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Alleviation of thermoregulatory responses of Baladi Does by chromium and Selenium-E supplementation in subtropical areas.

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Abstract.

This experiment was conducted to study the effect of the treating Baladi female goats with chromium and selenium-E during estrous cycle, pregnancy and postpartum periods to alleviate thermoregulatory responses of animals under hot conditions in Egypt to improve their performance throughout these stages. It has been used in this research 72 mature Baladi does (36 animal / season) with an average age of 2-3 years and an average body weight of 25 Kg, the experiment lasted for two seasons (mild and hot). Animals were divided randomly into three similar groups, the 1st group was kept without any treatments (control), the 2nd group was supplemented by chromium (chromium chloride, Cr). The 3rd group was injected intramuscularly twice a week with 2ml viteselen®, contained 0.5 mg selenium and 10.7 IU vitamin E (Se-E). Animals were kept in semi-open pens during the experimental period and allowed to graze for five hours daily at least. Thermoregulatory responses of the animal were estimated in terms of rectal temperature (RT), skin temperature (ST) and respiratory rate (RR). Results showed significant decrease in RT during the estrous cycle due to Cr and Se-E treatments. Also, Selenium-E injection showed lower ST during most of the different stages of estrous cycle. Under hot season, each of chromium and selenium-E reduced ST during estrous cycle while this effect was only due to Se-E for RR without chromium .Both Cr and Se-E treatments decreased RT and ST throughout different stages of pregnancy, except at late pregnancy of Se-E group. Under hot season conditions, does injected with Se-E were the lowest in RR during the mid and late pregnancy compared with other groups. While Cr group did not reveal significant effect on RR. During postpartum period Cr and Se-E supplementation under hot condition showed significant decrease in RT and ST. Both treatments decreased ($P<0.05$) RR during the postpartum period, only Se-E exhibited this decline under hot season.

Key words: Heat stress, rectal temperature, skin temperature, respiration rate, Chromium, Selenium-E, female goats

Introduction

Heat stress has a reducing effect on both the productivity and reproductive efficiency of farm animals **(Jordan, 2003).** The deleterious effects of heat stress are the result of either the hyperthermia associated with heat stress or the physiological adjustments made by the heat-stressed animal to regulate body temperature **(Hansen, 2009).**

Rectal temperature (RT), skin temperature (ST) and respiration rate (RR) are parameters which illustrate the mechanism of physiological adaptation **(Marai et al., 2007; Otoikhian et al., 2009; Phulia et al., 2010; Sharma et al., 2013).** Rectal temperature of goats was found to be elevated with high environmental temperature in several studies **(Devendra, 1987; Marai et al., 2007).** Even a rise of less than 1˚C in rectal temperature was enough to reduce performance in most livestock species which makes the body a sensitive indicator of physiological response to heat stress **(Shebaita and El-Banna, 1982**).

During exposure to heat, ST was increased due to vasodilation which was beneficial for increasing heat loss from the skin **(Slee, 1966).** Also, **Alam et al., (2011)** stated that the respiration rate increased significantly ($P<0.01$) with increasing the period of exposure to heat stress (from 4 to 8 h. per day) compared to the control group (0 h. heat exposure).

The primary role of chromium in metabolism is in enhancing the glucose uptake by the cells **(Davis and Vincent, 1997).** Chromium also activates certain enzymes and stabilizes proteins and nucleic acids **(Anderson, 1994).** Chromium supplementation reduces the negative effects of environmental stress **(Mowat, 1994; Lien et al., 1999; Sahin et al., 2001).**

Heat stress is associated with changes in antioxidant status by promoting oxidative stress and reducing the blood concentrations of antioxidant micronutrients (zinc, selenium, and vitamin E) in ruminants **(Bernabucci et al., 2002; Burke et al., 2007).** Selenium is an essential trace element vital for the normal growth and health of animals. Selenium (Se) has a biological function related to vitamin E in that Se is an essential component of glutathion peroxidase, an enzyme involved in detoxification of hydrogen peroxide and lipid hydroperoxides. Moreover, Se is a component of selenoproteins and is involved in immune and neuropsychological function in the nutrition of animals **(Meschy, 2000). Alhidary et al., (2012)** found that mean RT of sheep injected with 5 mg of Se was 0.3°C less than that of the control sheep (39.5°C vs. 39.8°C). However, there were no differences in RR between groups.

The objective of this study was focused on the importance of treating Baladi female goats with chromium and selenium-E to alleviate the adverse effect of heat stress on thermoregulatory responses (rectal temperature, skin temperature and respiration rate) during estrous cycle, pregnancy and postpartum period.

