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A preliminary Assessment of the Impact of Honey on the Reproductive Performance of Naked Neck Hens

Key words

honey;
naked neck;
egg quality;
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Abstract: Honey is natural nectar that bees gather from a variety of flowers. Different chemicals found in honey are essential for the growth of tissues and organs in all living things. The goal of the current study was to compare the effects of three different honey concentrations [0 g (control), 5 g (group A), and 10 g (group B)] on the reproductive efficiency and egg quality attributes of naked neck hens over a 35-day period. A total of 90 (72♀:18♂) naked neck hens (75 weeks old) were stratified at random into three experimental groups, each with three replicates of 10 birds (8♀:2♂) each, under a completely randomized design (CRD). The experimental groups—control, A, and B received supplemental treatments of honey in drinking water at concentrations of 0 g/liter, 5 g/liter, and 10 g/liter, respectively. One-way ANOVA with CRD was used to analyze the data. In comparison to the control and group A, group B had significantly increased egg production, egg fertility, and egg hatchability. However, statistical analysis revealed no changes ($P>0.05$) in the fertile hatch rate between the treatment groups. In the first and second week of the experiment, there were no statistically significant differences between the eggs from different treatments in terms of eggshell weight and eggshell ratio. There were also no significant differences between three treatments in the thickness of the eggshells in the first week of the experiment. Nonetheless, when compared to the control and group A, a positive ($P<0.05$) effect was seen in the group B's overall means of egg weight, eggshell weight, eggshell ratio, and eggshell thickness in the third week of the experiment. Similar to this, group B had significantly higher mean values for egg length, egg breadth, egg shape index, egg volume, and egg surface area than did group A and the control. In conclusion, honey at a concentration of 10 g/liter (w/v) may prove effective when given orally to elderly laying hens.

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Introduction

High ambient temperatures during the summer season cause laying hens to exhibit a range of symptoms known as heat stress (1). Heat stress drastically reduces egg production, quality, and size (2) and, if unchecked, could be fatal (3). Laying hens exposed to heat stress react by producing fewer eggs, smaller eggs, and eggs with thin shells or no shell at all (4). The majority of our farmers utilizes artificial and commercial anti-oxidants and stress relievers to help birds deal with heat stress (5). Using natural plant extracts and materials properly can replace the need for drugs like antibiotics, anti-oxidants, and stress relievers (6, 7, 8). One of the potential natural antioxidant sources is honey (9). Honey is a naturally occurring bee product that includes moisture, sugars like glucose and fructose, enzymes like catalase and reductase, trace minerals like copper, zinc, and calcium, vitamins like vitamin A, C, and E, as well as flavonoids and phenolic acids (10). Additionally, honey contains water-soluble vitamins such vitamin C, nicotinic acid, thiamine, biotin, riboflavin, cyanocobalamin, and pyridoxine (11). The beneficial effects of honey on both surgical and medical disorders have been proven through scientific investigation. According to Viuda-Martos et al. (2008) (12) and Tan et al. (2009) (13), honey has antifungal, antibacterial, antiseptic, antioxidant, and anti-inflammatory properties. It also boosts the immune system.

Honey is referred to as an erotic or aphrodisiac because it raises testosterone levels, sperm counts, and libido levels (14). Honey is a comprehensive food supply and a good source of soluble vitamins, glucose, fructose, potassium, magnesium, sodium, sodium chloride, calcium, iron, sulphur, and phosphates, which help to maintain reproductive health (9). According to Bains (1996) (15), adding ascorbic acid to stressed birds' diets can increase their ability to lay eggs, grow quickly, have thicker shells, and have stronger shells. Our body uses vitamin E for a number of purposes. The most significant role that vitamin E plays is as an intracellular antioxidant (16). The impact of dietary vitamin E on both male and female reproductive performance was confirmed by Evans et al. (1922) (17) and Putnam and Comben (1987) (18). Vitamin E is associated with reproductive processes in humans, poultry, and other animal species. Lack of this vitamin results in early embryonic death, failure to carry the zygote in females, and defective sperm production in males (19). Trace minerals participate in the chemical reactions that occur in living things and are crucial for growth and correct development, including the production of eggshell and bone (20). The most crucial trace minerals, which are found in eggs and necessary for both the development of chicken embryos and the productivity of broiler breeders, are manganese, zinc, and copper (21). Thin eggshells, low egg production, low fertility, poor hatchability, poor feathering, dermatitis, and an increase in embryo bone deformities are all symptoms of copper, zinc, and manganese deficiency, which has a direct impact on embryo development and breeder performance (22).

