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# Effects of Sidewall Brooding Polymer Cover Colours on the Indoor Climatic Condition and Physiological Response of Broiler Chickens

**M. Adegbenro [a*], O. A. Ayeni [a], A. O. Jongbo [b], O. A. Adeyeye [a] and R. Akinfenwa [a]**

[a] *Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria.*
[b] *Department of Agricultural and Environmental Engineering, Federal University of Technology, Akure, Nigeria.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. Authors MA, O. A. Ayeni and AOJ designed the study. Authors MA, O. A. Ayeni, AOJ, O. A. Adeyeye and RA prepared the proposal for the study. Authors O. A. Adeyeye and RA prepared the first draft of the manuscript. Authors O. A. Ayeni and AOJ reviewed the first draft and author MA reviewed the second draft. All authors read and approved the final manuscript.*

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## ABSTRACT

**Aims:** This study seeks to evaluate the growth performance and physiological response of broiler chickens brooded with blue, black, white and green side-curtains. It is essential to ensure that the thermal conditions within the poultry building are controlled most especially in the tropical climate where temperature is observed to exceed the thermoneutral zones of broiler chickens. During the brooding stage of broiler chicks, suitable temperature and relative humidity is crucial to ensure the welfare of the chicks.

**Corresponding author: E-mail: www.futa.edu.ng, madegbenro@futa.edu.ng, 1305madegbenro@futa.edu.ng;*

**Methodology:** In this study, four (4) brooding polymer colours were used namely; white, blue, black and green. Two hundred and fifty (250) day-old-chicks were acquired from a reputable hatchery, only two hundred and forty was (240) used for this experiment. For each of the polymer colour treatments, there were sixty (60) birds which were further divided into six (6) replicates, that is ten (10) chicks per replicate in a Completely Randomized Design (CRD).
**Results:** The results of the study revealed that the highest average temperature during the brooding stage was observed in the green polymer and the lowest temperature observed in the black polymer covering in the early hours of the day. The lowest indoor humidity (8.97%) was observed in the second and fourth weeks, while the highest humidity (52.76%) was observed in the white polymer in the sixth week. The indoor temperature ranges between 33.16°C and 33.89°C. During the brooding stage, the highest temperature (33.89°C) was recorded in the first week, there were no significant differences among the treatments, the lowest indoor temperature (33.16°C) was observed in the third week (at the end of the brooding stage).
**Conclusions:** In conclusion, there was no significant difference in the cloaca temperature of the birds reared in the four (4) sidewall polymer covers, which implies that farmers can adopt any of the polymer covers.

*Keywords: Polymer; physiological; cloaca; climate; thermometer.*

## 1. INTRODUCTION

Maintaining chicks in their comfort zone, where they are not expending energy to gain or lose heat to maintain body temperature, is one of the objectives during brooding [1]. More energy is required to maintain body temperature when birds are maintained in environments that are below their preferred temperature range. The feed that is consumed will eventually be used to provide extra energy during cold periods, while birds tend to consume a lesser amount of feed during hot periods to maintain body temperature. Maintaining the right temperature when brooding is simply one aspect of adequate care and effective husbandry methods. The temperature of the air affects its capacity to hold moisture. Compared to cold air, warm air could hold more moisture. The percentage of water saturation in the air at any given temperature is referred to as relative humidity. The ability of the bird to cool itself by panting and the creation of ammonia are both influenced by the humidity level [2].

During the first two weeks of the chick's life, maintaining the proper temperature is essential for brooding chicks. Early in life, the chick lacks the ability to properly manage its metabolism and maintain its body temperature [3]. As a result, a chick's ability to maintain a healthy body temperature depends on the ambient temperature since the body temperatures of the chicks drop as the room temperature reduces [4]. However, the chick's body temperature increases as the temperature in the room increases. Poor growth, poor feed conversion, and greater susceptibility to disease could arise from chilling or overheating during this critical time [3]. So that the chicks do not have to use energy to sweat or produce heat through metabolism, proper brooding techniques must be done to keep its body temperature stable. According to [4], a chick begins to master the ability to control its body temperature between the 12th and 14th days after hatching. If the chick's body temperature changes by a degree, it could cause the chicks to be subjected to stress and if not managed as soon as possible, could result in death [3]. As the bird's body temperature fluctuates, it will attempt to adjust, which will often have a detrimental impact on performance. A day-old chick's body temperature is roughly 39 °C, but by five days of age, it would have reached 41.1 °C, the same as an [3]. Compared to adult birds, chicks are more tolerant to high temperatures, but prolonged high temperatures decrease performance and increase mortality [5].

