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Effect of Giloy (*Tinospora cordifolia*) and Neem (*Azadirachta indica*) on physiological parameters of Marwari lambs under arid zone

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Abstract
The present study was designed with the intention to alleviate the negative effects of heat stress of growing lambs reared under hot environmental conditions. An experiment was conducted to assess the effect of Giloy (*Tinospora cordifolia*) and Neem (*Azadirachta indica*) alone and in combination on physiological parameters for 12 weeks on 42 Marwari male lambs and divided into seven groups, six lambs in each group in a randomized block design. The lambs of T_1 group were provided only basal diet (grazing + *ad lib.* fodder + 400 g concentrate per lamb per day) and were kept as control group and lambs of all other treatment groups were provided basal diet with herbal supplementation i.e. 0.5 per cent Giloy stem powder in group T_2, 1.0 per cent Giloy stem powder in group T_3, 0.5 per cent Neem leaf powder in group T_4, 1.0 per cent Neem leaf powder in group T_5, 0.25 per cent Giloy stem powder along with 0.25 per cent Neem leaf powder in group T_6 and 0.5 per cent Giloy stem powder along with 0.5 per cent Neem leaf powder in group T_7. At the end of experiment, highly significant changes were found in rectal temperature and respiration rate though; they were within normal physiological range. At the end of experiment it appears that incorporation of 0.5 per cent Giloy stem powder along with 0.5 per cent Neem leaves powder can be used as a part of strategy as they are effective to alleviate heat stress in lambs in arid zone of Rajasthan.

Keywords: Rectal temperature, respiration rate, giloy, neem, arid zone

1. Introduction
One of the major problems facing sheep farming in the arid and semi-arid regions like Rajasthan is the heat stress resulting from high ambient temperature and solar radiation causing the effective temperature of the environment to edge-out the thermo-neutral zone, particularly during summer season (Ali *et al.*, 1999) [1]. Environmental temperature above thermo neutral zone negatively affect livestock production and reproductive performance (Nardone *et al.*, 2010 [2]; Isani *et al.*, 2012 [3]; Baumgard and Rhoads, 2013) [4]. This could result in a high economic loss for sheep industry. Elevated body temperature, accelerated respiratory and heart rates and post absorptive metabolic changes are the most important characteristic findings for heat stress in ruminants (Bernabucci *et al.*, 2010 [5]; Al-Haidary *et al.*, 2012 [6]; Abdoun *et al.*, 2012) [7]. Several approaches have been used to alleviate heat stress to improve performance in farm animals, including management and feeding strategies. Herbs and their extracts possess a positive impact on physiological functions and help to ensure good health. Herbal supplementation may decrease core body temperature (Tcore) for the short term (Spiers *et al.*, 2004 [8]; Archer *et al.*, 2007) [9] and helps to improve immune function and antioxidant capacity during heat stress. Giloy (*Tinospora cordifolia*) is a large glabrous deciduous climbing shrub belonging to family *Menispermaceae*. Giloy is widely used in ethno medicine for its general tonic, antioxidant, antibacterial, immunomodulator, hepatoprotective and anti-inflammatory properties (Krishna *et al.*, 2009) [10]. Anti stress activity of Giloy evaluated by Devasena and Adilaxmamma (2014) [11] as reported significant reduction in reduced glutathione and superoxide dismutase activity in erythrocytes of goat when treated with Giloy. It is claimed that the plant climbing up the Neem tree is said to be the best as synergy between these two bitter plants enhances Giloy`s efficacy.

Neem (*Azadirachta indica*) belongs to the family *Meliaceae*. Research has shown that Neem boost the immune system by stimulating the production of T-cells when faced with infections (Upadhyay, 1990) [12].

To our knowledge, there is a lack of information pertaining to dietary inclusion of Giloy (*Tinospora cordifolia*) alone and in combination with Neem (*Azadirachta indica*) to the growing lambs; therefore, the objective of the present study was to evaluate the ability of Giloy and Neem to alleviate the effects of heat stress in growing lambs under hot summer conditions.

2. Materials and Methods

The present study was conducted on Marwari lambs maintained at Arid Region campus of Central Sheep and Wool Research Institute (ICAR-ARC-CSWRI), Bikaner. The average rainfall is low (250 mm) and erratic. The temperature varies between sub zero (-2 °C) during winter and high (49 °C) during summer. The experiment was conducted from May to July, 2019. Meteorological data *viz.* temperature and relative humidity were collected from Agriculture Research Station, Bikaner from May 2019 to July 2019 at weekly intervals. THI values were calculated from recorded meteorological variables as described below by formula given by Marai *et al.* (2007) [13].

