Int.J.Curr.Microbiol.App.Sci (2021) *10*(03): 298-308

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 10 Number 03 (2021)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2021.1003.040

Effect of Maternal Iodine Supplementation on Thermoregulation and Performance of Saidi Newborn Lambs

A. A. K. Saleh[1*], G. F. Abozed[1], H. Hamdon[2], M. Hayder[1], Eitedal H. El- Sayed[1] and T. M. M. Abdel Khalek[1]

[1]*Sheep and Goats Dept., Animal Production Research Institute, Dokki, Giza, Egypt*
[2]*Department of Animal Production, Faculty of Agriculture, New Valley University, Egypt*

**Corresponding author*

Keywords

Maternal iodine, Thermoregulation, Performance, Newborn lambs

Article Info

Accepted:
04 February 2021
Available Online:
10 March 2021

A B S T R A C T

This study was conducted to investigate the effect of maternal iodine supplementation on thermoregulation and performance of Saidi newborn lambs. The trial was performed on a total of 53 newborn lambs which were born to 40 ewes that were divided into two equal groups as *control group* (did not receive treatment) included 20 ewes lambed 26 newborn lambs and *treatment group* which were supplemented with iodine from the beginning of the last third of pregnancy until weaning of their lambs and this group consisted of 20 ewes lambed 27 newborn lambs. The trial was conducted during the winter lambing season. The results revealed that the lamb's birth weights were significantly higher ($p<0.05$) in the supplemented group and also, body weight and average daily gain of lambs at 1, 2 and 3 months were improved. Besides, the lamb's survival was higher in the iodine treated group at 1, 2 and 3 months of age. Rectal temperature and skin temperature of lambs at birth were significantly ($P<0.01$) higher in treated group than in control and similar trend was noticed at 2 weeks, 1 month and 2 months and this was accompanied with a significant increase in metabolic rate at all measurement periods in these lambs. Also, a significant increase in serum total protein, glucose, T3 and T4 concentrations was recorded in these lambs of treated ewes. In conclusion, iodine supplementation for ewes during late pregnancy and lactation periods have beneficial effects on thermoregulation of newborn lambs (by improving physiological responses and metabolic rate) which enhanced their ability to face cold conditions and improved their performance and survivability.

Introduction

Small ruminants (especially sheep) play a major role in the socio-economic status of millions in Egypt. The Egyptian Saidi sheep breed is the oldest breed located in Upper Egypt, it is characterized by coarse wool and high conception rate (82-92%) and twining rate (1.5%) and the mortality rate of newborns at birth was 4.5-7.0% and it increases to 10.0-18.2% up till weaning *(EL-Hommosi and Abdel-Hafiz, 1982; Elshazly and Youngs, 2019), (Galal, 1987), (Elshazly and Youngs, 2019).* The high mortality rate of Saidi newborn lambs is one of the major problems that occur to sheep breeders (especially during cold stress in winter lambing season) that consequently decreased the survival rate of lambs *(Elshazly and Youngs, 2019 and Abozed et al., 2020)*. So, research efforts should initially be aimed to reduce newborn lamb mortality due to these adverse conditions.

Mineral requirements of mammals during pregnancy increase by the progression of gestation because of embryo development and so, supplementation of trace minerals for ewes in late pregnancy is very important *(Zarbalizadeh-Saed et al., 2020)*. Iodine is a vital trace element required for many biological functions occurred in the animal body, it is essential for the production of thyroid hormones (Thyroxine and Triiodothyronine) that play a major role in controlling nutrient metabolism and consequently growth and development *(Ferri et al., 2003 and Hana et al., (2014)*. Sheep that live in an iodine-deficient area are exposed to the adverse effects of iodine deficiency on reproduction *(Zarbalizadeh-Saed et al., 2020)*. Moreover, iodine deficiency could cause abortion, stillbirth and increased neonatal mortality (Dunn and Delange, 2001; Smallridge and Ladenson, 2001 and Ferri *et al.,* 2003).