Materials and Methods

1. Animals and feeding:

This experiment was carried out in the Experimental Farms Project (Goats Farm), Nuclear Research Center, Atomic Energy Authority, Inshas. The experimental animals were healthy and clinically free of external and internal parasites and were fed basal ration of concentrate feed mixture (CFM) according to the allowances of **NRC (2007)** of goats. The CFM composed of 37.4% wheat bran, 27% yellow corn, 12.5% soybean meal, 10.0% undecorticated cottonseed cake, 5% rice bran, 4% sugarcane molasses, 3% limestone, 1% sodium chloride and 0.1 vitamin and minerals premix. Feed mixture was offered once daily at 10 am,based on 3.5% of body weight. Barseem hay was offered ad libitum. Fresh drinking water was available at all time.

2. Animal housing:

All experimental animals were kept in semi-open pens throughout the experimental period. These pens were provided with enough shade and ventilation in summer and protection from rain in winter. The does were allowed to graze five hours daily at least.

3. Experimental design:

Seventy-two mature female goats (36 animals/ season) aged 2-3 years old with average body weigh 25 ± 1.5 kg were randomly divided into three similar groups. Animals in the 1^{st} group were kept without any treatments (control), the 2^{nd} group was supplemented by chromium (chromium chloride trivalent), 0.8 mg/head/day as capsules **(Williams et al., 1994)** and the 3^{rd} group was injected intramuscularly with 2 ml viteselen®, contained 0.5 mg selenium and 10.7 IU vitamin E/head/day.

4. Ambient temperature, relative humidity and temperature humidity index:

The ambient temperature and relative humidity were recorded daily from meteorological station of Atomic Energy Authority during the whole experimental period. The temperature humidity index (THI) was calculated during mild and hot seasons according to **Marai et al., (2000)** as**:**

THI = db ºC – [(0.31- 0.31RH) × (db ºC-14.4)]

Where, THI= temperature humidity index, db ºC= dry bulb temperature in Celsius and RH = relative humidity ÷100.

A value for THI < 22.2 was considered remarkably an absence of heat stress, while the values from 22.2 to 23.3 referred to moderate (mild) heat stress, 23.3 to <25.6 referred to severe heat stress and >25.6 referred to very severe heat stress.

5. Rectal and skin temperature:

Rectal temperature (RT,ºC) was measured using digital clinical thermometer. Skin temperature (ST, ºC) was measured using K type sensor digital thermometer, model: 301 with measuring range: -50⁰C to 1300⁰C.

6. Respiratory rate:

Respiration rate (RR) was expressed as the number of respirations per minute (breaths/min.) and was measured by counting the flank movements in one minute. Complete inward and outward movement of the flank was counted as one respiration**.**

7. Statistical analysis

Data were expressed as mean ±SE. Data were analyzed statistically by GLM procedure of the SAS program **(SAS, 1998)**. Duncan's Multiple Range test was used to detect the differences among means of the experimental groups **(Duncan, 1955).**

$Y_{ijk} = \mu + S_i + T_j + (ST)_{ij} + e_{ijk}$

Where, Y_{ijk}= the dependent variables estimated, μ= Overall mean, S_i= the effect of i^{th} season (1=mild and 2=hot), T_j= the effect of j^{th} treatment (1=control, 2=chromium and 3=selenium-E), ST_{ij}= the effect of interaction between season and treatment and e_{ijk} = random error.

Results

1. Rectal temperature, skin temperature and respiration rate during estrous cycle:

It is obviously clear that RT, ST and RR were significantly (P<0.05) affected by season and treatments used in this study throughout different stages of estrous cycle as shown in Table 1. Treating does with chromium (Cr) or selenium-vitamin E (Se-E) significantly (P<0.05) reduced rectal temperature values compared with control group during estrous cycle. The lowest RT was 38.82±0.06 and 38.99± 0.07⁰C recorded by Se-E does at diestrus and estrus period with difference about -0.37 and -0.32 ⁰C less than control, respectively. Whereas, the lowest RT recorded due to Cr treatment was 39.03 ± 0.09⁰C and 39.04 ± 0.04 ⁰C at diestrus and metestrus phases, but only metestrus phase was significantly (P<0.05) less by about -0.60 ⁰C than control. It was found that, goats showed low ST in mild season than hot. In addition, does treated by Se-E had lower ST (37.69, 38.15 and 37.33 ⁰C) at diestrus, proestrus and estrus phases than either those treated by Cr or control group respectively, Whereas, Cr group showed only low significant ST 38.0±0.17⁰C at metestrus, otherwise, it did not show any significance comparing with control group (Table 1).