There have been several studies on the beneficial effects of honey on other animals, but there has been much less research on how honey affects laying hens' reproductive efficiency. The goal of the current study was to assess the potential positive effects of supplemental honey at various doses on egg production, fertility, hatchability, and egg quality in laying hens.

Material and methods

Location and duration of the experiment

The objective of the current investigation was to determine the impact of various honey concentrations [0 g (control), 5 g (group A), and 10 g (group B)] on the reproductive efficiency and egg quality of naked neck hens over the course of 35 days in the months of June and July 2018. This study was carried out at the Department of Poultry Science, The University of Agriculture Peshawar, Pakistan. The winters are brief, cool, and dry while the summers are hot, humid, and clear. Peshawar's long-term yearly average temperature ranges from 28°C to 40°C. The average yearly relative humidity is recorded between 40% and 75%. A total of 90 (72♀:18♂) naked neck hens (75 weeks old) were randomly divided into three experimental groups, each with three replicates of ten birds (8♀:2♂) each, under a completely randomized design (CRD). The experimental groups—control, A, and B received supplemental treatments of honey in drinking water at concentrations of 0 g/liter, 5 g/liter, and 10 g/liter, respectively. The experimental birds were maintained in a well-ventilated open-sided house in separate pens with a deep litter system. All laying hens came from the same flock, from the same housing system. The experimental birds were allowed to mat naturally, and an 8:2 female-to-male ratio was maintained for a total of five weeks, which included a two-week adaption period and a three-week laying period. A commercial layer ration was fed to the birds throughout the duration of the trial (Table 1). Internal house temperature was recorded daily by using a minimum-maximum thermometer placed at the center of the house, and ranged between 18 and 28°C and 32 and 36°C, respectively. Relative humidity (RH) remained in the range of 40 to 70%. A light schedule of 16L:8D was followed for the entire study period. The University of Agriculture Peshawar, Pakistan, authorized the guidelines under which the study was carried out.

Data collection

Reproductive performance

Three separate batches of eggs, each with a 7-day break between them, were placed in the incubator. A total of 96 hatching eggs per treatment (32/replicate) were set in incubator. Clean eggs were placed in incubators that were kept at 37.5 °C and 75% humidity for the 18-day incubation period. All of the eggs were stored in plastic trays for a week

Table 1: Composition of the ration offered to the experimental birds

Ingredient (%)	**Quantity**
Corn	62.30
Guar meal	3.00
Raw rice bran	4.00
Soybean meal 44%	1.31
Rape seed meal	2.00
DL-Methionine	0.23
L-threonine	0.08
Calcium carbonate	8.29
Salt	0.11
Corn gluten	1.00
Canola meal	8.00
Cotton seed meal	4.00
Lysine sulphate	0.36
Premix[1]	0.30
L-Tryptophan	0.01
Fish meal 47%	1.00
Feather meal 54%	4.00
Quantum 600FTU	0.01
Total	100.00
Nutrient (%)	
Crude protein	16.5
Metabolizable energy (kcal/kg)	2902
Calcium	3.55
Phosphorous	0.66
Sodium	0.16
Potassium	0.61
Lysine	0.82
Methionine	0.41

at the necessary temperature (65 °F) before being placed in the incubator. On the seventh day of incubation, eggs were candled to remove the infertile ones. The eggs were then put to the hatcher at the beginning of the 1% piping. Each batch's hatching process took 21 days to finish. Each group's hatched chicks were counted and documented in order to determine the percent fertility (F), hatch of fertile (HF), and hatchability (H). The fertility percentage was determined as the number of fertile eggs in relation to the total number of eggs laid multiplied by 100, while the hatchability percentage was determined as the number of chicks that actually hatched as a percentage of the total number of eggs set. Similar to this, the hatch of fertile percentage was determined as the number of chicks that have hatched was divided by the total number of fertile eggs.

Egg morphometry and quality

Daily egg production of each group of the experimental birds was recorded. Egg production percentage was determined as the ratio of total egg production to the number of females, multiplied by 100. Egg morphometry (egg shape index, egg volume and egg surface area) and quality (egg weight, eggshell weight, eggshell ratio or eggshell percentage, and eggshell thickness) of nine eggs from each experimental group was studied on weekly basis. Egg weight was measured using a digital scale with a 0.01 g precision, and egg length and breadth were measured using a digital vernier caliper with a 0.01 cm precision. Shape index was calculated as the ratio between egg width and egg length (23), whereas egg volume and egg surface area were determined using two different formulas for each parameter and averaging the results (24). A digital scale that had a 0.01 g accuracy was used to measure the weight of the eggshell. The eggshell ratio was calculated as the percentage ratio of eggshell weight to egg weight. Eggshell ratio was calculated by weighing albumen-free eggshell. The thickness of the eggshell was measured without inner and outer shell membranes using a dial pipe gauge and without splitting the shell. The average of three different readings from three different locations was used to calculate the eggshell thickness.

