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Evaluation of heat tolerance of Iraqi local goats

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Abstract: Temperature and humidity have a significant impact on the welfare and productivity of livestock. This study was conducted in the ruminant farm of the College of Agriculture at the University of Diyala. This study aimed to show the effect of each of the hair color of the local Iraqi goats, horns, dangles and pregnancy on each of the body temperature, rectal temperature, respiratory rate, thermal endurance coefficient and thermal adaptation coefficient for the month of August. The body, rectal temperature and thermal adaptation coefficient during the month of August in the afternoon. As for the thermal endurance coefficient, the opposite was observed, as it was higher in the morning reading than the evening reading.

Keyword: heat stress , physiologica , Iraqi goat

Introduction

Heat stress is one of the difficult stress factors in raising goats in light of the change in the climatic scenario all over the world due to global warming (El-Tarabany et al., 2017). Al-Hamdani (2000) showed the importance of the Iraqi goat, as it is one of the animals adapted to harsh environmental conditions and poor nutrition. Hence, interest in improving these animals began, especially that there are breeds that have a wide scope for genetic improvement, which has a role in filling part of the deficit resulting in the lack of meat and milk and the rise in their prices. Genetic improvement is a program through which animals are selected that are more susceptible to heat resistance. This program is considered a possible way to reduce the effect of heat stress on productivity in livestock (Paula-Lopes et al., 2003; Hansen, 2004; Lacetera et al., 2006). Different types of livestock differ in their sensitivity to ambient temperature and humidity, where the tolerance to heat stress is much higher in local breeds than in crossbred animals under high temperatures and humidity and this is mainly due to the fact that local breeds can dissipate excess heat more effectively than During the process of sweating, while the hybrid has the ability to sweat less (Hahn and Nienaber, 2007). Hammond and Olson (1994) defined the thermal endurance coefficient as the animal's ability to withstand heat, which has an important impact on productive capacity, that is, it has the ability to maintain the natural temperature of the animal's body in light of the high temperatures in the environment in which this animal lives. Thermal endurance coefficient is known as one of the oldest indicators for evaluating heat stress in animals and this is done using rectal temperature RT, after which the thermodynamic coefficient was developed later to include RT as well as respiratory rate RR (Gaughan et al., 2011). And goats are considered one of the most adapted species to heat stress conditions through production and reproduction, as well as disease resistance (Silanikove and Koluman, 2015). The ability of goats to adapt to heat stress is due to its morphological, anatomical and physiological characteristics (Silanikove et al., 2010)

Materials and methods

This study was conducted in the field of animal production / College of Agriculture at the University of Diyala in the city of Baquba, north of Baghdad, where Diyala governorate is located between two latitudes (33 3 - 35 6) on 47 female Iraqi local goats of different colors, aged between 2-4 years and for a period of one month. A father was placed in a semi-shaded barn and fed on the amount of 500 g per head. The concentrated fodder consists of 65% barley and 33% bran. The mixture was supplemented with the addition of 1% salt and 1% a mixture of vitamins and minerals and by providing water permanently

The Celsius temperature and relative humidity were measured at an average of three consecutive days (14-15-16) of August, and the measurement was twice a day in the morning and afternoon, as well as the respiratory rate was measured by the number of loin movements per minute, and the temperature was also measured The

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skin using a digital medical thermometer by placing it under the armpit of the right leg and measuring the rectal temperature also using a digital medical thermometer by inserting it into the rectal opening, taking into account its position in such a way that it is in contact with the rectal wall and at a depth of 2.5 cm in the rectum. Physiological measurements were taken twice a day In the morning at (7-8) and at noon at (2-3) for three days per month and during the duration of the experiment, as well as the morphological characteristics of the experimental animals were taken, including color, the presence or absence of horns, the presence or absence of pendants, as well as the presence or absence of pregnancy. Data analysis using the SAS program and using the mathematical model to study heat stress on physiological characteristics

Yijk = μ + Ai + Bj + Pk + CL + eijkL

Yijk =.watch value

 = the general average of the studied trait.

Ai = color (1 black, 2 brown, 3 white, 4 black and white, 5 white and brown)

Bj = pregnancy (0 no pregnancy, 1 pregnancy)

Pk = rattles (0 no rattles, 1 no rattles)

CL = horns (0 no horns, 1 no horns)

eijkL = random error that is assumed to be distributed randomly with a mean equal to zero and a variance of e2 σ

Table 1. Temperature and relative humidity (morning and evening) during the three days of August.