Table 1. Means (±SE) for factors affecting rectal temperature, skin temperature (^{o}C) and respiration rate (breathes/min) of Does during postpartum period.

Items	Estrous cycle phases											
	Diestrus			Proestrus			Estrus			Metestrus		
	RT	ST	RR	RT	ST	RR	RT	ST	RR	RT	ST	RR
Season (S)												
Mild	39.03 ±0.03	37.82 ±0.07	26 ±0.42	39.42 ±0.06	37.76 ±0.06	27 ±0.77	39.08 ±0.06	37.46 ±0.07	25 ±0.8	39.17 ±0.06	37.98 ±0.12	24 ±0.5
Hot	38.99 ±0.08	38.20 ±0.12	25 ±0.22	39.87 ±0.09	38.75 ±0.11	26 ±0.40	39.24 ±0.07	38.22 ±0.12	24 ±0.4	39.49±0.05	38.81 ±0.09	26 ±0.3
P- value	0.697	0.002	0.042	0.0001	0.0001	0.113	0.044	0.0001	0.193	0.0001	0.0001	0.0001
Treats (T)												
Control	39.19^{A} ±0.08	38.21^{A} ±0.14	26^{A} ±0.52	39.56^{B} ±0.09	38.28 ±0.13	27^{A} ±0.67	39.31^{A} ±0.10	38.07^{A}±0.17	25 ±0.3	39.64^{A} ±0.07	38.68^{A}±0.11	27^{A} ±0.21
Cr	39.03^{A} ±0.09	38.13^{A} ±0.13	26^{A} ±0.38	39.60 ^{B} ±0.05	38.34 ±0.11	28^{A} ±0.77	39.19^{A} ±0.04	38.12^{A}±0.07	25 ±1.1	39.04^{C} ±0.04	38.00^{B}±0.17	24^{C} ±0.27
Se-E	38.82^{B} ±0.06	37.69^{B} ±0.06	25^{B} ±0.28	39.79^{A} ±0.15	38.15 ±0.21	24^{B} ±0.55	38.99^{B} ±0.07	37.33^{B} ±0.10	24 ±0.8	39.31^{B} ±0.08	38.51^{A}±0.15	25^{B} ±0.55
P- value	0.003	0.001	0.01	0.044	0.433	0.0001	0.004	0.0001	0.417	0.0001	0.0001	0.0001
S*T												
Mild												
Control	39.13 ±0.07	37.70^{cd} ±0.02	26^{ab} ±0.96	39.68^{b} ±0.07	38.00^{c} ±0.04	29^{a} ±0.77	39.08^{cd} ±0.09	37.43^{c} ±0.08	25^{a} ±0.6	39.48^{b} ±0.10	38.63^{b} ±0.02	27^{a} ±0.36
Cr	39.03 ±0.13	38.15^{b} ±0.16	27^{a} ±0.58	39.53^{b} ±0.08	38.00^{c} ±0.11	29^{a} ±1.50	39.00^{cd} ±0.04	37.78^{b} ±0.05	24^{a} ±2.1	39.03^{c} ±0.08	37.45^{d} ±0.25	23^{b} ±0.39
Se-E	38.93 ±0.05	37.60^{d} ±0.06	25^{bc} ±0.48	39.08^{c} ±0.06	37.28^{d} ±0.07	23^{d} ±0.65	39.17^{bc} ±0.13	37.18^{c} ±0.11	27^{a} ±1.0	39.00^{c} ±0.07	37.88^{c} ±0.09	24^{b} ±0.86
Hot												
Control	39.25 ±0.14	38.73^{a} ±0.18	26^{ab} ±0.43	39.45^{b} ±0.16	38.55^{b} ±0.23	24^{cd} ±0.43	39.55^{a} ±0.15	38.72^{a} ±0.17	25^{a} ±0.2	39.80^{a} ±0.04	38.73^{ab} ±0.22	27^{a} ±0.22
Cr	39.03 ±0.12	38.10^{bc} ±0.22	25^{bc} ±0.21	39.68^{b} ±0.06	38.68^{ab}±0.15	28^{ab} ±0.45	39.38^{ab} ±0.03	38.46^{a} ±0.03	26^{a} ±0.3	39.05^{c} ±0.05	38.55^{b} ±0.05	24^{b} ±0.25
Se-E	38.70 ±0.09	37.78^{bcd}±0.11	24^{c} ±0.21	40.50^{a} ±009	39.03^{a} ±0.19	26^{bc} ±0.68	38.80^{d} ±0.02	37.48^{bc}±0.13	21^{b} ±0.3	39.63^{ab}±0.03	39.15^{a} ±0.10	26^{a} ±0.36
P- value	0.224	0.001	0.046	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.016

Means with different superscripts (A, B and C or a, b, c, …) in the same column are significantly different at ($P<0.05$).

