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EGG QUALITY CHARACTERISTICS, EGG NUMBER, AND BODY WEIGHT OF SPENT LAYERS FED WITH DIFFERENT LEVELS OF $NaHCO_3$

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One hundred and twenty spent (Babcock) egg-laying hens available at the age ot 90 weeks were randomly divided into 12 experimental units of ten hens each. These experimental units were randomly allotted to four treatment groups viz., A, B, C, and D with three replications each. Groups A, B, and C were fed on a layer mash diet supplemented with 2%, 4% and 6% Na HCO_3, respectively, while group D was kept on simple commercial layer ration which served as the control. The maximum shell thickness (0.34± 0.03 mm) was recorded in birds which were served with 4% $NaHCO_3$ in the feed and the minimum (0.29 ± 0.03 mm) in the control group. The fewest eggs with weak shells were recorded in birds served with 2% and 4% $NaHCO_3$ in the feed (3.7± 1.0 and 3.6± 1.0, respectively) while the most occurred (7.4± 0.6) in birds which were served with normal feed. The greatest number of eggs (4. 7 ± 1.0) were produced by the birds which were served with 2% $NaHCO_3$ in the feed while the least (3.7 ± 1.2) by the birds which were supplemented with 6% $NaHCO_3$ in the feed and the control group (3,9 ± 0.9). Haugh unit and yolk index values did not show any significant variation the levels of $NaHCO_3$ supplementation in the feed. The largest associated with body weight (1.58 ± 0.11 kg) was gained by the birds supplemented with 4% $NaHCO_3$ in the feed.

Key words: egg quality, sodium bicarbonate, layers, egg number, body weight

INTRODUCTION

During manual layer feed formulation, the concentration of anions and cations in the feed is often ignored, especially the levels of Cl- and HCO_3-, Although during computerized feed formulation some nutritions consider Cl- levels in feed, no attention is paid to the Cl-level of individual ingredients. Thus in low crude protein diets, synthetic lysine is added, which is available as L-lysine hydrochloride, for increasing the Cl - in the system. This leads to anion imbalance, clinically known as acidosis. The acid-base imbalance leads to many physiological abnormalities, for example, the increased Cl- level causes poor egg shells by reducing the relative concentration of HCO_3 -in the oviduct (Springer, 1976).

Weak shells, under practical conditions with aging hens, are a major problem of the poultry industry in Pakistan, resulting in considerable economic losses. Soft shelled and shell less eggs decrease egg production gradually in aged hens (Ottinger, 1991). To overcome the problem of anion and cation imbalance in aged hens, the commercial layer ration is supplemented with sodium bicarbonate as a rich source of bicarbonate may help shell formation and improve shell quality leading to increased egg number (Jordan, 1990). Thus, the present experiment was undertaken as an attempt to determine the effect of feeding diets containing $NaHCO_3$ upon egg shell quality and egg number.

MATERIALS AND METHODS

The study was conducted using 120 spent (Babcock) egg-laying hens available at the age of 90 weeks at the Poultry Research Centre, University of Agriculture, Faisalagad. These hens were randomly divided into 12 experimental units of ten hens each. These experimental units were randomly allotted to four treatment groups with three replications each. Groups A, B, and C were fed on a layer mash diet supplemented with 2%, 4% and 6% $NaHCO_3$ respectively, while group D was kept on a simple commercial layer ration which served as the control. The birds were maintained in simple, single-deck type cages. The following observations were recorded during the experiment.

Shell Thickness: Shell thickness was recorded using an average of three measurements taken from the broader end, the girth and from the pointed end by using a micrometer screw gauge. Prior to measurement, shell membranes were removed (Yoselewitz and Balnave, 1989).

Weak Shell: The number of eggs with weak shells was also recorded during the period of experiment for each unit and group-wise variations were calculated.

Egg Production: The number of eggs per experimental unit was recorded daily to convert to number of eggs per bird for the experimental period.

Interior Egg Quality: Randomly selected eggs i. e. 2 eggs per experimental unit taken at weekly intervals totalling 24 were used to study the following parameters: Haugh Unit: (Ratio between egg weight and albumen height). Each egg was weighed, broken and poured into a Petri dish. Albumen height (mm) was noted from two different places with the help of a spherometer according to Panda (1996).

$$H. U. = 100 \log \left[H - \frac{-/G\,(30W^{\cdot 37} - 100) + 1.9}{100} \right]$$

where H. U. = Haugh unit, H = albumen height (mm); W = weight of egg in grams; G = the gravitational constant i. e. 32.2 and 37, 1.9, 100 are constant values. Yolk

Index: (Ratio between yolk height and yolk diamemter). A Vernier caliper was used to measure the yolk diameter (the average of two measurements). A needle containing a moveable rounded loop was dipped into the yolk and the dipped portion of the needle was measured on the scale (cm) to note the yolk height according to Panda (1996).

Body Weight: The body weight (kg) of each bird was taken every week during the experiment.

