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Effect of Honey Supplementation on Egg Production, Egg Weight, Hatchability and Fertility of Naked Neck Hens

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ABSTRACT

Honey is natural nectar which is collected by bees from different variety of flowers. Honey comprises different substances which are vital for tissues/organs development in all living organism. To investigate the positive effect of honey in naked neck pullets, the present project was designed to explore its effect on some reproductive and productive parameters in birds. Seventy five weeks old naked neck hens were fed honey supplemented feed. The laying hens were randomly divided into three experimental groups with 03 replicates and each replicate consisted of 10 birds. Egg production, egg weight, egg hatchability and fertility was significantly ($P<0.05$) higher in birds fed on honey supplemented feed as compared with control group. A positive ($P<0.05$) impact was recorded in the overall mean value of egg weight. The results indicated that oral administration of honey at the level of 10 g (w/v) in drinking water was effective in improving egg production, egg weight, egg hatchability and egg fertility in birds during hot season.

INTRODUCTION

Poultry farming played a vital rule by producing eggs and meat to the rapidly growing human population (Ali *et al*., 2019; Ullah *et al* 2023). High environmental temperature during hot season elicits a series of responses in laying hens termed as heat stress (Ayo *et al*., 2011). Heat stress causes drastic reduction in egg production, quality and size (Kenan, 2005) and might be lethal if not controlled (Adeyemi *et al*., 2022). Laying hens under heat stress respond to heat stress in terms of reduced egg size, low egg production and finally thin shelled or shell-less eggs (Melesse *et al*., 2013). Most of our farmers make use of synthetic and commercial anti-oxidants and anti-stress to help the birds cope with heat stress. Proper utilization of natural plant extracts and materials are alternatives to the use of chemicals such as anti-oxidants, anti-stress and antibiotics (Ali *et al*., 2023; Ahmad *et al*., 2024; Mushtaq *et al*., 2024). Honey is one of the promising sources of natural anti-oxidants (Estevinho *et al*., 2008). Honey is a natural product of bees which contains moisture, sugars such as glucose and fructose, enzymes such as catalase and glutathione reductase, trace elements such as iron, copper, zinc and calcium, vitamins such as vitamin A, C and E as well as some flavenoids and phenolic acids (Michalkiewicz *et al*., 2008). The water-soluble vitamins such as vitamin C, nicotinic acid, thiamine, biotin, riboflavin, cyanocobalamin and pyridoxine are also present in the honey (Ciulu *et al*., 2011). Studies have confirmed the positive effects of honey on both surgical and medical conditions. Honey possesses antifungal, antibacterial, antiseptic, antioxidant and anti-inflammatory properties (Tan *et al*., 2009).

Honeys increase the level of testosterone, sperm count and libido level that's why honey is known as erotic or aphrodisiac (McLoone *et al*., 2021). As honey contain fructose and glucose so it can be used to obtain considerable amount of energy thus enhancing sexual virility (Bagde *et al*., 2013). Honey is complete diet rich in water-soluble vitamins, glucose, fructose, potassium, magnesium, sodium, sodium chloride, calcium, iron, sulphur and phosphates which help in maintaining the

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reproductive health (Estevinho *et al*., 2008).

Several studies have indicated that the hatchability can be affected by cyanocobalamin (Landauer, 1978). Highest hatchability was obtained in white leghorns by supplying 0.00345 to 0.00360 g of B12 per kilogram of the diet (Tuite and Austic, 1974). The positive effect of vitamin C was obtained for laying hens in terms of egg production when the birds were reared under heat stress or increased stocking density (Njoku *et al*., 1989). It was also notified that hatchability of Pekin ducks can be improved by ascorbic acid (Kontecka *et al*., 2001).

Deficiency of copper, zinc and manganese have direct effect on embryo development and performance of breeder and causes thin eggshell, low egg production, low fertility, poor hatchability, poor feathering, dermatitis and increased embryo bone abnormalities (Kienholz *et al*., 1961).

There are several trace minerals such as zinc that act as an active element of various systems of enzymes like carbonic anhydrase is a zinc dependent enzyme which is also known as uterine enzyme of laying hens and its deficiency may results in poor egg production (Tabatabaie and Nazari, 2007). Along with the calcium, carbonates ions are also important for the formation of calcium carbonates while carbonic anhydrase is necessary for the formation of that carbonate ions which in turn influence on eggshell quality (Roberts, 2004). Hence the current project was designed to study the impact of honey on the productive and reproductive performance of naked neck hens.