Cr= chromium, Se-E= Selenium +Vitamin-E.

Under hot conditions the animals received Cr showed significantly ($P<0.05$) lower RT (39.05±0.05 ^{0}C) at metestrus than control (39.80±0.04^{0}C). The significant decrease in RT due Se-E was 38.8 ± 0.02^{0}C at estrus period versus 39.55±0.15^{0}C for control. The marked reduction RT (38.7 ^{0}C) was due Se-E treatment at diestrus phase in hot season. However, treating female goats with Cr under hot condition showed insignificant decrease in ST during diestrus, estrus and metestrus phase compared with control. Se-E injection lowered ST significantly at diestrus and metestrus phase with mean values of 37.78 and 37.48^{0}C vs. 38.73 and 38.72^{0}C for control, respectively.

It is worthy to mention that, Se-E treated does almost had the lowest RR (24 breathes/min) during proestrus and estrus phases compared with control and Cr group. Cr group showed significantly lower RR (24±0.27 breathes/min) at metestrus compering with other groups. Under hot conditions Se-E group showed significantly marked decrease (21±0.3 breathes/min) in RR at estrus period comparing with 26±0.43 breathes/min for control. However, does supplied by Cr showed a fluctuated RR results during estrous, showing the highest RR (28 ±0.45 breathes/min) at proestrus and lowest RR (24 ±0.25 breathes/min) at metestrus compared with control (Table 1).

2. Rectal temperature, skin temperature and respiration rate during pregnancy:

Inspection the effect of treatments on RT, it is noticeable that Cr treatment decreased RT during early, mid and late pregnancy compared with control. Does injected with Se-E showed the same trend of RT. Cr group at late pregnancy recorded the lowest (38.03 ±0.3 ^{0}C) RT, however the higher value was about 39.14 ±0.08 ^{0}C for control at early pregnancy (Table 2). Cr or Se-E treated does had significantly ($P<0.05$ or $p<0.0001$) lower ST values than control group. Chromium group had the upper hand in decreasing ST during mid (37.67±0.19 ^{0}C) and late (37.55±0.21^{0}C) pregnancy more than Se-E treatment. Cr showed significant ($P<0.05$ or $p<0.0001$) increase in RR especially during mid and late pregnancy compared with control group. On the other hand, injection with Se-E during pregnancy revealed fluctuated trend of RR, showing an increase ($P<0.05$) at early pregnancy and a decrease ($P<0.05$) at late pregnancy comparing with control (Table 2).

Under mild and hot conditions, treated groups almost had RT values lower than control group during early pregnancy (EP), mid-pregnancy (MP) and late pregnancy (LP). The lowest RT was about 36.63±0.18^{0}C recorded by Cr does, followed by 37.23±0.09^{0}C for Se-E does during late pregnancy under mild condition. However, the lowest RT in the hot season was about 38.5±0.05^{0}C for Cr does and 38.65±.03^{0}C for Se-E group at EP. Cr treatment had markedly lower ST (36.76±0.05^{0}C and 36.63±0.18^{0}C) during mid and late pregnancy, respectively, comparing with other groups under mild conditions. Under hot season conditions, goats' ST response to applied treatments found to be higher magnitude in Se-E than Cr during early, mid and late pregnancy with the lowest ST 37.75±0.09^{0}C at early pregnancy (Table 2).

Respiration rate of does treated by Cr or Se-E was higher than control during early and mid-pregnancy of mild season. At late pregnancy Cr does had the highest (27 ±0.57 breathes/min) RR among other groups. However, under hot conditions Se-E does recorded the lowest RR (25 ±0.3 and 26 ±0.37) breathes/min at mid and late pregnancy comparing with 27 ±0.5 and 31 ±0.21 breathes/min for the other groups, (Table 2).

