Physiological Response of Hyla Weaner Rabbits Fed Wheat Offal-Carried Watermelon Rind

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Abstract

Rabbit production in tropical and subtropical areas of the world like Nigeria is faced with many problems related to hot climate, particularly heat stress. Climatic conditions in these regions are such that the hot (dry) season is relatively long, with intense radiant energy for an extended period of time, accompanied with high relative humidity. Rabbits are homoeothermic animals and are more sensitive to high air temperature conditions thereby limiting their ability to dispense excess body heat. Factors such as species of animal, the physiological status of the animals, the relative humidity, velocity of ambient air and the degree of solar radiation determine animal's zones of thermal comfort of animal. This study was conducted to assess physiological response of Hyla weaner rabbits fed Wheat Offal-Carried Watermelon Rind (WCWR). Five experimental diets comprising of 0, 10, 20, 30 and 40% levels of inclusion of WCWR were compounded. Data on thermo-physiological traits (rectal temperature, respiratory rate, pulse rate, ear temperature, eye temperature and skin temperature) were collected from forty-five (45) Hyla weaner rabbits. Data were also collected on ambient temperature, wind velocity and relative humidity to estimate the Temperature Humidity Index of the environment. Result revealed that the effects of the diets on the thermo-physiological traits of the rabbits; values of rectal temperature, respiratory rate, pulse rate, ear temperature, eye temperature and skin temperature were significantly ($p<0.05$) lowest in rabbits fed 30% inclusion level of WCWR. Base on the results of this study, it could be concluded that inclusion of WCWR in diet up to 30% has potential of ameliorating adverse effects of thermal stress on physiological traits of the rabbits.

Keywords: Climatic conditions, heat stress, Hyla rabbit physiology, traits

Introduction

Among monogastric animals, rabbits utilize fibrous materials for production of meat. Gidenne (2000) reported that rabbit has a low utilization of the fibrous fraction due to the rapid passage of feed through the gastrointestinal tract. However, through the caecotrophic activity, the digestibility of nutrients is incremented (Machado *et al*., 2012). High cost of formulated concentrates and pelletized feeds, compounded from the conventional ingredients, including maize and soybean militates against increased rabbit production (Agunbiade *et al*., 2001). Thus, attention is gradually shifting to supplementation with under-utilized agro-industrial unconventional feedstuff. The utilization of unconventional feedstuffs and forages which are not consumed by humans can be used to produce animal feeds (Asar 2010). Among such alternatives is the use of watermelon waste which is found abundant in energy, minerals and vitamins. Nigeria is one of the leading producers of watermelon in Africa. Watermelon rind is one of the several unwanted by-products generated by households and fruit sellers in Nigeria with a great quantity of this waste disposed indiscriminately into environment thereby causing pollution in one way or the other. Alagbe (2018) and Okia *et al*. (2010) reported the potentials of dry watermelon rind as an energy source in rabbit's nutrition.

Hyla rabbit is a meat breed with high productivity, growth rate, high disease resistant and more than 96 % survival rate of growing rabbits (Yamani, 1994). Nizza and Moniello (2000) reported that Hyla rabbits can attain a weight of 2,750 g in 90 days. Hyla rabbits are characterized by their rapid maturation; they are mated within 4 -5 months of age. Hyla rabbit is reported to be a productive breed that is used in many crossbreeding programs (Hamouda *et al*., 1990). It was introduced at experimental level in hot and humid countries like Benin, Ghana and Nigeria. The introduction of the exotic breeds were faced with many problems relating to adaptation to hot climate, particularly conditions of heat stress that reduce feed intake, growth and reproductive performance including an increased incidence of mortality. In these regions, ambient temperature and relative humidity frequently exceed critical thresholds necessary for homeostasis and normal body functions.