Generally, newborns of mammals depend on maternal iodine intake, mothers transfer iodine to their newborns during lactation by mammary glands and then the newborns build iodine pool in their thyroid gland *(Yan et al., 2017)*. It has been reported that maternal iodine supplementation improved the immunity status and metabolic rate of goat kids *(McGovern et al., 2016 and 2017)*. Also, an earlier study reported that poor reproductive performance of ewes and high perinatal lamb mortality rates were strongly associated with iodine deficiency *(Sargison et al., 1998)*. Recently, *Zarbalizadeh-Saed et al., (2020)* found that maternal iodine supplementation improved newborn lamb's daily gain, glutathione peroxidase activity "one of the immunological components", and T4 concentration. Thermoregulation is critical to the survival of the neonates of sheep and the newborn coat at birth was wet and the energy loss can be very high and this leads to a high mortality rate. It has been reported that iodine supplementation increased body heat production and metabolic rate due to increasing metabolism and this consequently maintains body temperature *(Hana et al., 2014 and Abozed et al., 2020)*. The objective of this study is to investigate the effect of maternal iodine supplementation on thermoregulation and performance of Saidi newborn lambs.

Materials and Methods

Animals and experimental design

This study was carried out in Mallawi Animal Production Research Station, Mallawi City, Minia Governorate during the winter season. The trial was conducted on newborn lambs of Forty Saidi pregnant ewes. These ewes were with an average age of 3 years and average body weight of 35 kg, ewes were divided into two equal groups (20 ewes per each) according to their age, parity, and body weight as;

Control group: (did not receive treatment) included 20 ewes lambed 26 newborn lambs (10 singles and 8 twins "11 females and 15 males").

Treatment group: treated with 12 mg of potassium iodide solution by oral administration every two days from the beginning of the last third of pregnancy until weaning of their lambs and this group consisted of 20 ewes lambed 27 newborn lambs (11 singles and 8 twins "12 females and 15 males").

The trial was done on the newborns of the two groups from birth till weaning. Ewes were fed during the experimental period according to NRC (2007) and the newborn lambs were fed maternal milk beside a creep feeding which was included after 35 days of birth until weaning. Lamb's body weight and survival rate was determined during the experimental period. Blood samples and all measurements were taken from newborn lambs at birth, 3 hrs., 12 hrs., 36 hrs., 48hrs., 72 hrs., 1 week, 2 weeks. 1 month, 2 months of age lamb's age.

Thermal responses, respiratory activities and gas exchange

Ambient temperature and relative humidity were recorded at all periods during the experimental period. Rectal temperature (RT, ^oC) was measured using a clinical thermometer. While, skin temperature (ST, ^oC) and wool temperature (WT, ^oC) were measured using a portable infrared thermometer (Radioshack). Respiration rate (RR) was determined by counting the flank movements and expressed as the number of breaths per minute. The respiratory minute volume of exhaled air per minute (GV) was measured by Dry Gas Meters, and gas volume was corrected to Standard Dry Temperature and Pressure (STPD) according to Yousef and Dill (1969). The volume of oxygen consumption (VO_2) and carbon dioxide production (VCO_2) were measured with the open-circuit technique with an infrared Gas Analyzer (Model-AR-411). Tidal volume was calculated by dividing the respiratory minute volume (GV) STPD by the respiration rate per minute. TV = GV 1/RR r.p.m. And the metabolic rate was calculated by this equation [VO_2 × (3866 + (GV adjusted to STPD × VCo_2×1200) × (1.163×60×24 / POWER (Body Weight, 0.75)]/1000.

Blood metabolites and hormones

Blood samples were collected from the jugular vein containing heparin; for the determination of packed cell volume (PCV %). After estimating the PCV, blood samples were centrifuged at 1,800 × g for 20 min. at 4°C. Serum samples were stored at -20°C for subsequent analysis of blood metabolites and hormones. Total protein, albumin and glucose concentrations were determined using commercial kits. Triiodothyronine (T3) and Thyroxine (T4) concentrations were determined using direct radioimmunoassay (RIA) techniques using ready-coated tub kits (Diagnostic Systems Laboratories, USA).

Statistical analysis

Statistical analysis was done by the SPSS program (v. 21) for Windows (SPSS Inc., Chicago, IL). Data were analyzed by an independent sample T-test. The following statistical model was used:

$$Y_{ij}= \mu + T_i + E_{ij}$$

Where, Yij= The studied trait, μ = The overall mean, Ti= The effect of treatment, Eij= The experimental error.