The physiological processes of birds are externally controlled by light filters, which could also affect birds' growth and development [6]. Light spectra have an impact on broiler growth. When raised under blue or green light, broilers gain much more weight than those raised under red or white light [7]. Blue light enhances growth in older birds [7], but green light stimulates growth in young birds and accelerates muscular growth [8]. Red and blue light were shown to have worse effects on the fibre diameter of the breast and thigh muscles [9]. Green light is advised to be utilised up to day 17 and blue light afterwards [9]. The blended blue-green light system has also been employed in certain studies to improve broiler body weight [9].

Hesham and colleagues, however, only partially endorsed these findings [10]. Although the criteria were better in the case of blue light, they claimed that the conditions of the plumage, the health of the foot and toe, and development performance were not significantly impacted by light colour.

Another important component of light is colour. Human retinal pigments come in three varieties (red, green, and blue), whereas chicken retinal pigments come in two varieties (rhodopsin and iodopsin) [11]. Between 400 and 700 nm, the wavelengths of daylight are distributed rather evenly. Artificial lighting is frequently utilised in the most modern systems for managing chicken farms; thus, choosing the right lighting for the farm is essential. Birds' eyes (retinal photoreceptors) and the brain's photosensitive cells enable them to see light (extra-retinal photoreceptors). Birds are calmed by blue and green light, but those raised in red light are more active, showing increased walking, flying, head movement, litter scratching, body shaking, wing flapping, wing/leg stretching, feather plucking, aggression, and cannibalism [12]. Blue light encourages frequent meals, deep sleep, sitting, and idleness, whereas green light encourages drinking, preening, and dust bathing [12]. In this way, orange-red light increases reproduction, whereas blue-green light stimulates growth in chickens [13]. Different wavelengths of light stimulate the retina in different ways, which can alter behaviour and have an impact on growth and development [14]. Light spectra influence broiler growth. Compared to broilers raised in red or white light, those raised under blue or green light gain much more weight [7]. Blue light boosts growth in older birds [10], but green light accelerates muscle growth and stimulates growth in young birds [8].

## 2. MATERIALS AND METHODS

### 2.1 Experimental Site

The Federal University of Technology Teaching and Research Farm served as the site for this study. At the Federal University of Technology's Poultry Research Farm in Akure, Ondo State, Nigeria, the chicken house was built and assessed. Latitudes 7° 17' 03" to 7° 19' 06" north, and longitudes 5° 07' 02" to 5° 09' 05" east, are the coordinates for the place. It has two primary seasons, the rainy season (April to October) and the dry season, and has a humid tropical climate with maximum temperatures that range from 22°C to above 30°C (November to March). Around 2400 mm of rainfall there each year.

### 2.2 Experimental Chicks

Two hundred and fifty (250) day old Arbor Acre broiler chicks were obtained from a reputable hatchery and two hundred and forty chicks were (240) were randomly selected for the experiment on a mash diet. The chicks were divided into four (4) treatments of side-polymers namely; white side-polymer represents treatment 1 (control), blue polymer represents treatment 2, black polymer represents treatment 3 and green polymer represents treatment 4 which were used for brooding the chicks between two (2) – three (3) weeks to ascertain the physiological response of chicks to different colours of side-polymers, each of which contained six (6) replicates with ten (10) birds per replicate.

### 2.3 The Side-Polymers Materials

Four (4) side-polymers with different colours (white, blue, black and green) were purchased from local vendor in Akure, Nigeria. Each polymer was used to cover the pen during brooding to produce different vision to the chicks. The side-polymer were raised up at the beginning of the third week of keeping the chicks.