MATERIALS AND METHODS

The present research evaluated the impact of honey on egg production, egg weight, hatchability and fertility of naked neck hens during hot season. Honey was supplemented at different concentrations in drinking water. The experimental birds were raised under similar environmental conditions. The experimental birds were allowed to natural mating and ratio of males to females (2:8) were kept for a period of five weeks which include two weeks of adaptation and three weeks of laying period, the pre-hatching parameters were calculated before setting of eggs in incubator for fertility and hatchability analysis.x

Bird's husbandry and experimental design

A total of 72 female and 18 male naked neck birds having age of 75 weeks were obtained from university poultry farm. All the birds were kept in the cages under similar environmental conditions. Commercial layer ration was fed to the experimental birds. The division of the birds was made in three groups with a further division of three replications in each group and each replicate consisting of 10 birds with a ratio of 2:8. To assess the effect of honey on study parameters, the experimental birds in Groups A, B and C were provided with 5 (w/v), 10 (w/v) and 0 (control) g of honey per liter of drinking water respectively for a period of five weeks in the months of June and July. The trial period lasted for 5 weeks total, with an adaptation period of 2 weeks and three weeks of egg collection to explore the impact of honey on egg productive performance of naked neck hens.

Collection of data on egg

The collection of eggs was done in each group separately after two weeks of adaptation period. Daily eggs production of each group was stored in the plastic trays for a period of one week at required storage temperature (65°F). Daily egg production was recorded in each group of experimental birds. The percentage of egg production in each replicate was calculated as the ratio of total number of eggs laid in a particular replicateto number of laying hens in each replicate.

$$\text{Egg production (\%)} = \frac{\text{Total number of eggs produced in a particular replicate}}{\text{Total number of laying hens in that particular replicate}} \times 100$$

Digital weighing scale was used to measure the egg weight.

The pre-hatching parameters included in this study were calculated before setting of eggs in incubator while hatchability in each group of the experiment was determined at the end of incubation. Before setting the eggs in incubator, all the eggs produced were stored at required temperature in plastic tray for a period of one week. The eggs were set in incubator at the interval of 7 days. A total of 3 batches were set in incubator during experimental trials. In the setting compartment the temperature was 37.5°C and relative humidity 75%. Hatched chicks of each group were counted and recorded. The total egg hatchability and fertility were calculated by using the following formulae.

$$\text{Total egg hatchability} = \frac{\text{Chicks hatched}}{\text{Total eggs set}} \times 100$$

$$\text{Fertility} = \frac{\text{Total eggs set} - \text{Infertile eggs}}{\text{Total eggs set}} \times 100$$

Statistical analysis

Complete randomized design (CRD) was used for the analysis and computing of the collected data. For significance, the difference means were reviewed by least significant difference (LSD) (Guide, 2010).

RESULTS

Effect on egg production

Oral administration of honey in drinking water was found significantly ($p<0.05$) by enhancing egg production (Table I). During first week egg production was significantly higher in the group B followed by the similar egg production in the group A and control group. At the end 2nd week significantly higher egg production was recorded in the group B followed by group A and control group. egg production of Group A was not different from control group. At the end of third week significantly higher egg production was recorded in the group B followed by group A while lower was recorded in the control group.

Table I. Impact of honey supplementation on egg production and egg weight in naked neck hens.

Groups	Dose level (W/V) g	1st week	2nd Week	3rd week
Egg production				
Control	00	$35.71^{b}\pm0.72$	$36.74^{c}\pm0.75$	$36.93^{c}\pm0.22$
Group-A	05	$36.10^{b}\pm0.75$	$40.20^{bc}\pm0.25$	$42.12^{b}\pm0.15$
Group-B	10	$52.74^{a}\pm1.10$	$56.53^{a}\pm2.14$	$59.24^{a}\pm1.16$
P-value		0.0006	0.0224	0.0185
Egg weight				
Control	00	$49.36^{b}\pm0.54$	$49.07^{b}\pm0.45$	$49.10^{c}\pm0.04$
Group-A	05	$49.12^{b}\pm0.22$	$49.45^{b}\pm0.11$	$50.25^{b}\pm0.23$
Group-B	10	$51.19^{a}\pm0.42$	$52.41^{a}\pm0.10$	$52.90^{a}\pm0.11$
P-Value		0.0064	0.0070	0.0001

Means in the column having different superscript are significantly different at $\alpha=0.05$. Control= (untreated with honey), Group-A, treated with 5g of honey per liter drinking water, Group- B, treated with 10g of honey per liter drinking water.