3. Rectal temperature, skin temperature and respiration rate during postpartum period (PP) :

Applying Cr or Se-E led to significant decrease ($P<0.05$) in RT, ST and RR during postpartum compared with control. Goats received Cr showed the lowest RT during 30th and 45th days PP with mean values of about 39.05±0.06 and 38.86 ±0.12 ^{0}C, respectively; however the significant decrease due to Se-E was 39.15±0.09 ^{0}C on day-30 PP. Furthermore, Cr decreased ($P<0.05$) ST on the 15th and 45th days postpartum with mean values of 37.53 ±0.10 ^{0}C and 37.87 ±0.08 ^{0}C, respectively. While, Se-E treatment lowered ST markedly (37.89 ±0.1 ^{0}C, $P<0.05$) on 30th day PP comparing with other groups. The higher RR was 27 ±0.91 breathes/min on the 15th day PP for Cr group, while the lowest RR recorded was 24 breathes/min for Se-E at 15th and 30th day PP (Table 3).

In hot season, the significant decrease in RT was due to Se-E injection on 30th and 45th days PP with mean values of 38.72±0.05^{o}C and 39.2±0.02 ^{0}C, respectively, in addition to significant lower RT 39.37±0.13^{o}C on day-45 PP due to Cr treatment versus 39.6±0.03^{o}C for control. Cr decreased ($P<0.05$) ST on the 15th and 45th day PP during hot and mild season with vale of about 37.5 ^{0}C. The same effect was obtained during mild and hot seasons on 45th day PP compared with control with values of 37.6 ±0.1 ^{0}C vs. 38.18 ±0.42 ^{0}C and 38.15 ±0.08 ^{0}C vs. 38.6 ±0.45 ^{0}C, respectively. On the other side, Se-E group gave significant lower (37.46 ±0.06 ^{0}C) ST than other groups on the 30th day PP during hot season.

Does treated with Cr or Se-E during PP period showed RR lower ($P<0.05$) than control under mild season, chromium group recorded low RR (26 breathes/min) on the days 15 and 45 postpartum. However, under hot season, does injected with Se-E had the lowest RR (20 breathes/min) on 15th and 30th day postpartum and 24±0.42 breathes/min on the 45th day PP followed by Cr group with RR 21±0.57 on day 30 PP compared with control does (Table 3).

Discussion

The decrease in rectal temperature due to Cr supplementation in the current study agree with the findings of **Kobeisy et al., (2004)** who found that chromium supplementation tended to decrease rectal temperature in sheep. Furthermore, **Moonsie-Shgeer and Mowat (1993)** found that supplemental Cr (from highy-Cr yeast) tended to reduce rectal temperatures in stressed feeder calves. In the same trend, **Liu et al., (2015)** on heat stressed growing pigs stated that, compared with control diet, Cr pigs had lower RT (40.2 vs. 39.9, $P<0.05$) under heat stress (HS) conditions, indicating an amelioration in the level of HS experienced in Cr pigs**.**

Whereas**,** these results disagreed with the finding of **Yari et al. (2010**) who concluded that supplementation of calves pre and post-weaning in summer season had no effect on rectal temperature between all experimental groups. **An-Qiang et al. (2009)** studied the effect of Cr picolinate addition to heat stressed lactating Holstein cows (15-24 days post-partum), and reported no significant effect on rectal temperatures, respiration rates due to Cr treatment. In growing lambs, supplementation with chromium picolinate at doses of 50, 75 and 100 mg per kg diets under the summer Egyptian conditions did not show any effect on rectal temperature **(Abd El-Monem and Abd El-Hamid, 2008).**

With regard to the decrease in rectal temperature observed in goats injected with Se-E, **Alhidary et al. (2012)** found that, sheep injected with 1 ml of sodium selenate (5 mg Se) was approximately 0.3°C less than that of the control sheep (39.7°C vs. 40.0°C).

Skin temperature results for untreated group agreed with **Fahmy (1994), Marai et al. (1997)** and **khalifa et al. (2000)** with goats. The authors stated an increase in ST as a result of exposure to heat stress conditions. Skin temperature is a physiological parameter that can be used for heat stress assessment as the heat exchange between the body and environment is achieved through the skin. The adjustment of skin blood flow to regulate transfer of heat from body core to the skin results in a shift in skin temperature in response to elevated temperatures **(Habeeb et al., 1992).** The current significant decrease in ST due to Se-E supplementation at estrous cycle (diestrus and estrus phase), pregnancy and postpartum period under hot season conditions is in agreement with **Zeidan et al. (2001) and Al-Zafry and Medan (2012**) with New Zealand white rabbits. The authors found that supplementation with Se-E significantly reduced skin temperature than control group of heat stressed rabbits, indicating that injection of vitamin E and selenium complex ameliorates the heat stress effect. Whereas, **Chauhan et al. (2015)** with sheep exposed to heat stress condition reported an increase in ST by increasing ambient temperature and found non-significant effect due to Se-E dietary supplementation on ST as compared to control group that disagree with the current study results of Se-E.