### 2.4 Body Temperature

The temperature of the individual birds was taken at the cloaca region of the birds throughout the experimental period. This was done in order to monitor the heat stress level of the broiler chicken within each treatment to ascertain the side-polymer colour that has the least stressor to the broiler chickens and also compare the results with the data from the indoor temperature and humidity sensors.

### 2.5 Temperature and Humidity Sensors Instrumentation

At the beginning of the experiment, Digital Humidity and Temperature (DHT11) sensors were installed at 0.2 m above the floor to measure the temperature and humidity all through the period of the experiment. Adequate floor space (13.25 m width) was provided in each treatment to avoid overcrowding, the floor space was 1.40 m x 1.06 m. The data from the sensors was monitored, processed and stored on the internet using a Wi-Fi module ESP8266. This was done to monitor the relationship between the indoor temperature and the relative humidity.

## 2.6 Experimental Diet

The commercial starter and finisher feed was purchased from a reputable feed mill industry and used at corresponding levels of development, this helped to ensure that the only source of variation in the experiment was the colour of side-polymer which represents the treatment. The experimental starter diet contained 22% crude protein and 3000kcal/kg metabolizable energy. This was given for the period of twenty-one (21) days, while the finisher diet contained 19% crude protein and 3200kcal/kg metabolizable energy which was given at twenty-two (22) to forty-two (42) days.

## 2.7 Vaccination of Experimental Birds

The birds were vaccinated against Newcastle disease (Gumboro and Lasota) between the first week and fourth week (Starter phase). Standard hygiene measures were maintained throughout the experimental period [15].

## 2.8 Statistical Analysis

Two hundred and forty was (240) broiler chickens were arranged in a Completely Randomized Design (CRD). The house was partitioned into four (4) sections in order to have four (4) treatments and each treatment had six (6) replicates with ten (10) birds each. Treatment 1 (white colour polymer), treatment 2 (blue coloured polymer), treatment 3 (black coloured polymer), and treatment 4 (green coloured polymer). The experiment was conducted in two phases, the brooding phase and the finishing phase. During brooding, starter feed from a reputable feed mill was measured and fed to the birds in each pen every 24 hours and the left-over feed was measured. The experiment lasted six weeks. All data collected from the experimental birds was subjected to one-way analysis of variance (ANOVA) using the general linear model procedure of SPSS (Version 24). Where significant differences were observed, New Duncan's Multiple Range Test was employed to separate the means. The level of significance was taken at (P<0.05). The statistical model is presented in equation 1.

$$Y_{ij} = \mu + A_i + \varepsilon_{ij} \quad (1)$$

Where: $Y_{ij}$ is individual observation, μ is general mean, $A_i$ is effect of treatment and $\varepsilon_{ij}$ is experimental error.

# 3. RESULTS AND DISCUSSION

The temperature within each polymer cover colours were measured and analysed. The results obtained are presented in Table 1 and Fig. 1. The indoor temperature ranges between 33.16°C and 33.89°C. During the brooding stage, the highest temperature (33.89°C) was recorded in the first week, there were no significant differences among the treatments, the lowest indoor temperature (33.16°C) was observed in the third week (at the end of the brooding stage). There were no significant differences (P>0.05) among the treatments.

The humidity within each polymer cover colours were measured and analysed. The results obtained are recorded in Table 2 and Fig. 1. The indoor humidity varied between 52.76% and 8.97%. Although, the highest humidity (52.76%) was recorded in the last week, there were no significant differences (P>0.05) among the treatments during the first four weeks of the study, the humidity varied significantly (P<0.05) during the last two weeks of the experiment. The lowest indoor humidity (8.97%) was observed in the second and fourth weeks, while the highest humidity (52.76%) was observed in the white polymer in the sixth week of the experiment. At the end of the experiment, the recorded humidity from the sensors was used to plot a graph for each treatment.