Heat stress is one of the major challenges facing livestock production (including rabbits) in tropical and subtropical regions. Heat stress affects the efficiency and economy of rabbit enterprise. Ways by which animals respond to thermal distress differs, not only between species but also between breeds and between individuals within a breed. In developing countries, the most limitations to rabbit production is the susceptibility to heat stress which is a systemic stress that evokes a series of changes in the biological functions of homeotherms (Marai *et al*., 1991). There are numerous physiological mechanisms for coping with heat stress; these include sweating, more rapid respiratory rate and greater vasodilation with increased blood flow to the skin surface; reduced rate of metabolism, decreased dry matter and nutrient intake, and altered water metabolism (David, 2000). As reported by Yaqub *et al*. (2001), body temperatures are among the physiological data that are sensitive to minute change in livestock and most related to important number of varied functions of the body. Besides rectal temperature, respiratory rate and pulse rate are the major thermo physiological traits indicating heat stress in animals (Butswat *et al*., 2000; Fadare *et al*., 2012). Remedial measures can be successful only when proper evaluation of stress level is possible (Smitha *et al.,* 2011). Thus, this study was conducted to assess thermo-physiological response of Hyla weaner rabbits fed wheat offal-carried watermelon rind.

Materials and Methods

The study was conducted at the student project site of Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan. A total number of forty- five (45) Hyla weaner rabbits (six weeks old) were used for the experiment. The rabbits were purchased from reputable commercial rabbits' farms. The animals were housed in individual cages and were acclimatized for two weeks before the commencement of the experiment. The rabbits were provided with water *ad- libitum* while feed was served twice daily.

Fresh watermelon rind was obtained from major fruit markets in Ibadan. The watermelon rind was thoroughly rinsed with water to remove sand particles. The rind was cut into smaller pieces and ground with a machine. It was thoroughly hand-mixed with wheat offal in increasing concentration. The blend of wheat offal-carried watermelon rind (WO: WR) was prepared in the ratio 1:1; the blend WR was thoroughly mixed with WO by hand until the fluid from WR was not superfluous (Makinde and Sonaiya, 2007). The blends were evaluated on the capacity to sun-dry to ≤10 to 12% in 7 h; as moisture content >12% is not desirable pertaining to good keeping quality (Rozis, 1997). The blend was then sun-dried by spreading thinly on polythene sheets (0.5 mm thickness) on a concrete floor. Five concentrate diets were compounded comprising 0, 10, 20, 30 and 40% levels of inclusion of wheat offal-carried watermelon rind meal (Table 1). The diets were fed to weaner Hyla rabbit based on 4% of their body weight on dry matter basis.

Table 1: Gross composition of the experimental diets

Ingredients	0% WOWR	10% WOWR	20% WOWR	30% WOWR	40% WOWR
Maize	40.00	30.00	20.00	10.00	0.00
WCWR	0.00	10.00	20.00	30.00	40.00
Soybean Meal	5.50	5.50	5.50	5.50	5.50
Palm kernel cake	30.00	30.00	30.00	30.00	30.00
Groundnut cake	5.00	5.00	5.00	5.00	5.00
Rice bran	12.00	12.00	12.00	12.00	12.00
Fish Meal	3.00	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	2.00	2.00	2.00	2.00	2.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100

0% WOWR - Control (without wheat offal-carried watermelon rind); 10% WOWR: 10% wheat offal-carried watermelon rind; 20% WOWR: 20% wheat offal-carried watermelon rind; 30% WOWR: 30% wheat offal-carried watermelon rind; 40% WOWR: 40% wheat offal-carried watermelon rind

Thermo-physiological traits of the rabbits such as rectal temperature, respiratory rate, pulse rate, ear temperature, skin temperature and eye temperature were taken on each animal. These thermo-physiological parameters were taken two times a week to avoid undue stress to the animals. The rectal, ear, skin and eye temperature were measured using infrared thermometer which was pointed directly to the rectum, ear, exposed skin, and eye to take respective temperature of these parts of the rabbits. Respiration rate was recorded as the number of frequency of flank movements per 20 seconds and was calculated as breathes/minute as reported by Thwaites *et al.* (1990). Pulse rate was also recorded as beats per second by placing the stethoscope on the thigh of the rabbits to determine the rhythmic beats of the heart which was later calculated as beats / minute according to Thwaites *et al.* (1990). Data were also collected on ambient temperature, relative humidity and wind velocity in the rabbitry were recorded with use of Weather application (Ad-Paradise App Dev Studio for Weather Live and Widget Alerts).