THI = db^{o}C – [(0.31-0.31RH) (db^{o}C-14.4)]
THI = Temperature humidity index
db = Dry-bulb temperature (^{o}C)
RH = Relative humidity as fraction of a unit (%)

Forty-two growing male Marwari lambs (3-4 months old) were divided into seven groups T_1, T_2, T_3, T_4, T_5, T_6 and T_7 having six lambs in each group on body weight basis. The lambs of T_1 group were provided only basal diet (grazing for a period of 8 hours + *ad lib*. fodder + 400 g concentrate per lamb per day) and were kept as control group. The lambs of T_2 group were provided basal diet supplemented with 0.5 per cent Giloy stem powder. The lambs of T_3 group were provided basal diet supplemented with 1.0 per cent Giloy stem powder. The lambs of T_4 group were provided basal diet supplemented with 0.5 per cent Neem leaf powder. The lambs of T_5 group were provided basal diet supplemented with 1.0 per cent Neem leaf powder. The lambs of T_6 group were provided basal diet supplemented with 0.25 per cent Giloy stem powder and 0.25 per cent Neem leaf powder. The lambs of T_7 group were provided basal diet supplemented with 0.5 per cent Giloy stem powder and 0.5 per cent Neem leaf powder. Physiological variables *viz.*, rectal temperature and respiration rate of lambs were recorded at fortnightly intervals. The rectal temperature was measured by a digital clinical thermometer in degree Fahrenheit (^{0}F). The respiration rate was recorded by observing flank movement for one minute in which each inward and outward movement of the flank was counted as one complete respiration. The respiration rate was expressed as breaths per minute (bpm). The data obtained in the study was analyzed in one-way ANOVA using SPSS 20.00 statistical analysis software.

3. Results and Discussion

The values of average temperature (°C), average relative humidity (%) and average THI at weekly intervals have been presented in Table 1. Marai *et al.* (2007) [13] established THI threshold of 25.6 for sheep. In present study, the calculated THI values revealed that the experimental lambs were in extreme severe heat stress, during the course of experiment. The mean values of rectal temperature of lambs in °F under different treatment groups at fortnightly intervals of experiment have been presented in Table 2. The mean values of rectal temperature (°F) varied from102.62°F (5th fortnight) to 103.37°F (zero day) in T_1, 101.3°F (6th fortnight) to 103.45°F (zero day) in T_2, 101.1°F (6th fortnight) to 103.44°F (zero day) in T_3, 101.82°F (5th fortnight) to 103.42°F (zero day) in T_4, 101.67°F (5th fortnight) to 103.47°F (zero day) in T_5, 100.94°F (6th fortnight) to 103.37°F (zero day) in T_6 and 100.75°F (6th fortnight) to 103.37°F (zero day) in T_7 group. The statistical analysis of variance revealed significant (P<0.05) effect on mean rectal temperature of lambs at 4th fortnight, whereas, highly significant (P<0.01) at 5th, 6th fortnight and on average rectal temperature of whole experiment. The mean values of respiration rate of lambs in breaths per minute under different treatment groups at fortnightly intervals of experiment have been presented in Table 3. The mean values of respiration rate (breaths/minute) varied from 71.34 (4th fortnight) to 79.84 (1st fortnight) in T_1, 62.67 (6th fortnight) to 76.50 (zero day) in T_2, 59.5 (6th fortnight) to 77.17 (zero day) in T_3, 62.00 (6th fortnight) to 77.00 (zero day) in T_4, 59.17 (6th fortnight) to 78.84 (zero day) in T_5, 58.50 (6th fortnight) to 78.00 (zero day) in T_6 and 57.50 (6th fortnight) to 76.84 (initial) in T_7 group. The statistical analysis of variance revealed significant (P<0.05) effect on mean respiration rate of lambs in 1st fortnight, whereas, highly significant (P<0.01) effect was observed in 5th and 6th fortnight. Non-significant effect was observed for rest of the fortnights as well as on average respiration rate of whole trial. The obtained results indicated that there were fluctuations in physiological responses of lambs *i.e.* rectal temperature and respiration rate which varied with the changes in the environmental temperature. Results of present findings showed that there was highly significant reduction in average rectal temperature and respiration rate in treatment groups compared to control. The present findings were similar with Al-Ramadan and Alamer (2010) [14] who reported significant reduction in rectal temperature and respiration rate in sheep supplemented with herb *Sisymbrium irio* and also indicated that *Sisymbrium irio* was effective to alleviate heat stress in sheep. In sheep, panting is the major evaporatory heat loss mechanism and respiratory frequencies tend to follow closely the heat loss by evaporation (Marai *et al.*, 2007) [13]. This physiological adjustment is essential to maintain normal body temperature and to prevent hyperthermia (Lowe *et al.*, 2001 [15]; Baumgard and Rhoads, 2013) [4]. Hence, the observed lower respiration rate and rectal temperature in lambs supplemented with Giloy stem powder and Neem leaves powder indicates that they were not under heat stress compared to lambs of control group which were not supplemented with Giloy stem powder and Neem leaves powder. It might be due to anti stress activity of Giloy.