Effect on egg weight

The impact of different levels of honey supplementation in drinking water on egg weight is indicated in (Table I). The honey supplementation was found to be useful in improving the egg weight throughout the experimental period. Supplementation of high level of honey (10g w/v) has significantly ($p<0.05$) enhanced the egg weight throughout the experimental period. More ever low level (5g w/v) and control group indicated marked significance with each other during 3rd week of experimental trials. However, the most significant and consistent improvement in egg weight was observed due to higher doses (10g w/v) of honey supplemented during experimental trials.

Effect on hatchability and fertility

Oral administration of honey in drinking water was found to be effective ($p<0.05$) on overall hatchability and fertility (Table II). Hatchability was higher for the group B supplemented with 10g (w/v) honey in drinking water followed by Group-A (5g w/v) and Control (0.00g w/v). similarly, the fertility was also significantly recorded in the group B supplemented with 10g (w/v) honey in drinking water followed by Group-A (5g w/v) and Control (0.00g w/v).

Table II. Impact of honey on hatchability and fertility of naked neck hens.

Groups	Dose level (W/V)g	Hatchability (%)	Fertility (%)
Control	00	$63.33^{b}\pm1.66$	$72.93^{b}\pm1.66$
Group-A	05	$65.00^{b}\pm2.88$	$73.33^{b}\pm1.66$
Group-B	10	$71.42^{a}\pm0.75$	$79.20^{a}\pm0.68$
P- value	-	0.010	0.025

For abbreviations and statistical detail, see Table I.

DISCUSSION

The recorded egg production was significantly different throughout the experimental period due to administration of honey in drinking water. Deficiency of pyridoxine, ascorbic acid and calcium brought significant effect on egg production in laying hens (Ahmed and Othman, 2013). As honey is good source of pyridoxine (0.024mg/100g), ascorbic acid (0.5mg/100g) and calcium (6mg/100g) (Bagde *et al*., 2013). The present results supported the findings of Weiss (1979) who reported that deficiency of pyridoxine significantly effect on egg production and hatchability in egg type birds. The present results are in-line with the Kontecka *et al*. (2011) who recorded significantly improved egg production in laying hens using dietary ascorbic acid under high environmental temperature or stocking density. Estevinho *et al*. (2008) and Ahmed and Othman (2013) reported that honey is rich in all water-soluble vitamins, carbohydrates and minerals such as ca, mg, K, S, Fe, Zn, PO_4 while ca is one of the most important nutrient required for optimal egg shell quality and egg production in laying hens. In contrast to present study, Keshavarz (1996) suggested that supplementation of dietary calcium had no positive effect on egg production.

The present study was found to be effective in improving overall egg weight throughout the experimental trials. Zn, Mn and Cu affect the overall egg weight in laying hens (Monica *et al*., 2020). As honey is a rich source of Zn (0.22mg/100g) Mn (0.02-2 mg/100g) and Cu (0.2-0.6 mg/100g) (Bagde *et al*., 2013). As per results 10 g (w/v) showed significant improvement in egg weight gain. The oral administration of honey might be effective in improving the egg weight due to maximum availability of Zn, Mn and Cu in 10g (w/v) as compared to control and 5 g (w/v). The present results are in agreement with Abioja *et al*. (2016) who recorded positive impact of honey on average egg weight in egg type of birds. The present results are according to Monica *et al*. (2020) who observed significant enhancement in the average egg weight due to supplementation of Zn+Mn+Cu in organic form. The present study is also in line with Maciel *et al*. (2010) who reported that supplementation of Cu, Zn and Cu resulted in increased egg weight. The present results are in disagreement to Saldanha *et al*. (2010) as the treatment groups showed non-significance in terms of egg weight due to supplementation of Zn, Mn, Cu, Fe in organic forms.