On the other side, **Abdulaziz (2006)** studied the effect of heat stress and supplemental chromium on thermo-respiratory responses in non-pregnant Saidi ewes exposed to direct solar radiation for two contentious hours and found that Cr supplementation had no significant effect on skin temperature. The present results are in agreement with those of **Abdulaziz (2006)** in respect of Cr results of estrus and postpartum under hot season conditions, but disagreed with pregnancy period results which revealed significant decrease in ST due to chromium supplementation. Inspection of the current hot season results of Cr treatment during estrous, pregnancy and postpartum periods; it generally did not have significant effect on respiration rate compared with control. The current results are in agreement with those of **Lacetera et al., (2002)** who concluded that administration of Cr to heat-stressed periparturient cows did not significantly affect respiration rate. However, under mild conditions the present results are in contrary with the findings of the same author, which revealed significant decrease in RR due to Cr supplementation (Table 2). In addition, **An-Qiang et al., (2009)** studied the effect of Cr Picolinate addition to heat stressed lactating Holstein cows (15 - 45 days postpartum), and found no significant effect on respiration rates due to Cr supplementation. Results of Se-E revealed significant decrease in respiration rate under hot season conditions throughout estrous, pregnancy and postpartum periods. These results agree with finding of **Chauhan et al., (2015),** who studied the ameliorative effect of selenium and vitamin-E dietary supplementation in heat stressed sheep and found that sheep given combined diet of Se and vitamin E had a lower respiration rate under HS compared with those fed the low Se and vitamin E diet or control. Whereas, the current results disagree with those of **El-Shahat and Abdel Monem (2011)** and **Alhidary et al. (2012)** in heat stressed sheep**.** The authors stated that treating sheep with Se alone or Se and /or vitamin E did not have significant effect on respiration rate.

In conclusion, this study revealed that chromium and selenium-E supplementation could be used to alleviate heat stress effects since it showed decrease in thermoregulatory responses during some stages of estrous, pregnancy and postpartum periods of Baladi does specially under hot season.

Table 2. Means (±SE) for factors affecting rectal temperature, skin temperature (ºC) and respiration rate (breathes/min) of does during pregnancy period.

Items	Pregnancy Period								
	Early pregnancy			Mid-pregnancy			Late pregnancy		
	RT	ST	RR	RT	ST	RR	RT	ST	RR
Season (S)									
Mild	39.09 ±0.05	37.53 ±0.04	26 ±0.3	38.37 ±0.07	37.11 ±0.09	25 ±0.3	37.04 ±0.81	37.04 ±0.81	25 ±0.44
Hot	38.68 ±0.05	38.16 ±0.08	22 ±0.4	38.93 ±0.06	38.85 ±0.10	26 ±0.3	39.39 ± 0.02	38.29 ± 0.06	29 ±0.42
P- value	0.0001	0.0001	0.0001	0.0001	0.0001	0.005	0.0001	0.0001	0.0001
Treatments (T)									
Control	39.14^{A} ±0.08	38.10^{A} ±0.14	23^{B} ±0.5	38.93^{A} ±0.08	38.59^{A} ±0.22	25^{B} ±0.5	38.28^{A} ±0.21	37.81^{A} ±0.12	28^{B} ±0.80
Cr	38.81^{B} ±0.07	37.84^{B} ±0.04	24^{A} ±0.6	38.48^{B} ±0.09	37.67^{B} ±0.19	27^{A} ±0.3	38.03^{B} ±0.30	37.55^{B} ±0.21	29^{A} ±0.49
Se-E	38.71^{B} ±0.03	37.59^{C} ±0.06	24^{A} ±0.7	38.53^{B} ±0.08	37.69^{B} ±0.17	25^{B} ±0.2	38.34^{A} ±0.23	37.63^{AB} ±0.11	24^{C} ±0.41
P- value	0.0001	0.0001	0.034	0.0001	0.0001	0.0001	0.001	0.033	0.0001
S*T									
Mild									
Control	39.39^{a} ±0.05	37.45^{d} ±0.05	24 ±0.2	38.68 ±0.10	37.57^{c} ±0.13	23^{c} ±0.7	37.25^{b} ±0.01	37.25^{c} ±0.01	24^{c} ±0.67
Cr	39.13^{b} ±0.07	37.70^{c} ±0.5	26 ±0.3	38.08 ±0.08	36.76^{d} ±0.05	26^{ab} ±0.2	36.63^{c} ±0.18	36.63^{d} ±0.18	27^{b} ±0.57
Se-E	38.76^{cd} ±0.04	37.43^{d} ±0.06	27 ±0.6	38.35 ±0.09	37.00^{d} ±0.16	25^{b} ±0.3	37.23^{b} ±0.09	37.23^{c} ±0.09	23^{c} ±0.32
Hot									
Control	38.90^{c} ±0.10	38.75^{a} ±0.06	22 ±0.9	39.20 ±0.1	39.60^{a} ±0.11	27^{a} ±0.5	39.30^{a} ±0.02	38.37^{a} ±0.09	31^{a} ±0.21
Cr	38.50^{e} ±0.05	37.98^{b} ±0.03	22 ±0.9	38.88 ±0.03	38.57^{b} ±0.11	27^{a} ±0.5	39.43^{a} ±0.02	38.46^{a} ±0.03	31^{a} ±0.21
Se-E	38.65^{de} ±0.03	37.75^{c} ±0.09	22 ±0.4	38.70 ±0.13	38.37^{b} ±0.07	25^{b} ±0.3	39.45^{a} ±0.05	38.03^{b} ±0.10	26^{b} ±0.37
P- value	0.0001	0.0001	0.085	0.065	0.016	0.0001	0.0001	0.0001	0.0001