Data were analyzed as completely randomized design using the General Linear Models procedure of (SAS, 2008) for analysis of variance (ANOVA) while differences between means were resolved by Duncan's multiple range tests. Statistical significance was established when probability was less than 5% level of significance. Data were also subjected to correlation analysis.

Results and Discussion

Thermo-physiological response of Hyla weaner rabbits fed graded levels of watermelon waste with wheat offal is presented in Table 2. There were significant effects ($p<0.05$) of the experimental diet on thermo-physiological traits of the rabbits. Rabbits fed diet T_5 (40% WOWR) had highest values of rectal temperature (24.00 ± 0.54^oC); rabbits on diet T_2 (10% WOWR) recorded highest values of pulse rate (126.36 ± 1.62 beats/minute), respiratory rate (81.62 ± 1.75 breathes/minute), skin temperature (22.87 ± 0.47 ^oC), eye temperature (22.91 ± 0.48 ^oC) and ear temperature (22.88 ± 0.48 ^oC). Rabbits on diet T_3 (20% WOWR) recorded lowest values of all the thermo-physiological traits except rectal temperature which was recorded in rabbits on T_1 (0% WOWR). Higher values of rectal temperature, skin temperature and ear temperature for New Zealand white rabbit weaners was reported by Yaqub *et al*. (2021). Popoola and Oseni (2021) reported higher values of rectal temperature, pulse rate and respiratory rate for heterogenous rabbits. Fadare (2015) also reported higher values of rectal temperature, respiratory rate and pulse rate for Havana Black, New Zealand white, California white and Palomino Brown. The result of the present study indicated that rectal temperature, pulse rate and respiratory rate of these rabbits were within the normal range of comfort zone and the animals were not thermally stressed as reported by Fayez *et al.* (1994). These authors reported 32^0C, 137 beats/min and 85 breathes/min for rectal temperature, pulse rate, respiratory rate respectively as comfort limits of heat tolerance for rabbits.

Table 2. Thermo-physiological response of Hyla weaner rabbits fed graded levels of watermelon waste with wheat offal.

Thermo-physiological variables	**T_1** (0%)	**T_2 (10%)**	**T_3** (20%)	**T_4** (30%)	**T_5** (40%)	**SE (±)**
Rectal temperature (°C)	19.96^{b}	23.61^{ab}	17.06^{b}	23.99^{a}	24.00^{a}	0.54
Pulse rate (beats/minute)	119.10^{b}	126.36^{a}	115.24^{b}	122.29^{a}	122.78^{a}	1.62
Respiratory rate (breathes/minute)	67.30^{b}	81.62^{a}	58.62^{c}	77.58^{ab}	78.51^{ab}	1.75
Skin temperature (°C)	18.75^{b}	22.87^{a}	16.15^{c}	21.40^{ab}	21.60^{ab}	0.47
Eye temperature (°C)	19.52^{b}	22.91^{a}	16.62^{c}	21.48^{ab}	21.85^{ab}	0.48
Ear temperature (°C)	19.38^{b}	22.88^{a}	16.37^{c}	22.00^{ab}	21.75^{ab}	0.48

$^{a, b, c}$ means of different superscripts along the same row are statistically significant (p<0.05); SEM – Standard error of mean.