Results and Discussion

Body weights, daily gain and survival

The mean weights and daily gains of the lambs are shown in Table (1) and (2). The lamb’s birth weights were significantly higher ($p<0.05$) in the supplemented group compared to control. Also, weights of lambs at 1, 2 and 3 months were significantly higher ($p<0.01$) in the supplemented group. Besides, the results demonstrated that the average daily gain of lambs was improved in the supplemented group than the control.

Similar results were found in sheep by *Rose et al., (2007)* and *Boland et al., (2008).* Also, consistent findings were obtained in Buffalo by *Zeedan et al., (2010 & 2014)* and in camels by *Abd El-Salaam et al., (2018). Abozed et al., (2020)* found that body weights of ewes were significantly higher in the iodine-supplemented group compared to the control pre and post-lambing ewes. Additionally, *Pattanaik et al., (2001)* found that iodine supplementation positively influenced the live weight gain of goats compared with control. Recently, *Zarbalizadeh-Saed et al., (2020)* found that maternal iodine supplementation improved newborn lamb's daily gain and immunological status. These results can be due to the improvement in thyroid function by iodine supplementation which increases body metabolic activity and body weight *(Abd El-Salaam et al., 2018).*

The present results revealed that the lambs' survival rate was higher in the iodine treated group than the control at 1, 2 and 3 months of age (Table 1). Similarly, it has been reported that maternal iodine supplementations decreased lamb mortality *(Ferri et al., 2003).* In addition, *Parker and McCutcheon, (1989)* reported that correcting iodine deficiency improved the number of lambs reared per ewe. Also, *Sargison et al., (1998)* reported that high lamb mortality rates were strongly associated with iodine deficiency. Besides, neonatal weakness, mortality and skeletal immaturity were reported as signs of iodine deficiency disorder *(Campbell et al., 2012).* Additionally, a previous study reported that lambs with iodine deficiency did not follow their mothers and refused to drink and this could lead to high mortality (Sinclair & Andrews 1961).

Table.1 Effect of maternal iodine supplementation on lambs body weight and survival

Age	Groups		Sig.
	Control	Treatment	
At birth weight	2.56 ± 0.14	2.96 ± 0.06	*
At 1st month	5.91 ± 0.15	7.50 ± 0.18	**
At 2nd month	9.55 ± 0.28	10.96 ± 0.29	**
At 3rd month	12.26 ± 0.42	14.23 ± 0.31	**
No. of total lambs born	**26**	**27**	**-**
No. of alive lambs born	**25**	**26**	**-**
Lambs survival 1 month	**21**	**25**	**-**
2 months	**20**	**25**	**-**
3 months	**20**	**25**	**-**

* = significant (P< 0.05), ** = significant (P< 0.01)

Table.2 Effect of maternal iodine supplementation on lambs daily gain

Age	Groups		Sig.
	Control	Treatment	
1 month	95.4 ± 8.46	134.9 ± 6.20	**
2 months	129.8 ± 6.82	123.4 ± 6.92	NS
3 months	96.9 ± 9.84	116.8 ± 5.91	NS

