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Honey administration in laying pullets during hot-dry season does not alter lipids and vitamin A content of eggs

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Abstract

An experiment was carried out to determine the effect of honey on lipid profile and vitamin A content of eggs from laying pullets during hot-dry season. One hundred and twenty laying pullets (aged 28 weeks) used were randomly assigned to 3 doses of honey: 0 (0H), 10 (10H) and 20ml honey (20H) per litre water for 16 weeks. Each treatment group consists of 4 replicates with 10 birds per replicate. During a 16-week experimental period, data on egg cholesterol, HDL, LDL, VLDL and vitamin A were determined and subjected to one-way analysis of variance. Egg cholesterol, HDL, LDL, VLDL and vitamin A concentrations were not significantly (P>0.05) affected by dosage of honey in drinking water. Birds on 0H, 10H and 20H recorded 1163.8, 1154.7 and 1160.0 mg/dL respectively for egg cholesterol and 129.8, 151.0 and 123.3 IU vitamin A, respectively. In conclusion, administration of honey in drinking water of laying pullets to combat heat stress during hot-dry season may not affect egg lipids and vitamin A content.

Keywords: anti-oxidants, fat, cholesterol, climate change, heat stress

Introduction

Poultry birds in the tropics are continuously under the onslaught of heat stress (Rozenboim *et al.*, 2007; Olubodun *et al.*, 2015). High environmental temperature that usually exceeds the thermal comfort of the birds, coupled with raised relative humidity increases the heat load. The adverse effects of elevated pen temperature on the performance of layer chickens are well documented. Heat Stress (HS) is associated with suppressed feed intake, live-weight, egg production, egg weight, shell quality and internal qualities of eggs in laying chickens (Kadim *et al.*, 2008; Ayo *et al.*, 2011; Khan *et al.*, 2011; Abioja *et al.*, 2014). It triggers hypothalamic-hypophyseal-cortex axis releasing corticosterone. Circulating corticosterone exhibits cytotoxic properties and enhances the generations of reactive oxygen species (Yu, 1994). These are radicals that cause perturbations in oxidative balance, overwhelming the natural oxidative defence mechanisms in the cells. The use of phyto-chemicals which possess or are suspected to possess efficacious anti-oxidant properties in the management of heat stress in poultry production is becoming more popular (Lee *et al.*, 2017). Honey has recently received attention as a candidate of possible natural sources of anti-oxidant in chickens (Abioja *et al.*, 2012; Wasagu *et al.*, 2013; Osakwe and Igwe, 2015; Oke *et al.*, 2016; Adekunle *et al.*, 2017) with some positive results. It contains no fat and cholesterol contents.

However, the use of honey must be with caution. It was reported that there were infiltrations of fat cells in the liver tissue of albino rats (Avwioro *et al.*, 2012) when honey was administered for a long period. This may result in non-alcoholic fatty liver disease or in other unpleasant conditions harmful to health if not well managed. It has been discovered that long term administration of honey caused deformation and atrophy of specific reproductive apparatus in laying chickens (Abioja,

Unpublished data). Other authors had earlier stated that chronic consumption of unprocessed Nigerian honey resulted in decreased bile flow, increased bile cholesterol and decreased plasma cholesterol in albino rats (Alagwu *et al.*, 2009). The fear that more cholesterol molecules especially much dreaded low-density lipoproteins may be deposited in the eggs of chickens offered honey is pervading the air. Besides, vitamin A content is important in human nutrition. Improvement in vitamin A content of eggs will go a long way in correcting its deficiency and contribute to the welfare of consumers. Millions of preschool-aged children in developing countries are suffering from vitamin A deficiency, which may lead to blindness (Underwood, 1998). The deficiency of vitamin A is a public health issue that needs attention. Fortification of eggs for the children will be a welcome idea, should honey help in achieving this. Report on vitamin A content of eggs from pullets fed honey is not readily available. Therefore, the present study was aimed at determining the deposition of cholesterols and vitamin A in eggs of laying pullets offered honey during hot-dry season.

Materials and methods

Experimental location and meteorological observations

This experiment was carried out at *Aiyedoto Farm Settlement*, Ojo Lagos, Nigeria (latitude 6° 27' 25"N, longitude 3°12' 21"E and altitude of 36 meter above sea level). The climate of the experimental site is humid, located in the rain forest vegetation zone of western Nigeria. Wet-and dry-bulb temperatures and relative humidity at the level of the birds in the pen at 0800 h and 1600 h were monitored throughout the experimental period. The temperature-humidity index was calculated from relative humidity and wet- and dry-bulb temperature data.