Effect of diurnal variations on thermo-physiological indices of Hyla weaner rabbit fed graded levels of watermelon waste with wheat offal is presented in Table 3. The result revealed significant effects (p<0.005) of diurnal fluctuations on thermo-physiological indices of the rabbits. Higher values of rectal temperature, pulse rate, respiratory rate, eye temperature, skin temperature and ear temperature were obtained during the hot period (PM) as compared to values obtained during cool periods (AM) of the day. This is an indication that prevailing environmental conditions particularly ambient temperature have marked effects on thermo-physiological traits of the rabbits most especially rectal temperature of the rabbits. Also, fluctuation in environmental conditions (Fig.1) have marked effects on thermo-physiological indices of the rabbits According to Finzi *et al*. (1992), the average body temperature (determined through rectal temperature) goes up from morning till night, while environmental air temperature goes up from morning till noon then decreases at night. Result obtained in this study, disagreed with result of Zeferino *et al.* (2011); Fadare *et al.* (2021). Fadare *et al.* (2021) reported that higher mean rectal temperature was obtained in the morning relative to other hours of the day in New Zealand white rabbit weaners; the authors further ascertained the result as indication in part that the prevailing ambient temperature did not have a marked effect on the rectal temperature of the rabbit during the afternoon, presumably that the thermoregulatory mechanisms of the rabbits were able to maintain thermal homeostasis of the rabbits during the afternoon and early evening hours. Fayez *et al*. (1994) elucidated that the significance of the increase in respiration is that it enables the animal to dissipate heat by vaporizing high moisture through the respiratory air which accounts for about 30% of the total heat dissipation. The result obtained in this study on pulse rate agreed with studies conducted on heat tolerance of chicken by (Boa-Amponsem, 1992) who reported that pulse rate is relatively less effective under hot-humid conditions as compared to hot-dry conditions. In the current study, the ear surface, eye and skin temperatures are within the range as reported by Zeferino *et al.* (2011). The statistically significant diurnal fluctuations in mean ear, eye and skin temperatures obviously indicate that the rabbits employed these organs in offsetting the body heat load during the hot periods of the days. Diurnal fluctuations induced changes in sympathetic activity that resulted in redistribution of blood flow from the viscera to the periphery to enable dissipation of heat from the body (Lublin and Wolfeson, 1996; Cham and Badoer, 2008).

Table 3: Effect of diurnal variations on thermo-physiological indices of Hyla weaner rabbit fed graded levels of watermelon waste with wheat offal.

Thermo-physiological variables	Cool period (AM)	Hot period (PM)
Rectal temperature (°C)	30.90±0.83[b]	35.66±0.46[a]
Pulse rate (beats/minute)	102.79±2.05[b]	114.82±1.71[a]
Respiratory rate (breathes/minute)	63.02±2.21[b]	73.17±1.79[a]
Skin temperature (°C)	31.89±0.52[b]	34.37±0.36[a]
Eye temperature (°C)	32.67±0.51[b]	34.830±.35[a]
Ear temperature (°C)	32.99±0.51[b]	34.12±0.40[a]

[a, b]means of different superscripts along the same row are statistically significant ($p<0.05$)

Table 4 shows the correlation between environmental data and thermo-physiological indices of Hyla weaner rabbit fed graded levels of watermelon waste with wheat offal. The result revealed that there high and positive correlations between all the thermo-physiological indices of the rabbits. This implies that increase in any of the thermo-physiological traits of the rabbits will lead to increase in the other traits. Similar result was obtained by Popoola and Oseni (2021) who reported high, positive and significant ($p<0.05$) relationship between rectal temperature, pulse rate and respiratory rates. Result of this study disagree with report of Finzi *et al.* (1992) that ear and body temperature showed a low and non-significant correlation; the authors further explained that this may be due to the fact that dispersion of sensitive heat from the ear surface is only a minor cooling factor in comparison with the increase in breathing rate.

Table 4: Correlation between environmental and thermo-physiological indices of Hyla weaner rabbit fed graded levels of watermelon waste with wheat offal.