Statistical analysis

Using SAS's GLM technique, one-way ANOVA was used to analyze the data under CRD (25). Using the procedure outlined by Steel and Torrie (1981) (26), means were compared to see if there was a significant difference using the least significant difference test. The statistical model employed was as follows:

$$Y_{ij} = \mu + S_i + \varepsilon_{ij}$$

Where, Y, each observation; μ, Population mean; Si, Effect of ith treatment; Ɛij, Random error.

Results

Reproductive efficiency

In the current study, adding honey to drinking water in various concentrations had a substantial impact on naked neck hens' reproductive performance (Table 2). Over the course of the experiment, group B experimental birds produced more eggs, had more fertile eggs, and were more likely to hatch than group A and the control birds (P<0.05). The addition of honey at various quantities to drinking water did not, however, result in any differences (P>0.05) in the hatch of fertile.

Egg quality traits

The statistical analysis revealed significant differences in egg quality parameters across treatment groups (Table 3). The egg weight rose significantly during the course of the experiment when high levels of honey (10 g w/v) were introduced (P<0.05). Similarly, during the third week of the trial, the oral administration of honey significantly improved the eggshell weight and eggshell ratio as compared to the other groups at a higher dose (10 g, w/v). However, no significant differences were found between the treatment groups during weeks 1 and 2 of the study period. During weeks 2 and 3 of the trial, the oral administration of honey significantly increased the eggshell thickness as compared to the other groups at a higher dose (10 g, w/v). However, no differences were observed between the treatment groups during the first week of the trial.

Egg morphometric traits

Table 4 displays the overall impact of various honey supplementation dosages on egg morphometric characteristics. During weeks 2 and 3 of the trial, the oral administration of honey significantly increased the mean value of egg length as compared to the other groups at a higher dose (10 g, w/v). However, no differences were observed between the treatment groups during the first week of the trial. Similarly, during the third week of the trial, the oral administration of honey at a greater dose (10 g, w/v) significantly increased the egg width, egg shape index, egg volume, and egg surface area when compared to the other groups. However, no significant changes were discovered between the treatment groups during weeks 1 and 2 of the study period.

Discussion

Reproductive efficiency

As mentioned above, this study was conducted in hot, humid season (June, July). According to Mashaly et al. (2004) (27), heat stress can result in less egg number (3, 28), reduced fertility and hatchability (29). Internal and external egg quality deteriorations happening as a result of heat stress may also contribute to reduced fertility and hatchability (30). The study shows that when white leghorn hens are subjected to high temperatures there is a decline in reproductive activity leading to reproductive failure and poor egg quality. Research findings presented in Ebeid et al. (31) suggest that reproduction of the animal is highly affected with high temperatures. In the present study, egg production, fertility, and hatchability was, however, significantly higher throughout the experimental period due to administration of higher dose of honey in drinking water. Honey is a rich source of minerals, vitamins, phenolic compounds and anti-oxidants (32, 33), which may add to overcome the adverse effects inflicted by heat stress. The present results agree with the findings of other researchers (8, 11, 34, 35, 36, 37, 38, 39, 40). Similar to the current findings, Lika et al. (40) concluded that honey supplementation in drinking water has some good impacts (up to 25%) on laying bird's egg production. Such variations in fertility and hatchability resulted from the addition of honey are also supported by the results of El-Neney et al. (41) who evaluated that honey supplementation to layer diets at different levels significantly improved fertility and hatchability as compared to control. This variation might be attributed to the fact that honey provides protection against infertility (42).

Table 2: Impact of honey on overall reproductive performance of naked neck hens[1]

Treatments[2]	Parameters[3]			
	EP (%)	F (%)	HF (%)	H (%)
Control	$35.71^{b} \pm 0.72$	$73.33^{b} \pm 1.66$	86.30 ± 0.30	$63.33^{b} \pm 1.66$
Group A	$36.10^{b} \pm 0.75$	$73.33^{b} \pm 1.66$	88.43 ± 2.29	$65.00^{b} \pm 2.88$
Group B	$56.74^{a} \pm 1.10$	$80.20^{a} \pm 0.68$	89.95 ± 3.59	$74.42^{a} \pm 0.75$
P-value	0.001	0.022	0.219	0.015