**Table 1. Indoor temperature of the experimental birds (°C)**

| Treatments | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 |
|---|---|---|---|---|---|---|
| T1 (White) | $33.89^{a}$ | $33.77^{a}$ | $33.16^{a}$ | $33.77^{a}$ | $33.77^{b}$ | $31.59^{a}$ |
| T2 (Blue) | $33.89^{a}$ | $33.77^{a}$ | $33.16^{a}$ | $33.77^{a}$ | $33.78^{b}$ | $31.57^{a}$ |
| T3 (Black) | $33.89^{a}$ | $33.77^{a}$ | $33.16^{a}$ | $33.77^{a}$ | $33.89^{a}$ | $31.40^{b}$ |
| T4 (Green) | $33.89^{a}$ | $33.77^{a}$ | $33.16^{a}$ | $33.77^{a}$ | $33.89^{a}$ | $31.24^{c}$ |
| P-value | 1.00 | 1.00 | 0.86 | 1.00 | 0.00 | 0.00 |

**Table 2. Indoor humidity of the experimental birds (%)**

| Treatments | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 |
|---|---|---|---|---|---|---|
| T1 (White) | 15.10[a] | 8.97[a] | 23.58[a] | 8.97[a] | 8.97[c] | 52.76[a] |
| T2 (Blue) | 15.10[a] | 8.97[a] | 23.60[a] | 8.97[a] | 10.31[b] | 48.60[b] |
| T3 (Black) | 15.10[a] | 8.97[a] | 23.62[a] | 8.97[a] | 15.10[a] | 48.78[b] |
| T4 (Green) | 15.11[a] | 8.97[a] | 23.61[a] | 8.97[a] | 15.10[a] | 52.41[a] |
| p-value | 1.00 | 1.00 | 0.90 | 1.00 | 0.00 | 0.00 |