The existing results showed considerable differences in terms of total egg hatchability due to administration of honey at different levels in drinking. The most effective ($p<0.05$) outcome was recorded in Group-B due to supplementation of higher level (10g w/v) of honey as compared to other treated groups. Thiamine and ascorbic acid affect the overall hatchability and embryonic development in laying hens (Naber *et al*., 1954; Landauer, 1961; Weiss, 1979). As honey is a rich source of thiamine (0.02mg/100g) and ascorbic acid (0.5mg/100g) (Bogdanov *et al*., 2008; Bagde *et al*., 2013). The present results are in agreement with Ciulu *et al*. (2011) who reported that honey contains all water soluble vitamins including ascorbic acid, pantothenic acid, thiamine, nicotinic acid, riboflavin, biotin, pyridoxine, cyanocobalamin and folic acid whereas ascorbic acid possess antioxidant properties and supplementation of ascorbic acid has significantly positive impact on hatchability in broiler chickens. The observations of Weiss (1979) are also in line with the present findings who recorded positive impact of ascorbic on egg production and hatchability in laying hens. Kontecka *et al*. (2006) recorded significant effect of ascorbic acid only under heat stress but there is no information in the available literature concerning non-significant effect of ascorbic acid on hatchability. The present findings are in line with Edens (2015) and Fasanmi *et al*. (2009) who observed a positive impact on egg hatchability due to supplementation of selenium in the diet of laying hens. The present results are also in line with Adebiyi *et al*. (2014) who also reported that supplementation of selenium has beneficial effect on hatchability as compared to other treated groups. However, the present findings are not in agreement with Surai (2012) who recorded non-significant results in terms of egg hatchability due to supplementation of selenium as compared to other treatment groups.

The results of present study showed significant enhancement in egg fertility for group-B due to supplementation of honey in drinking water as compared to control and group-A. Deficiency of Zn, Cu and Fe affect the spermatogenesis and overall fertility in laying hens (Bagde *et al*., 2013). As honey is a rich source of Zn (0.22mg/100g), Fe (0.42mg/100g) and Cu (0.02-0.6mg/100g) (Gammanpila *et al*., 2007). As per results 10 g (w/v) showed significant improvement in egg fertility. This improvement in egg fertility might be due to the maximum availability of Zinc, iron and copper in 10g (w/v) as compared to control and 5 g (w/v).

Noel *et al*. (2023) recorded significant impact of dietary zinc on fertility of laying birds. Honey is excellent source of calcium, potassium, manganese, copper and zinc and iron (Adebiyi *et al*., 2014). As per results 10 g (w/v) of honey in drinking water showed significant improvement in egg fertility. This improvement in egg fertility might be due to the maximum availability of Zn (0.22mg/100g), Fe (0.42mg/100g), and Cu (0.2-0.6mg/100g) in 10g (w/v) as compared to control and 5 g (w/v).

The present findings are in accordance with Washburn and Stino (1973) who recorded a significant decline in egg fertility when Japanese quails were fed a diet low in copper and iron. Adebiyi *et al*. (2014) also suggested that supplementation of $ZnSO_4$ had no effect on fertility percentage as compared to control. Hassan *et al*. (2012) and Elsaadany (2016) reported that the main reason of high fertility may be Zn utilization which may improve the quality of ova and semen as well as sexual virility in broiler breeder chicken and laying hens. Although egg fertilization and embryo development are completely dependent on genetic and non-genetic factors which originates from male and female but traditionally, fertility in poultry was considered as an independent trait either of female or male (Gregorc *et al*., 2012).

CONCLUSION

Findings of present project concluded that addition of honey up to 10g per liter (w/v) in drinking water resulted in better reproductive performance (egg production (%), egg fertility and hatchability) than other experimental groups.

DECLARATIONS

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Ethical statement

The experimental work was approved by the Advanced Studies and Research Board (ASRB) (No.532/ASRB/UAP), The University of Agriculture, Peshawar, KP, Pakistan.

Generative AI and AI-assisted technology statement

The authors declare that no use of AI technology was used in this manuscript

Statement of conflict of interest

The authors have declared no conflict of interest.

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