Means with different superscripts (A, B and C or a, b, c, …) in the same column are significantly different at ($P<0.05$).
Cr= chromium, Se-E= Selenium +Vitamin-E.

Table 3. Means (±SE) for factors affecting rectal temperature, skin temperature (ºC) and respiration rate (breathes/min) of does during postpartum period.

Items	Postpartum period								
	15-day PP			30-day PP			45-day PP		
	RT	ST	RR	RT	ST	RR	RT	ST	RR
Season (S)									
Mild	38.62 ±0.09	37.64 ± 0.11	28 ±0.59	39.38±0.07	38.25 ± 0.07	30 ±0.45	38.08±0.07	38.0 ±0.07	28 ± 0.49
Hot	39.29 ±0.04	37.86 ± 0.10	26 ±0.79	39.01±0.04	38.22 ± 0.09	23 ± 0.68	39.39±0.03	38.32 ±0.05	26 ± 0.33
P- value	0.0001	0.127	0.0001	0.0001	0.709	0.0001	0.0001	0.0001	0.0001
Treatments (T)									
Control	38.89 ±0.10	37.74^{AB} ±0.13	29^{A} ±0.49	39.40^{A} ±0.06	38.40^{A} ±0.12	30^{A} ±0.61	39.29^{A} ±0.07	38.38^{A} ±0.01	30^{A} ±0.55
Cr	38.90 ±0.10	37.53^{B} ±0.12	27^{B} ±0.91	39.05^{B} ±0.06	38.41^{A} ±0.06	25^{B} ±1.0	38.86^{B} ±0.12	37.87^{B} ±0.08	26^{B} ±0.25
Se-E	39.08 ±0.12	37.99^{A} ±0.13	24^{C} ±0.84	39.15^{B} ±0.09	37.89^{B} ±0.10	24^{B} ± 0.9	39.20^{A} ±0.04	38.21^{A} ±0.07	26^{B} ±0.42
P- value	0.249	0.032	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
S*T									
Mild									
Control	38.38 ±0.14	37.40 ±0.16	30^{a} ±0.49	39.60^{a}±0.08	38.10^{c} ±0.17	31^{a} ±1.1	38.97^{d} ±0.07	38.18^{b} ±0.42	32^{a} ±0.42
Cr	38.50 ±0.18	37.55 ±0.20	26^{b} ±1.20	39.00^{b} ±0.13	38.33^{bc} ±0.09	30^{ab} ±0.65	38.35^{e} ±0.12	37.60^{c} ±0.10	26^{c} ±0.39
Se-E	38.83 ±0.15	37.98 ±0.18	28^{ab} ±0.13	39.56^{a} ±0.06	38.33^{bc} ±0.08	29^{b} ±0.25	39.10^{cd} ±0.08	38.23^{b} ±0.10	27^{bc} ±0.32
Hot									
Control	39.25 ±0.03	38.08 ±0.14	28^{ab} ±0.44	39.20^{b}±0.03	38.70^{a} ±0.03	29^{b} ±0.15	39.60^{a} ±0.03	38.60^{a} ±0.45	28^{b} ±0.45
Cr	39.30 ±0.06	37.50 ±0.13	29^{a} ±1.20	39.10^{b} ±0.02	38.50^{ab} ±0.09	21^{c} ±0.57	39.37^{b} ±0.13	38.15^{b} ±0.08	27^{bc} ±0.25
Se-E	39.33 ±0.10	38.00 ±0.18	20^{c} ±0.43	38.72^{c} ±0.05	37.46^{d} ±0.06	20^{c} ±0.21	39.20^{bc} ±0.02	38.2^{b} ±0.10	24^{d} ±0.42
P- value	0.45	0.075	0.0001	0.0001	0.0001	0.0001	0.0001	0.003	0.0001

Means with different superscript (A, B and C or a, b, c, …) in the same column are significantly different at ($P<0.05$).
Cr= chromium, Se-E= Selenium +Vitamin-E.