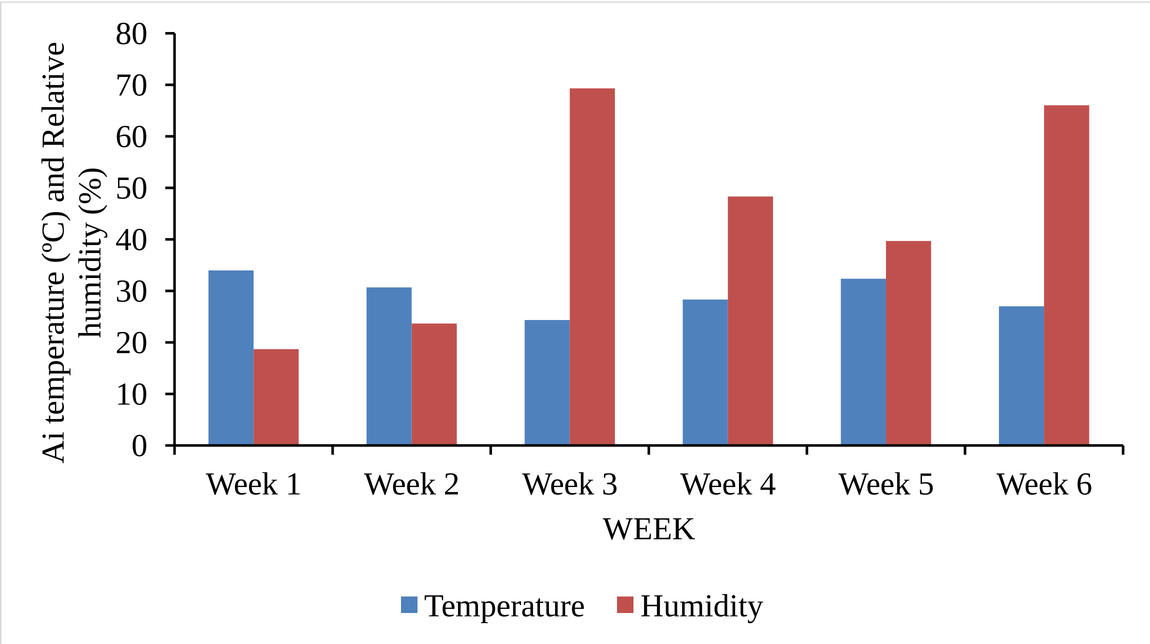


**Fig. 1. The air temperature and relative humidity of the indoor condition of the white polymer**

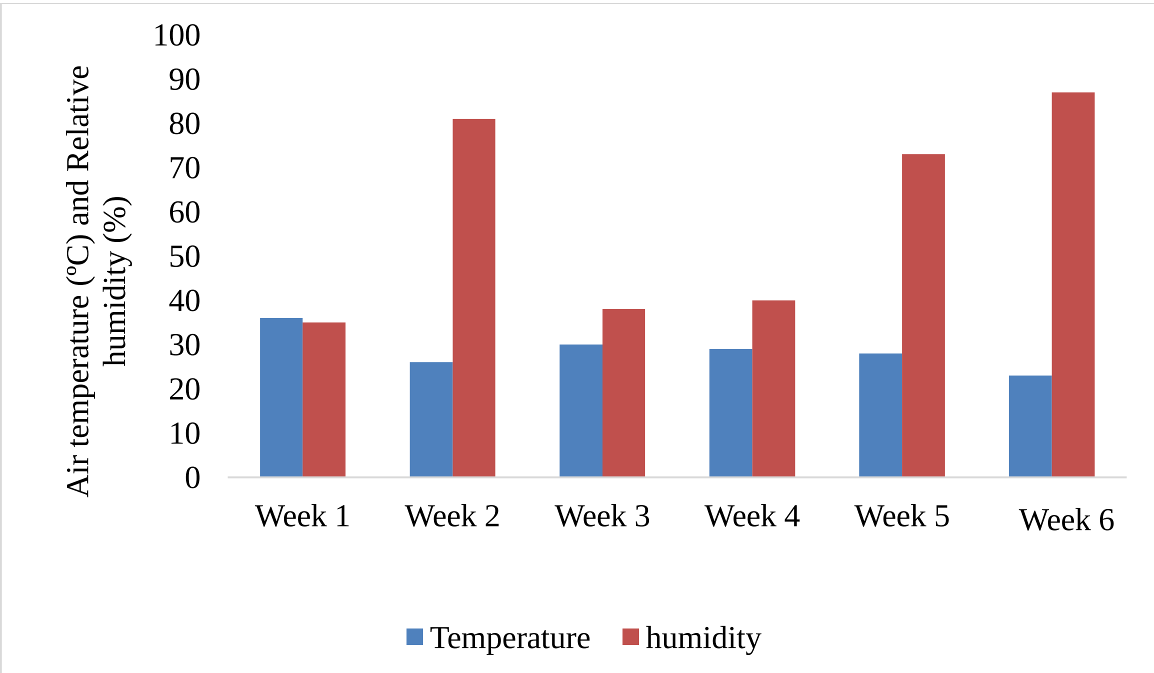


**Fig. 2. The air temperature and relative humidity of the indoor condition of the blue polymer**

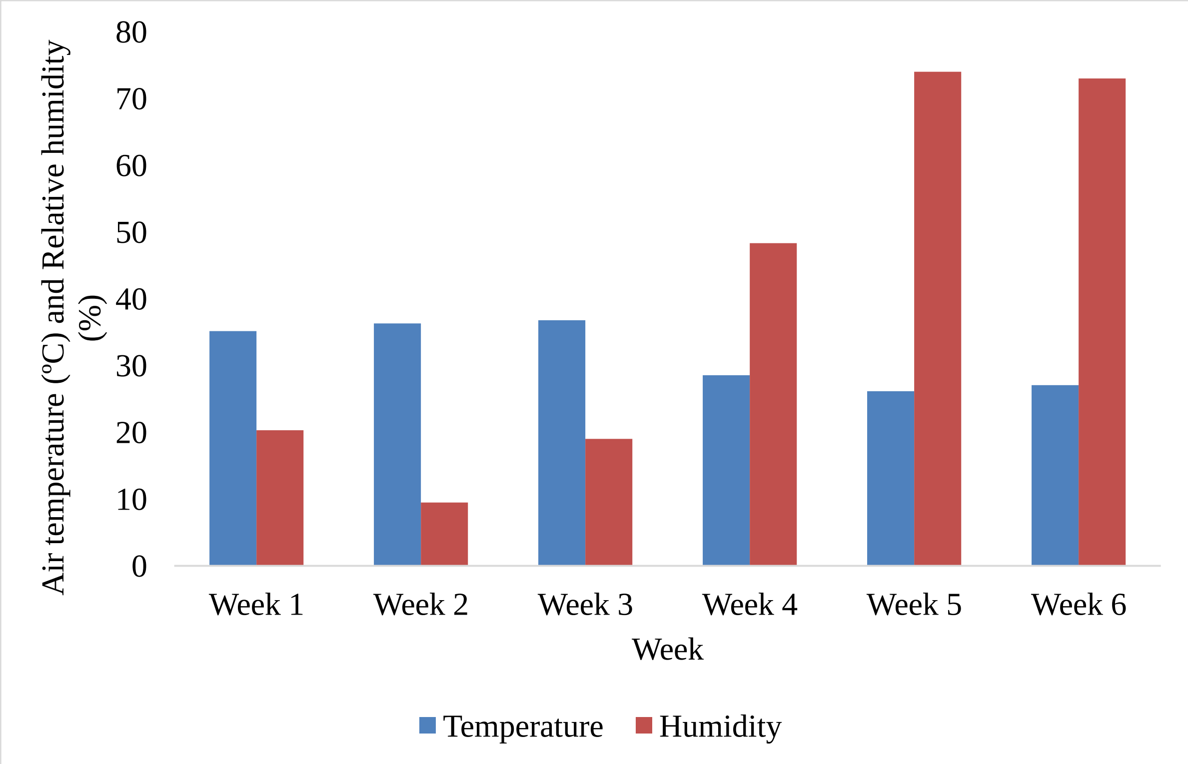


**Fig. 3. The air temperature and relative humidity of the indoor condition of the black polymer**

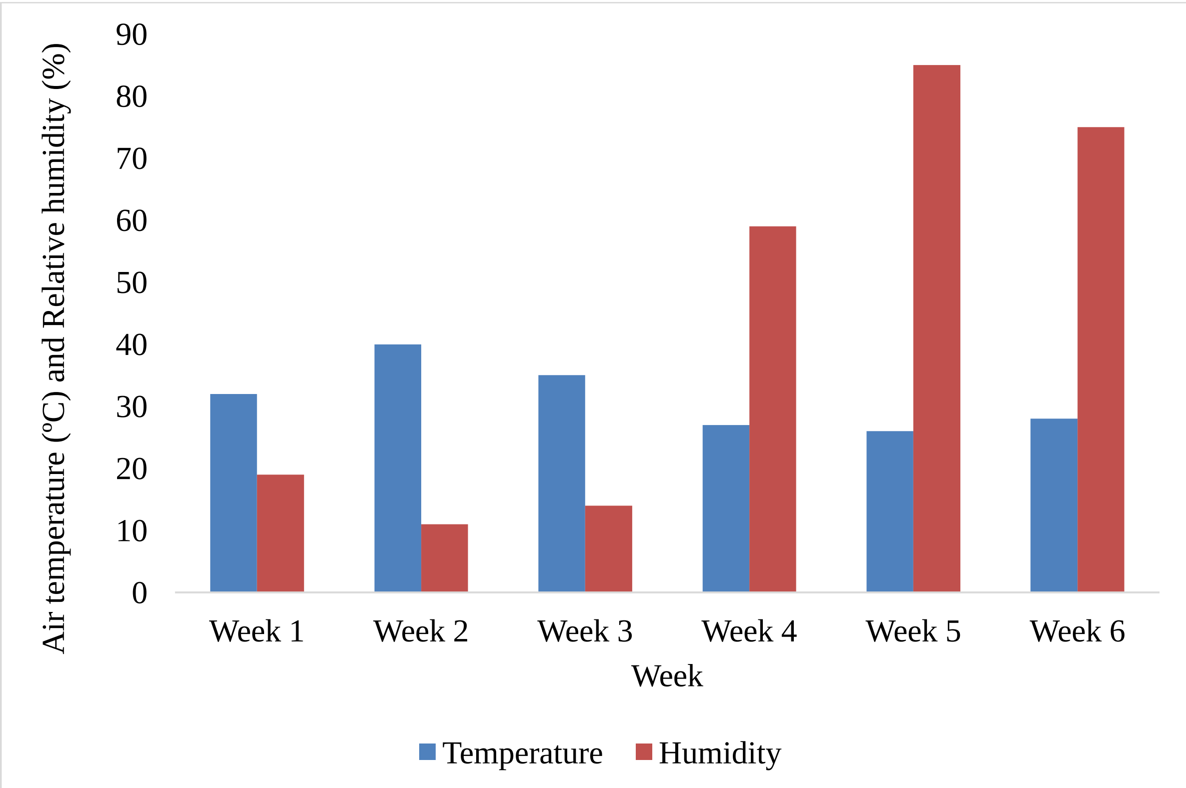