The days	Temperature		Relative humidity %		Temperature and humidity guide	
	S	M	S	M	S	M
8 /14	37.8	49.2	21	17	31.95	40.16
8 / 15	36.7	43.9	24	18	31.35	36.82
8 / 16	36.6	45.8	23	17	31.28	37.64
modified	37.03	46.3	22.66	17.33	31.52	38.20

According to the temperature and humidity index according to the Marai equation (and others, 2001) shown below

THI= Tdp - [(0.31 - 0.31 RH) (Tdp - 14.4)]

Where Tdp is the ambient temperature and RH is the relative humidity

The thermal endurance coefficient was calculated according to (Rhoad, 1944) equation and modified by (Jindal, 1984) and according to the following formula

HTC = 100 - 10 (RT - 39.1)

It means

HTC = Thermal Endurance Factor

RT = Mean measured rectal temperature

C = mean normal rectal temperature in goats (Abdulkareem et al., 2020)°39.1

According to the equation of thermal adaptation according to the equation of Benezra (1954), the closer the value of AC to 2 means that the animal is more adapted to the heat.

AC = (measured RT / normal RT) + (measured RR / normal RR)

It means

RT = rectal temperature in degrees Celsius

RR = respiratory rate per minute

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Results and discussion

Table 2. Mean ± standard error of some factors affecting body temperature (C), rectal temperature (C) and respiratory rate (min) for Iraqi local goats.

Influencing factors	Views	mean ± standard error					
		Body temperature		rectal temperature		breathing rate	
		S	M	S	M	S	M
Overall average	**47**	39.07	39.84	39.34	40.49	37.87	59.00
hair colour							
black	5	39.42 **b** ± 0.13	40.60 **a** ± 0.34	39.62 **b** ± 0.12	41.44 **a** ± 0.48	37.20 **b** ± 5.91	64.00 **a** ± 2.28
brouwn	18	39.07 **b** ± 0.10	40.04 **a** ± 0.23	39.32 **b** ± 0.06	40.27 **a** ± 0.20	38.77 **b** ± 3.17	59.88 **a** ± 2.21
white	4	39.05 **a** ± 0.16	39.90 **a** ± 0.22	39.30 **b** ± 0.24	40.97 **a** ± 0.22	34.50 **b** ± 2.87	63.00 **a** ± 8.22
white + black	12	38.93 **b** ± 0.16	39.47 **a** ± 0.21	39.26 **b** ± 0.12	40.37 **a** ± 0.23	35.50 **b** ± 2.41	55.00 **a** ± 2.00
white + brown	8	39.11 **a** ± 0.11	39.42 **a** ± 0.37	39.37 **b** ± 0.09	40.32 **a** ± 0.31	41.50 **b** ± 1.05	57.87 **a** ± 2.67
the horns							
having horns	43	39.12 **b** ± 0.06	39.86 **a** ± 0.14	39.37 **b** ± 0.05	40.51 **a** ± 0.13	37.86 **b** ± 1.64	59.23 **a** ± 1.38
lack of horns	4	38.62 **a** ± 0.21	39.57 **a** ± 0.54	39.07 **a** ± 0.11	40.27 **a** ± 0.54	38.00 **b** ± 2.58	56.50 **a** ± 4.64
rattles							
The presence of charms	17	39.04 **b** ± 0.08	58.05 **a** ± 1.56	40.94 **b** ± 2.43	40.22 **a** ± 0.17	40.94 **b** ± 2.43	58.05 **a** ± 1.56
No charms	30	39.10 **b** ± 0.09	59.53 **a** ± 1.87	36.13 **b** ± 1.88	40.64 **a** ± 0.17	36.13 **b** ± 1.88	59.53 **a** ± 1.87
pregnancy							
Pregnancy	33	39.05 **b** ± 0.08	39.88 **a** ± 0.16	39.34 **b** ± 0.06	40.53 **a** ± 0.16	37.33 **b** ± 1.82	58.09 **a** ± 1.52
no pregnancy	14	39.13 **b** ± 0.09	39.74 **a** ± 0.24	39.35 **b** ± 0.07	40.39 **a** ± 0.22	39.14 **b** ± 2.77	61.14 **a** ± 2.57