Table 1: Temperature (°C), Relative humidity (%) and THI

Weeks	Temperature (°C)	Relative humidity (%)	THI
1	33.6	59.0	31.15
2	30.6	44.1	27.78
3	33.8	54.6	31.04
4	39.5	83.9	38.20
5	38.2	82.4	36.93
6	37.1	61.5	34.40
7	34.1	79.4	32.85
8	34.3	77.1	32.87
9	36.4	87.9	35.58
10	34.6	54.5	31.79
11	33.7	56.5	31.10
12	32.0	64.9	30.10
Average	34.8	67.1	32.74

Table 2: Rectal temperature (°F) of lambs at fortnightly intervals in different treatment groups

Treatment groups	Periods (fortnights)							
	0	I	II	III	IV	V	VI	Average
T_1	103.37	103.25	103.20	103.14	102.79	102.62^{B}	102.69^{c}	103.01^{b}
T_2	103.45	103.20	103.15	102.74	102.22	101.94^{AB}	101.30^{b}	102.57^{a}
T_3	103.44	103.14	102.92	102.95	102.27	101.87^{AB}	101.10^{ab}	102.53^{a}
T_4	103.42	103.25	103.32	102.82	102.75	101.82^{A}	100.84^{ab}	102.60^{a}
T_5	103.47	103.25	103.35	103.09	102.67	101.67^{A}	100.70^{a}	102.60^{a}
T_6	103.37	103.29	103.17	103.14	102.39	101.30^{A}	100.94^{ab}	102.51^{a}
T_7	103.37	103.22	103.17	102.94	102.25	101.42^{A}	100.75^{a}	102.45^{a}
SEM	0.12	0.11	0.10	0.17	0.22	0.25	0.17	0.10

Note: Means with different superscripts (A,B) in a column differ significantly (p<0.01), Means with different superscripts (a,b) in a column differ significantly (p<0.05)

Table 3: Respiration rate (breaths per min) of lambs at fortnightly intervals in different treatment group

Treatment groups	Periods (fortnights)							
	0	I	II	III	IV	V	VI	Average
T_1	76.67	79.84^{c}	76.17	74.17	71.34	73.67^{B}	73.34^{b}	75.03
T_2	76.50	72.67^{abc}	71.34	69.67	68.84	63.84^{A}	62.67^{a}	69.36
T_3	77.17	74.34^{bc}	73.50	69.17	66.17	62.67^{A}	59.50^{a}	68.93
T_4	77.00	74.50^{bc}	72.17	68.34	66.84	63.84^{A}	62.00^{a}	69.24
T_5	78.84	75.00^{bc}	72.17	68.67	66.67	62.50^{A}	59.17^{a}	69.00
T_6	78.00	69.17^{ab}	71.84	66.00	65.00	60.34^{A}	58.50^{a}	66.98
T_7	76.84	65.34^{a}	66.67	62.17	60.67	58.50^{A}	57.50^{a}	63.96
SEM	3.26	2.67	2.78	2.58	2.72	2.32	2.50	2.47

Note: Means with different superscripts (A,B) in a column differ significantly (p<0.01), Means with different superscripts (a,b) in a column differ significantly (p<0.05)

4. Conclusion

Supplementation of Giloy (*Tinospora cordifolia*) and Neem (*Azadirachta indica*) may be a positive indicator of immune response and effective to control heat stress condition in lambs. At the end, based on the physiological parameters *viz*. rectal temperature and respiration rate of lambs, it appears that incorporation of 0.5 per cent Giloy stem powder along with 0.5 per cent Neem leaves powder can be used as a part of strategy to be adopted to alleviate heat stress of growing lambs in arid zone of Rajasthan.

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