** = significant (P< 0.01), NS = not significant (P≥ 0.05)

Table.3 Effect of iodine supplementation on thermal responses of lambs

Age	Parameters			
	Groups	**Rectal temp. (RT) C^o**	**Skin temp. (ST) C^o**	**Wool temp. (WT) C^o**
At birth	**Control**	38.67 ± 0.08	26.51 ± 0.49	22.81 ± 0.54
	Treatment	39.02 ± 0.09	28.80 ± 0.54	24.64 ± 0.64
	Sig.	**	**	*
At 3 hrs.	**Control**	38.98 ± 0.10	27.48 ± 0.43	24.79 ± 0.49
	Treatment	39.11 ± 0.07	28.19 ± 0.39	24.35 ± 0.40
	Sig.	NS	NS	NS
At 12 hrs.	**Control**	38.99 ± 0.07	27.70 ± 0.53	23.23 ± 0.62
	Treatment	39.10 ± 0.05	26.57 ± 0.37	22.54 ± 0.52
	Sig.	NS	NS	NS
At 36 hrs.	**Control**	39.02 ± 0.07	27.32 ± 0.64	23.23 ± 0.69
	Treatment	39.09 ± 0.05	26.04 ± 0.70	21.87 ± 0.71
	Sig.	NS	NS	NS
At 1st day	**Control**	39.09 ± 0.06	27.78 ± 0.43	24.37 ± 0.43
	Treatment	39.08 ± 0.07	28.30 ± 0.52	24.72 ± 0.66
	Sig.	NS	NS	NS
At 2nd day	**Control**	39.27 ± 0.05	28.12 ± 0.55	23.58 ± 0.55
	Treatment	39.39 ± 0.06	28.94 ± 0.43	24.50 ± 0.51
	Sig.	NS	NS	NS
At 3rd day	**Control**	39.26 ± 0.05	26.51 ± 0.57	23.27 ± 0.60
	Treatment	39.43 ± 0.06	28.06 ± 0.64	23.72 ±0.64
	Sig.	NS	NS	NS
At 2 weeks	**Control**	39.25 ± 0.03	27.03 ± 0.43	23.60 ± 0.49
	Treatment	39.42 ± 0.05	28.34 ± 0.30	24.71 ± 0.43
	Sig.	**	**	NS
At 1 month	**Control**	39.32 ± 0.04	27.23 ± 0.21	24.02 ± 0.41
	Treatment	39.45 ± 0.04	28.68 ± 0.24	24.32 ± 0.49
	Sig.	*	**	NS
At 2 months	**Control**	39.36 ± 0.04	28.04 ± 0.36	24.41 ± 0.41
	Treatment	39.48 ± 0.02	27.74 ± 0.47	24.32 ± 0.42
	Sig.	*	NS	NS

Table.4 Effect of iodine supplementation on respiratory activities and metabolic rate of Saidi newborn lambs

Age	Parameters				
	Groups	**RR(breathe/minute)**	**Gas volume (L/minute)**	**Tidal volume (ml/breathe)**	**Metabolic rate (Kcal/day)**
At birth	**Control**	53.76 ± 4.21	1.93 ± 0.08	39.12 ± 2.61	114.40 ± 10.94
	Treatment	53.40 ± 3.73	2.12 ± 0.08	43.21 ± 3.18	151.05 ± 11.57
	Sig.	NS	NS	NS	*
At 3 H	**Control**	46.29 ± 2.71	1.78 ± 0.11	40.39 ± 3.29	95.20 ± 7.51
	Treatment	42.80 ± 2.73	2.02 ± 0.07	52.97 ± 6.02	135.38 ± 6.41
	Sig.	NS	*	NS	**
At 12 H	**Control**	49.43 ± 2.86	1.77 ± 0.10	39.79 ± 4.21	103.92 ± 6.50
	Treatment	42.82 ± 2.01	1.92 ± 0.09	47.12 ± 3.55	132.71 ± 9.50
	Sig.	NS	NS	NS	**
At 36 H	**Control**	51.63 ± 3.37	1.86 ± 0.09	38.18 ± 2.71	107.33 ± 7.50
	Treatment	54.33 ± 3.59	1.82 ± 0.10	34.48 ± 1.85	120.11 ± 6.91
	Sig.	NS	NS	NS	NS
At first day	**Control**	53.05 ± 2.80	1.88 ± 0.07	37.51 ± 2.62	107.27 ± 6.65
	Treatment	46.53 ± 2.70	1.91 ± 0.07	42.85 ± 2.54	128.11 ± 11.32
	Sig.	NS	NS	NS	NS
At second day	**Control**	55.78 ± 2.55	1.89 ± 0.07	34.83 ± 1.67	109.26 ± 8.73
	Treatment	51.06 ± 2.13	2.15 ± 0.11	43.91 ± 3.29	137.10 ± 6.54
	Sig.	NS	*	*	**
At third day	**Control**	51.56 ± 3.44	1.86 ± 0.09	37.50 ± 2.05	116.10 ± 5.87
	Treatment	49.56 ± 2.38	1.99 ± 0.09	41.14 ± 2.25	159.96 ± 10.11
	Sig.	NS	NS	NS	**
At 2 weeks	**Control**	47.33 ± 1.48	1.75 ± 0.07	37.84 ± 2.18	121.72 ± 5.15
	Treatment	44.65 ± 1.43	1.98 ± 0.07	54.19 ± 2.17	141.59 ± 4.10
	Sig.	NS	*	*	**
At 1 month	**Control**	45.83 ± 1.45	1.84 ± 0.08	41.08 ± 2.56	86.45 ± 6.91
	Treatment	43.53 ± 1.19	2.19 ± 0.08	50.65 ± 1.95	114.76 ± 9.96
	Sig.	NS	**	**	*
At 2 months	**Control**	46.17 ± 1.63	2.05 ± 0.06	45.46 ± 2.28	82.72 ± 3.53
	Treatment	45.82 ± 1.39	2.46 ± 0.09	54.34 ± 2.26	104.77 ± 4.43
	Sig.	NS	**	**	**