Experimental animals and management

One hundred and twenty *ISA Brown* layer chickens aged 28 weeks were used for the experiment which lasted 16 weeks. The birds were randomly allocated to three (3) treatments consisting 4 replicates and 10 layer birds per replicate. Birds in the three groups were supplied water for 16 weeks during hot-dry season with 0ml (Control), 10mL (10H) and 20mL (20H) honey per litre water, respectively. Standard ration was given *ad libitum to the birds for the experimental period.*

Data collection

Determination of lipids and vitamin A content in eggs

Two eggs were randomly collected from each replicates. The egg yolk was prepared by pooling and blending two yolks per sample. Samples were subjected to extraction and saponification. The lipoprotein content (total cholesterol, high-density lipoprotein (HDL), low-density (LDL) and very low-density lipoprotein (VLDL)) were measured by specific commercial kits. Vitamin A levels was determined using HPLC (Catignani, 1986).

Statistical analysis

Data collected was subjected to one-way analysis of variance (ANOVA) using SYSTAT (SYSTAT, 1992). Model: $Y_{ij} = \mu + T_i + \sum_{ij}$; where Y_{ij}= dependent variables, μ= population mean, T_i = i^{th} effect due to addition of honey to drinking water (i = 1,2,3), and $\sum_{ij}$= residual error. Means that are statistically different ($P<0.05$) were separated with Duncan's Multiple Range Test (DMRT).

Results

Table 1 shows the summary of meteorological observations during the experiment. Environmental temperature averaged 31.5°C during the experiment. Average temperature in the morning

(08.00h) and afternoon (16.00h) was 30.4 and 32.5°C, respectively. Wet-bulb temperature 27.8°C, 28.8°C and 28.0°C, and relative humidity of 82.3%, 76.7% and 79.5% were recorded in the morning, afternoon and on average, respectively. Administration of honey in drinking water did not significantly (P>0.05) influence egg cholesterol, high-density, low-density and very low-density lipoprotein (Figures 1-4). Figure 5 shows that vitamin A content of egg from laying pullets was not significantly (P>0.05) affected by different dosage of honey. Birds on 0H, 10H and 20H recorded 1163.8, 1154.7 and 1160.0 mg/dL, respectively for egg cholesterol. Vitamin A content in egg was 129.8, 151.0 and 123.3 IU for the three treatment groups, respectively

Table 1: Summary of meteorological observations during the experiment

Parameters	08.00h	16.00h	Average
Dry-bulb temperature (°C)	30.4	32.5	31.5
Wet-bulb temperature (°C)	27.8	28.8	28.0
Relative humidity (%)	82.3	76.7	79.5
Temperature-humidity index	83.8	86.0	84.9

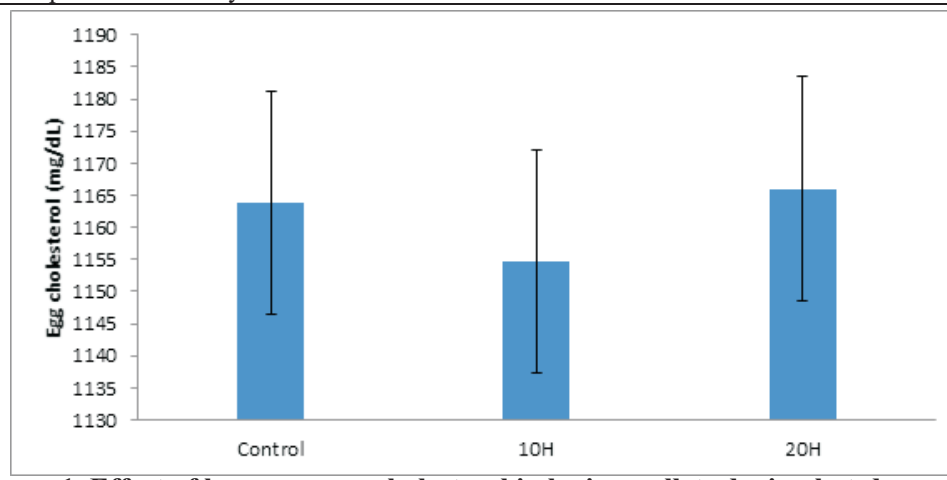

Figure 1. Effect of honey on egg cholesterol in laying pullets during hot-dry season