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تخفيف الإستجابات الحرارية لإناث الماعز البلدي بإضافة الكروميوم والسيلينيوم-هـ في المناطق شبه الحارة.

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1. قسم التطبيقات البيولوجية – شعبة تطبيقات النظائر المشعة – مركز البحوث النووية – هيئة الطاقة الذرية
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خلاصة

إجريت هذه التجربة لدراسة تأثير معاملة اناث الماعز المحلية بالكروم والسيلينيوم-هـ خلال دورة الشبق ومرحلة الحمل وما بعد الولادة علي مدي تخفيف الإستجابات الحرارية للحيوانات تحت الظروف الحارة في مصر وبالتالى تحسين أدائها خلال تلك المراحل . وقد استخدم فى هذا البحث 72 عنزة بلدي ناضجة (36 حيوان / موسم) بمتوسط عمر 2-3 سنوات ومتوسط وزن الجسم 25 كجم. واستمرت التجربة لموسمين (معتدل وحار) حيث قسمت الحيوانات عشوائيا الي ثلاث مجاميع الاولي بدون معاملات (مجموعه ضابطه) والمجموعة الثانية تم معاملتها بمادة الكروميوم – في صورة كلوريد الكروميوم- وبمعدل 0.8 ملجم/رأس/ يوم (مجموعة الكروم) أما المجموعة الثالثة تم حقنها في العضل بـ 2مل مرتين اسبوعياً من مخلوط السيلينيوم+فيتامين هـ (فايتسيلين) وهذة الكمية تعادل 0.5ملجم من السيلينيوم و 10.7 وحدة دولية فيتامين هـ /رأس/يوم. تم وضع الحيوانات في حظائر نصف مفتوحة خلال فترة التجربة وسمح لها بالرعي لمدة خمسة ساعات يومياً علي الأقل. وتم تقدير الإستجابات للتأقلم الحرارى علي الحيوانات متمثلة في درجة حرارة المستقيم والجلد ومعدل التنفس.

أوضحت النتائج أن معاملة الماعز البلدية بالكروم والسيلينيوم-هـ خلال تللك الفترات أدت الي:

إنخفاض معنوي في درجة حرارة المستقيم مقارنة بالكنترول خلال دورة الشبق. كما أدي الحقن بالسيلينيوم-هـ الي انخفاض حرارة الجلد خلال معظم مراحل الشبق المختلفة. وتحت الجو الحار قلل كل من الكروم والسيلينيوم-هـ حرارة الجلد خلال دورة الشبق في حين كان هذا التأثير فقط للسيلينوم علي معدل التنفس دون الكروم.

انخفضت درجة حرارة المستقيم والجلد خلال فترات الحمل المختلفة، ماعدا فترة الحمل المتأخر لمجموعة السيلينيوم-هـ لم تظهر اي تأثير معنوي علي حرارة المستقيم. وتحت ظروف الجو الحار سجلت الأناث المحقونة بالسيلينيوم اقل معدل تنفس أثناء فترة الحمل الأوسط والمتأخر مقارنة بالمجاميع الأخري. في حين لم يكن للكروم تأثير معنوي علي معدل التنفس.

أدت معاملة إناث الماعز بالكروم والسيلينيوم-هـ تحت الظروف الحارة الي إنخفاض حرارة المستقيم خلال فترة ما بعد الولادة حتي وإن كان هذا الإنخفاض غير معنوي في بعض الأحيان . وأظهرت المعاملة بالكروم انخفاض في حرارة الجلد خلال اليوم 15 و45 بعد الولادة، أما السيلينيوم فخفض حرارة الجلد خلال اليوم 30 فقط خاصة تحت الجو الحار. وأظهرت كلتا المعاملتين انخفاض معنوي في معدلات التنفس خلال فترة ما بعد الولادة حيث اظهر السيلينيوم-هـ هذا الانخفاض تحت الجو الحار دون الكروم.