The results in this study showed in Table No. 2 that hair color has an effect on the absorption of heat from the surrounding environment when it rises. It was noted that the evening measurement was significantly higher than the morning measurement due to the high air temperature for each of the black and brown hair

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color and the mixture of white with black for each of Body temperature, rectal temperature and respiratory rate. As for white hair color and a mixture of white and brown, it was noted that there was no significant effect between the morning and evening measurements, because the light-colored animals have a lower ability to absorb temperature than the dark-haired animals, and this result was reached previously (Asres and Amha, 2014). As for the presence of horns, it was noted that the evening measurement was significantly higher than the morning measurement for each of the Body temperature, rectal temperature, and respiratory rate, because the hollow tubules of goats' horns are not surrounded by keratinocytes, which form the plates surrounding the hollow tubes like sheep where the sheep's horns are

The porosity of goats is higher and this makes the goats unable to get rid of excess heat through evaporation from the pods and this result is similar to what was found (Zhang et al., 2018; Mutindi et al., 2022). As for the characteristics of the presence or absence of pendants in both cases, the evening measurement was significantly higher than the morning measurement of each of the body temperature, rectal temperature and respiratory rate for the local Iraqi goats, and this result is in contradiction to what was reached (Mutindi et al., 2022). As for pregnancy, it was noted that in the presence or absence of pregnancy, the evening measurement was significantly higher than the morning measurement of both body temperature, rectal temperature and respiratory rate, as heat stress has consequences on the normal development of offspring during pregnancy and shortening the duration of pregnancy and this result is similar to what was reached Referred to by (Coloma-Garcia et al., 2020).

Table 3. The mean ± the standard error of some factors affecting the thermal endurance coefficient and the thermal adaptation coefficient of the local Iraqi goats.

Influencing factors	Views	mean ± standard error			
		Thermal Endurance Coefficient		Thermal adaptation factor	
		S	M	S	M
Overall average	**47**	97.51	86.06	2.99	4.14
hair colour					
black	5	94.80 **a** ± 1.24	76.60 **b** ± 4.86	2.97 **b** ± 0.31	4.43 **a** ± 0.12
brouwn	18	97.72 **a** ± 0.66	88.22 **b** ± 2.02±	3.04 **b** ± 0.16	4.18 **a** ± 0.11
white	4	98.00 **a** ± 2.44	81.25 **b** ± 2.28	2.82 **b** ± 0.14	4.36 **a** ± 0.43
white + black	12	98.33 **a** ± 1.29	87.25 **b** ± 2.39	2.87 **b** ± 0.12	3.92 **a** ± 0.10
white + brown	8	97.25 **a** ± 0.97	87.75 **b** ± 3.11	3.19 **b** ± 0.05	4.07 **a** ± 0.14
the horns					
having horns	43	97.25 **a** ± 0.53	85.86 **b** ± 1.36	2.99 **b** ± 0.08	4.15 **a** ± 0.07
lack of horns	4	100.25 **a** ±	88.25 **a** ± 5.48	2.99 **b** ± 0.13	4.00 **a** ± 0.25

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		1.10			
rattles					
The presence of charms	17	97.64 **a** ± 0.78	88.70 **b** ± 1.72	3.16 **b** ± 0.12	4.08 **a** ± 0.08
No charms	30	97.43 **a** ± 0.66	84.56 **b** ± 1.77	2.90 **b** ± 0.09	4.17 **a** ± 0.10
pregnancy					
Pregnancy	33	97.51 **a** ± 0.65	85.63 **b** ± 1.62	2.97 **b** ± 0.09	4.09 **a** ± 0.08
no pregnancy	14	97.50 **a** ± 0.77	87.07 **b** ± 2.28	3.06 **b** ± 0.14	4.25 **a** ± 0.13

As for the results of Table No. 3, it shows that the thermal endurance coefficient in the morning measurement is significantly higher than the evening measurement for each of the characteristics of colour, horns, pendants and pregnancy, due to the high relative humidity in the morning, which negatively affects the performance of the animals (Table 1), which works to reduce the evaporation process for the goat's body. As for the thermal adaptation coefficient, its results were the opposite of the thermal endurance coefficient. It was noted that the evening measurement was significantly higher than the morning measurement, and this indicates an increase in the number of breathing times as well as the rectal temperature from their ideal levels, knowing that the ideal degree and according to the equation used is 2 and this result is similar to what was reached (Singh et al., 2013).

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