**Fig. 4. The air temperature and relative humidity of the indoor condition of the green polymer**

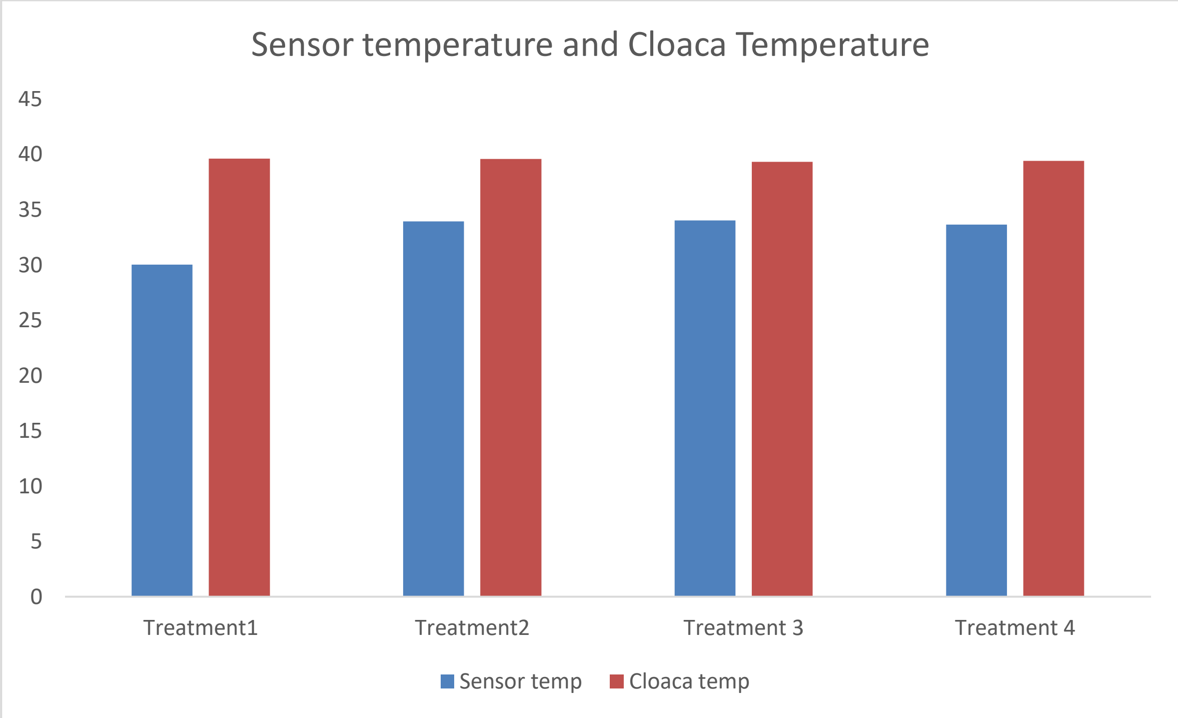


**Fig. 5. A graphical illustration of the indoor temperature and cloaca temperature**

## 4. CONCLUSION

The environmental condition of the brooding pen with white, blue, black and green was examined, and the effect it has on the physiological responses of broiler chickens, especially during brooding. The white polymer was the best as it had the most favourable environmental conditions, but it was very expensive and unaffordable by local farmers. The green provided a condition similar to the white and had no significant difference with the white in terms of the performance, it is also affordable as it is cheaper in this area and therefore, it could serve as replacement for white.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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