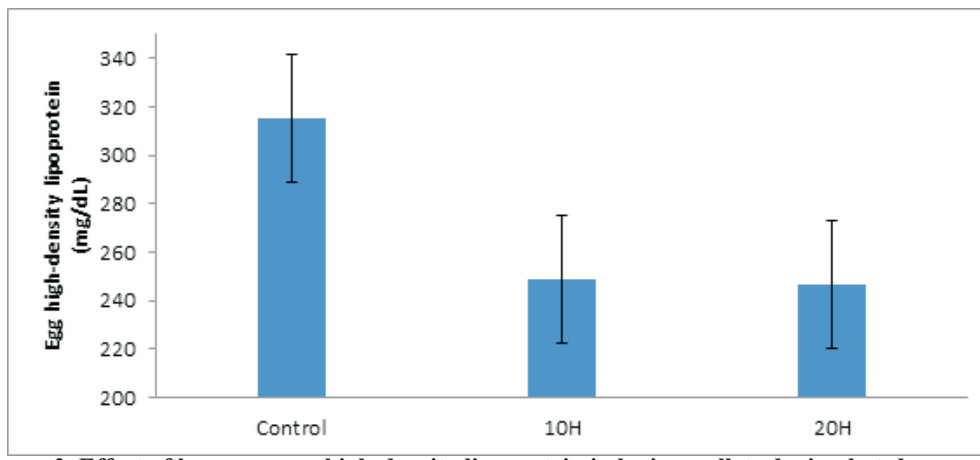

Figure 2. Effect of honey on egg high-density lipoprotein in laying pullets during hot-dry season

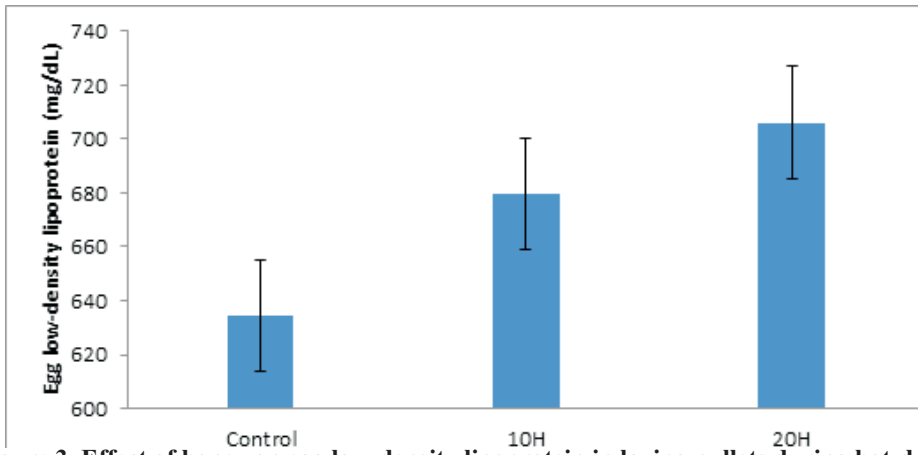

Figure 3. Effect of honey on egg low-density lipoprotein in laying pullets during hot-dry season

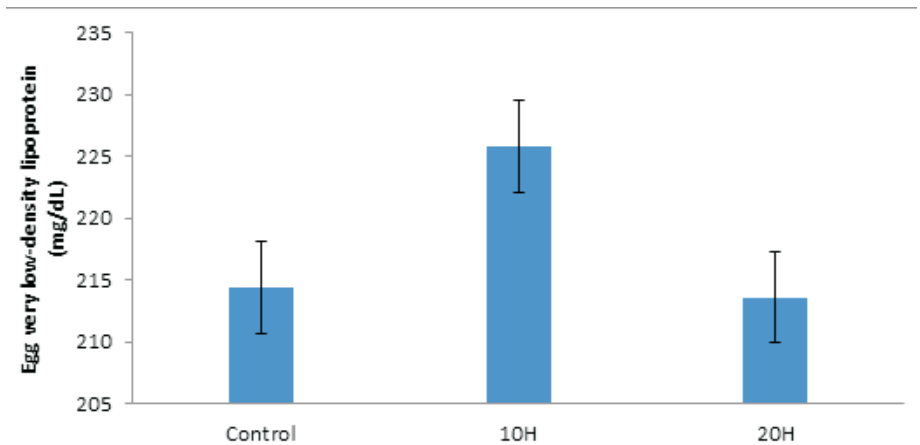

Figure 4. Effect of honey on egg very low-density lipoprotein in laying pullets during hot-dry season