Variables	Rectal temperature	Puls e rate	Respiratory rate	Skin temperatur e	Eye temperature	Ear temperatur e
Rectal temperature		0.49	0.50	0.59	0.62	0.61

Pulse rate	0.80	0.68	0.67	0.67
Respiratory rate		0.70	0.67	0.68
Skin temperature			0.89	0.88
Eye temperature				0.88
Ear temperature				

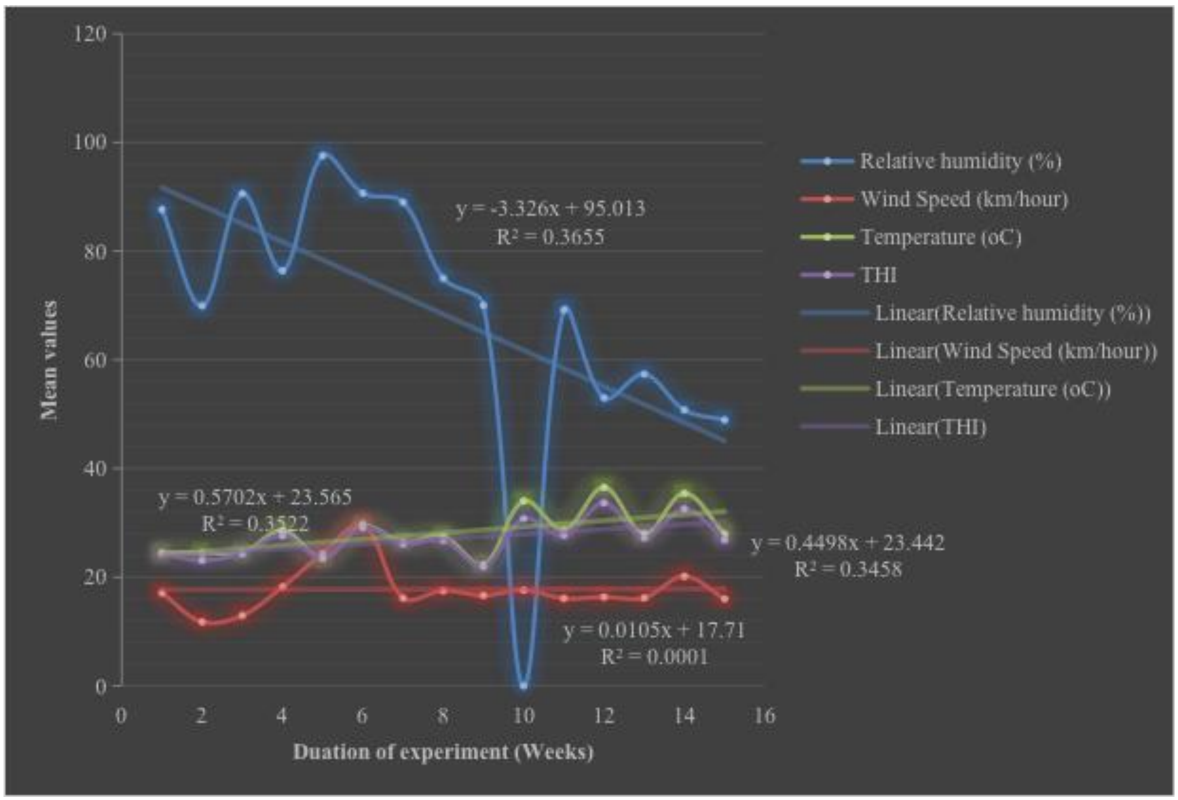

Figure 1. Environmental data variables during the experimental period

Conclusion

Based on the results of this study, it could be concluded that inclusion of WCWR in diet up to 30% has potential of ameliorating adverse effects of thermal stress on physiological traits the rabbits. There was significant effect of diurnal fluctuation on physiological traits of the rabbits. Also, there was high and positive correlations between all the thermo-physiological indices of the rabbits.

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