Mean in the column having different superscript are significantly different (P>0.05), [1]Values are means ± SE of 3 replicates (n = 3),[2]Control= untreated with honey, Group A= treated with 5 g of honey per liter drinking water, Group B= treated with 10 g of honey per liter drinking water, [3]EP= egg production, F= fertility, HF= hatch of fertile, H= hatchability

Table 3: Impact of honey supplementation on egg quality traits of naked neck hens[1]

Parameters[2]		Treatments[3]			
		Control	Group A	Group B	P-value
Week 1	EW (g)	$49.36^b \pm 0.54$	$49.12^b \pm 0.22$	$51.19^a \pm 0.42$	0.006
	ESW (g)	5.36 ± 0.06	5.43 ± 0.03	6.00 ± 0.35	0.350
	ESR	10.86 ± 0.16	11.05 ± 0.01	11.73 ± 0.73	0.582
	EST (mm)	0.30 ± 0.00	0.30 ± 0.00	0.31 ± 0.00	0.161
Week 2	EW (g)	$49.07^b \pm 0.45$	$49.45^b \pm 0.11$	$52.41^a \pm 0.10$	0.007
	ESW (g)	5.45 ± 0.08	5.50 ± 0.05	6.12 ± 0.30	0.174
	ESR	11.11 ± 0.16	11.12 ± 0.08	11.69 ± 0.58	0.379
	EST (mm)	$0.30^c \pm 0.00$	$0.31^b \pm 0.00$	$0.32^a \pm 0.00$	0.008
Week 3	EW (g)	$49.10^c \pm 0.04$	$50.25^b \pm 0.23$	$52.90^a \pm 0.11$	0.000
	ESW (g)	$5.46^b \pm 0.06$	$5.65^b \pm 0.09$	$6.36^a \pm 0.10$	0.019
	ESR	$11.09^b \pm 0.14$	$11.14^b \pm 0.19$	$12.37^a \pm 0.22$	0.017
	EST (mm)	$0.30^c \pm 0.00$	$0.31^b \pm 0.00$	$0.33^a \pm 0.00$	0.004

Mean in the row having different superscript are significantly different ($P<0.05$), [1]Values are means ± SE of 3 replicates (n = 3), [2]EW= egg weight, ESW= eggshell weight, ESR= eggshell ratio, EST= eggshell thickness, [3]Control= untreated with honey, Group A= treated with 5 g of honey per liter drinking water, Group B= treated with 10 g of honey per liter drinking water

Table 4. Impact of honey supplementation on egg morphometric traits of naked neck hens[1].

Parameters		Treatments			
		Control	Group A	Group B	P-value
Week 1	EL (cm)	5.30 ± 0.00	5.30 ± 0.00	5.30 ± 0.00	0.896
	EW (cm)	4.03 ± 0.03	4.06 ± 0.03	4.06 ± 0.03	0.896
	ESI (%)	75.62 ± 0.73	75.92 ± 0.73	75.77 ± 0.73	0.571
	EV $(mm)^3$	42.79 ± 0.73	43.49 ± 0.73	43.53 ± 0.73	0.899
	ESA $(mm)^2$	61.25 ± 0.54	61.76 ± 0.52	61.80 ± 0.54	0.904
Week 2	EL (cm)	5.30b ± 0.00	5.31b ± 0.00	5.32a ± 0.00	0.012
	EW (cm)	4.06 ± 0.03	4.10 ± 0.00	4.11 ± 0.300	0.301
	ESI (%)	76.72 ± 0.71	76.30 ± 0.02	77.37 ± 0.36	0.273
	EV $(mm)^3$	43.48 ± 0.71	44.29 ± 0.02	44.71 ± 0.36	0.249
	ESA $(mm)^2$	61.72 ± 0.50	62.38 ± 0.03	62.71 ± 0.25	0.207
Week 3	EL (cm)	$5.30^c \pm 0.00$	$5.33^b \pm 0.00$	$5.35^a \pm 0.00$	0.000
	EW (cm)	$4.10^c \pm 0.00$	$4.12^b \pm 0.00$	$4.15^a \pm 0.00$	0.000
	ESI (%)	$77.30^b \pm 0.2$	$77.24^b \pm 0.02$	$77.59^a \pm 0.04$	0.074
	EV $(mm)^3$	$44.21^c \pm 0.2$	$44.89^b \pm 0.02$	$45.87^a \pm 0.04$	0.000
	ESA $(mm)^2$	$62.27^c \pm 0.04$	$62.93^b \pm 0.04$	$63.73^a \pm 0.01$	0.000

