Agric Res*. 2010;5(13):1739–1748pp.
6. Jacob J, Wilson P, Miles H, Mather F. Factors affecting egg production in back yard poultry system, University of Florida. *Science*. 2016;17 (1):234–239.

7. Abudabos M, Aljumaah R, Algawaan A, Sornokh H, Atiyat R. Effects of hen age and egg weight class on the hatchability of free range indigenous chicken eggs. *Rev Bras Cienc*. 2017;19(1):33–40. doi:10.1590/1806-9061-2016-0264
8. Amin A, Adel Feizi H, Ashrafzadeh T, Hosein N. Effects of heat stress on acid-base imbalance, plasma calcium concentration, egg production and egg quality in commercial layers. faculty of veterinary medicine. Iran: Islamic Azad University of Tabriz; 2013.
9. Amhara National Regional State Bureau of Agriculture and Rural Development. Poultry development and marketing strategy. Bahir Dar, Ethiopia; 2006.
10. Ethiopian Agricultural Research Organization. Summary of Livestock Research Strategy; 2000.
11. Farhad A, Fariba R. Factors affecting quality and quantity of egg production in laying hens: a review, Department of Animal Science, Faculty of Nursing and Obstetric, 12 Islamic Azad University. Kurdistan, Iran: Sanandaj Branch; 2011.
12. Setsumi M, Mahlehla M. The effect of egg size (weight) on the egg shell thickness, egg yolk and hatchability in koekoek chickens Department of Animal Science. National University of Lesotho; 2020.
13. Mohamed K, Eva T . Relationship between eggshell thickness and other eggshell measurements in eggs from litter and cages. To cite this article: Italian Journal of Animal; 2014.