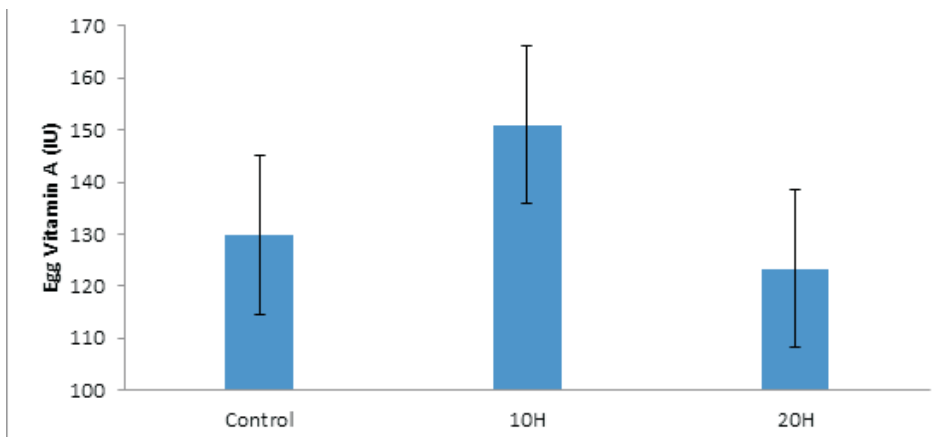

Figure 5. Effect of honey on egg vitamin A content in laying pullets during hot-dry season

Discussion

The problem of heat stress (HS) in poultry production comes to climax during the hottest months of the year. The period, termed hot season in the tropical regions (Abioja *et al.*, 2012; 2015), is characterised by environmental temperature that often exceeds (Abioja *et al.*, 2010). Optimal productivity in laying chickens is obtained when at pen temperature range of 16-25°C, beyond which hens exhibit signs of HS (Sahin *et al.*, 2006). The average temperature recorded during this study (31.5°C) is high enough to impose stress upon the birds, and even 6.5°C above the upper critical limit of recommended temperature range. The experimental location, Lagos is a coastal region, with relative humidity as high as 76.7-82.3% during the study. Detrimental effect of HS on birds is further aggravated by the elevated pen temperature coupled with high relative humidity (Ciftci *et al.*, 2005). Reproductive efficiency is negatively affected by heat stress in avians (Rozenboim *et al.*, 2007). Heat spell leads to direct and indirect losses in laying chicken production due to reduction in quantity and quality of eggs, increased morbidity and mortality, and low resistance to diseases (Ciftci *et al.*, 2005). HS is known to consecutively lower egg size, egg number and finally the egg quality. Honey has been of tremendous help in ameliorating the negative effects of HS in laying pullets. Its use in drinking water of layers at 20 mL per litre for 4 weeks improved egg hen-day production and shell thickness (Adekunle *et al.*, 2016). It resulted in increased egg mass in the first week as well (Abioja *et al.*, 2016). In this study however, no effects of honey were observed in egg lipid (cholesterol, VLDL, LDL and HDL) and vitamin A profiles. In another report, there were no effects of honey consumption for 7 days on plasma cholesterol, HDL, LDL and cholesterol HDL ratio in male Wister Albino rats (Aliyu *et al.*, 2012). In contrast, the same authors observed decreased level of VLDL. The present finding however agreed with Ramesh *et al.* (2009) that the use of herbal preparation Abana™ and garlic paste on lipid profile of layers had no significant influence on yolk cholesterol. Nobakht (2007) also reported that the inclusion of rice bran in layers diet did not significantly affect yolk cholesterol. Dietary vitamin E and Selenium ingested by hens has been reported to be carried into the eggs (Surai *et al.*, 2016). But here fat components were not transferred from the maternal systems into eggs produced by the treated pullets. The fact that honey administration in laying pullets during hot-dry season does not alter lipids content of eggs may be adduced to little or no fat content in honey. It has been confirmed by many authors that honey does not contain fat (Cantarelli *et al.*, 2008; Alvarez-Suarez, 2014; Chua and Adnan, 2014; Bogdanov, 2016). Some authors listed out the nutritional composition of honey without any reference to fat or lipid content (Ball, 2007; Adenekan *et al.*, 2012; Omoya *et al.*, 2014), while others reported little content of fat in honey from different countries and regions (Tan *et al.*, 1988; Singh and Kuar Bath, 1997; Buba *et al.*, 2013). The report on composition of different unifloral honeys in Bangladesh indicated that honey contains little amount of lipid and therefore not considered a good source of lipid (Singh and Kuar Bath, 1997; Buba *et al.*, 2013). In previous work with honey in poultry species, percentage abdominal fat was reported to remain constant in broiler chickens offered varying levels of honey in drinking water (Oke *et al.*, 2016). Other reports show a decrease in serum cholesterol level (Obun *et al.*, 2008).

In a study to determine the yolk retinol content in eggs from hens fed different

levels of dietary vitamin A, egg yolk retinol content increased linearly as maternal dietary vitamin A increased (Mendonça *et al.*, 2002). The authors concluded that the nutritional value of eggs, related to vitamin A, can be improved by dietary manipulation of hen diets. However, honey administration in drinking water did not improve the vitamin A content of egg yolk in the present study.

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