Statistical Analysis. The data obtained was subjected to statistical analysis using Completely Randomized Design and significant differences between the means were compared using Duncan's Multiple Range test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Maximum shell thickness (0.34 ± 0.03 mm) was observed in birds treated with 4% sodium bicarbonate and minimum (0.29 ± 0.03 mm) in birds fed with the control diet (Table 1). This shows that supplementation with $NaHCO_3$ led to a significant improvement in shell thickness compared with control birds. Similarly thicker egg shells in layers supplemented with sodium bicarbonate in the diet were also observed by Frank and Burger (1965), Howes (1967), Mongin (1970), and Charles (1973). Sodium bicarbonate, after absorption, is split into Na^+ and HCO_3- ions, liberating HCO_3- in the system which corrects the acid-base imalance and HCO_3- combines with Ca^+ to form calcium carbonate, which is the main structure of the shell. The bird has also its own system of HCO_3- production through respiration but this system may fail to provide the required HCO_3-concentration during metabolic acidosis due to increased Cl- concentration in the blood (Springer, 1976). Therefore, sodium bicarbonate serves as a source of exogenous HCO_3-. In the present study shell thickness increased with increasing level of $NaHCO_3$ in the feed but the optimum level of supplementation for maximum shell thickness was 4%. The higher (6%) than optium level of sodium bicarbonate did not show beneficial results, which might be due to an increased blood pH (i. e. HCO_3- creates alkaline pH) and the shell formation may be affected by alkaline pH of blood (Teeter et al., 1985).

The number of shell-less eggs was reduced significantly with the supplementation of $NaHCO_3$. This might b due to better physiological activity of the oviduct. Since a significant improvement in shell thickenss is an indication of better physiological function of the oviduct, then it seems to be logical that the number of shell less eggs should also be reduced. These results are in line with the findings of Ernst et al. (1975).

Most eggs (4. 7 ± 1.0%) were produced by the birds fed 2% supplemental sodium bicarbonate in the feed and the least (3.7 ± 1.2%) by the birds which were served with 6% $NaHCO_3$ or normal fedd (3.9± 0.9%). There was an improvement in shell quality and reduction in the number of shell-less eggs in the presence of sodium bicarbonate, indicating more efficient physiological activity of the oviduct which resulted in a significant ($P < 0.01$) improvement in egg production. Moreover, sodium bicarbonate is a good source of Na^+ and feeding with a diet having high sodium contents may improve egg production (Whitehead and Shannon, 1974).

Table 1. Egg quality characteristics, egg number, and body weight in spent layers supplemented with different levels of NaHCO3 in the feed.

Groups	Shell thickness (mm)	Weak shell	Egg number	Haugh unit	Yolk index	Body weight (kg)
			Mean ± SD			
Control	0.29^{c}	7.40^{a}	3.90^{b}	69.64	0.38	1.51^{b}
	±0.03	±0.60	±0.90	±10.52	±0.02	±0.07
2% $NaHCO_3$	0.33^{b}	3.70^{c}	4.70^{a}	70.70	0.39	1.51^{b}
	±0.03	±1.00	±1.00	±13.28	±0.01	±0.06
4% $NaHCO_3$	0.34^{a}	3.60^{c}	4.30^{ab}	73.19	0.39	1.58^{a}
	±0.03	±1.60	±0.80	±11.76	±0.02	±0.11
6% $NaHCO_3$	0.33^{b}	5.00b	3.70^{b}	72.24	0.38	1.51^{b}
	±0.03	±0.60	±1.20	±10.50	±0.02	±0.07

Column-wise similar super scripts show statistically non-significant variations at.05.

Haugh unit values were found to be 70. 70 ± 13.28, 73.19 ± 11.76, 72.24 ± 10.50, whereas yolk index values were 0.39 ± 0.01, 0. 39 ± 0.02, 0.38 ± 0.02 for 2, 4 and 6% bicarbonate, respectively. It is clear that there was no improvement in these properties of the egg. This might be due to an aging effect (North, 1984). A diet containing sodium bicarbonate, did not result in a significant improvement in interior quality of eggs (Whitehead and Shannon, 1974 and Ernst et al., 1975).

The greatest body weight (1. 58 ± 0.11) was observed in the birds fed on 4% sodium bicarbonate. Sodium bicarbonate improved the body weight of layers (Harms, 1982). Body weight of layers has a direct impact on egg production and low body weight is a prerequisite of better egg production. It is a basic requirement that sodium bicarbonate supplementation in the feed should also be evaluated on the basis of body weight of layers. Low body weight (1.51 ± 0.06) was found in the birds fed with the normal diet as well as 2% and 6% sodium bicarbonate in the feed. Sodium bicarbonate may cause metabolic alkalosis which increases HCO_3- in the metabolic pool of the bird. This may be reflected as low egg production as well as less gain in body weight along with weak egg shells, because the alkalosis may decrease the amount of carbon dioxide available for egg shell formation (Teeter et al., 1985).

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NOSIVOST, KVALITETA JAJA I TELESNA MASA NOSILJA HRANJENIH RAZLIČITOM KOLIČINIM $NaHCO_3$ U OBROKU

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SADRŽAJ

U eksperimentu je korišćeno 120 nosilja (Babcock), starosti 90 nedelja, koje su po slučajnom izboru podeljene u 12 eksperimentalnih jedinica. Eksperimentalne grupe A, B, C i kontrola D su formirane od po tri jedinice. U hranu za grupe A, B i C dodavano je 2, 4 i 6% Na HCO3, po redosledu, dok je grupa D hranjena komercijalnom hranom za nosilje. Najveća debljina ljuske (0.34 + 0.03 mm) je utvrđena u grupi B, a minimalna (0.29 + 0.03 mm) u D grupi. Najmanje jaja sa slabo ljuskom je utvrđeno u grupama A i B (3..7 + 1.0 i 3.6 + 1.0, po redosledu), a najviše u kontrolnoj grupi (7.4 + 1.0). Najveća nosivost je zabeležena u grupi A (4.7 + 1.0), a najmanja u grupi C (3.7 + 1.2) i kontrolnoj grupi (3.9 + 0.2). Najbolji prirast je utvrđen kod ptica koje su dobijale obrok sa 4% Na HCO3.