Mean in the row having different superscript are significantly different ($P<0.05$), [1]Values are means ± SE of 3 replicates (n = 3), [2]EL= egg length, EW= egg width, ESI= egg shape index, EV= egg volume, ESA= egg surface area, [3]Control= untreated with honey, Group A= treated with 5 g of honey per liter drinking water, Group B= treated with 10 g of honey per liter drinking water

Egg quality and morphometry

As stated earlier, this study was executed in the months of June and July, which are notorious for being the hottest. Egg weight is one of the essential phenotypic parameters that affect egg quality and hen reproductive soundness (43). Laying hens exposed to heat stress react by producing fewer eggs, smaller eggs, and eggs with thin shells or no shell at all (4, 44). The decrease in the eggshells thickness and weight due to high temperatures (45) leads to increased egg breakage during the storage and transportation. In the current study, egg quality and morphometric traits were, however, improved significantly (P<0.05) due to administration of higher dose of honey in drinking water. Honey is a rich source of minerals, vitamins, phytochemicals and antioxidants (32, 33). Crozier et al. (46) demonstrated that use of phytochemicals like polyphenols with antioxidant activity helps to solve heat stress in chickens. These results are in agreement with those of Osakwe and Igwe (39) and Abioja et al. (5), who recorded a positive impact of honey's supplementation on egg quality and morphometry in egg laying birds. Similarly, honey has no significant effects on hen egg shell thickness at initial two weeks, while significant effects were recorded at last week. This variation could be attributed to the increase in Ca and P digestibility, also may be due to the high content of acid derivatives such as benzoic, 4-hydroxy-benzoic acid in propolis, which favor Ca and P salts higher solubility in the diet (47). Honey is a rich source of ascorbic acid (0.5 mg/100 g) (33). Hence, significant effect of 10 g (w/v) honey on egg shape index, egg volume, and egg surface area might be due to the maximum availability of vitamin C in 10 g (w/v) as compared to other groups.

Conclusion

The current findings suggest that oral honey administration at a concentration of 10 g (w/v) in drinking water may enhance egg production, egg fertility, egg hatchability, and egg characteristics in egg-laying birds during the hot season. The limitation of this study is that it was conducted for a total of five weeks, which included a two-week adaption period and a three-week laying period. The experimental period and parameters could be expanded in future studies to validate the results more effectively.

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Preliminarna ocena vpliva medu na reproduktivno zmogljivost kokoši z golim vratom

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Izvleček: Med je naravni nektar, ki ga čebele nabirajo na različnih cvetovih. Različne kemikalije, ki jih najdemo v njem, so bistvene za rast tkiv in organov vseh živih bitij. Cilj te študije je bil primerjati učinke treh različnih koncentracij medu [0 g (kontrola), 5 g (skupina A) in 10 g (skupina B)] na reproduktivno sposobnost in kakovost jajc pri kokoših z golim vratom v 35-dnevnem obdobju. Skupaj 90 (72 ▯ 18 ▯)kokoši z golim vratom (starih 75 tednov) je bilo naključno razdeljenih v tri poskusne skupine, vsaka s tremi ponovitvami po 10 kokoši (8 ▯ 2 ▯)v popolnoma randomiziranem vzorcu (CRD). Poskusne skupine – kontrola, A in B – so dobile med v pitni vodi v koncentracijah 0 g/liter, 5 g/liter in 10 g/liter. Za analizo podatkov je bila uporabljena enosmerna ANOVA s CRD. V primerjavi s kontrolno skupino in skupino A so se pri skupini B znatno povečale proizvodnja jajc, oplojenost in valilnost jajc. Vendar statistična analiza ni pokazala sprememb ($P > 0,05$) v deležu oplojenih jajc med skupinami. V prvem in drugem tednu poskusa med jajci iz različnih obravnav ni bilo statistično značilnih razlik glede mase jajčne lupine in razmerja jajčnih lupin. Prav tako med tremi obravnavami v prvem tednu poskusa ni bilo statistično značilnih razlik v debelini jajčne lupine. Kljub temu je bil v primerjavi s kontrolo in skupino A v tretjem tednu poskusa opažen pozitiven ($P < 0,05$) učinek pri skupnih povprečnih vrednostih mase jajc, mase jajčne lupine, razmerja jajčne lupine in debeline jajčne lupine v skupini B. Podobno je imela skupina B bistveno višje povprečne vrednosti dolžine jajc, širine jajc, indeksa oblike jajc, prostornine jajc in površine jajc kot skupina A in kontrolna skupina. Zaključimo lahko, da se med v koncentraciji 10 g/liter (m/v) lahko izkaže za učinkovitega, če se daje peroralno starejšim kokošim nesnicam.

Ključne besede: med; goli vrat; kakovost jajc;plodnost; valilnost