Table.5 Effect of iodine supplementation on some blood parameters of Saidi newborn lambs

Age	Parameters					
	Groups	PCV %	Glucose (mg/dl)	Total protein (g/dl)	Albumin (g/dl)	Glubulin (g/dl)
At birth	Control	31.25 ± 0.61	52.37 ± 3.01	4.80 ± 0.11	2.48 ± 0.10	2.32 ± 0.16
	Treatment	33.31 ± 0.93	63.42 ± 2.19	5.47 ± 0.19	3.06 ± 0.14	2.41 ± 0.15
	Sig.	NS	**	**	**	NS
At 24 h	Control	31.33 ± 1.17	51.32 ± 4.33	5.01 ± 0.14	2.45 ± 0.10	2.56 ± 0.18
	Treatment	33.15 ± 0.91	63.78 ± 4.27	5.52 ± 0.18	2.93 ± 0.10	2.60 ± 0.21
	Sig.	NS	*	*	**	NS
At 48 h	Control	30.50 ± 0.80	57.74 ± 3.90	5.20 ± 0.16	2.70 ± 0.16	2.50 ± 0.11
	Treatment	31.00 ± 1.09	67.37 ± 2.48	5.91 ± 0.15	3.13 ± 0.14	2.79 ± 0.11
	Sig.	NS	*	**	*	NS
At 1 week	Control	30.42 ± 0.65	53.53 ± 5.44	5.28 ± 0.16	2.64 ± 0.10	2.65 ± 0.14
	Treatment	32.38 ± 0.69	68.83 ± 2.98	5.89 ± 0.19	2.95 ± 0.10	2.94 ± 0.22
	Sig.	*	*	*	*	NS
At 2 weeks	Control	28.42 ± 0.72	58.26 ± 3.09	5.28 ± 0.14	2.70 ± 0.09	2.58 ± 0.14
	Treatment	33.31 ± 1.01	69.19 ± 2.00	5.84 ± 0.23	2.89 ± 0.11	2.95 ± 0.23
	Sig.	**	**	*	NS	NS
At 1 month	Control	29.08 ± 0.68	59.96 ± 3.43	5.52 ± 0.21	2.81 ± 0.13	2.71 ± 0.24
	Treatment	31.09 ± 0.46	68.78 ± 2.47	6.11 ± 0.14	3.11 ± 0.14	3.00 ± 0.19
	Sig.	*	*	*	**NS**	NS
At 2 months	Control	28.75 ± 0.69	59.64 ± 3.56	5.34 ± 0.17	2.88 ± 0.06	2.47 ± 0.16
	Treatment	31.55 ± 0.71	68.66 ± 2.41	6.13 ± 0.15	3.16 ± 0.08	2.96 ± 0.14
	Sig.	**	*	**	**	*

Table.6 Effect of iodine supplementation on thyroid hormones of Saidi newborn lambs

Age	Parameters		
	Groups	T3 (ng/dl)	T4 (ug/dl)
At birth	Control	2.89 ± 0.25	58.70 ± 7.12
	Treatment	4.23 ± 0.44	96.61 ± 11.30
	Sig.	*	**
At 2 weeks	Control	2.88 ± 0.26	66.17 ± 6.06
	Treatment	3.82 ± 0.21	92.35 ± 10.07
	Sig.	**	*
At 1 month	Control	3.43 ± 0.21	76.80 ± 5.82
	Treatment	4.38 ± 0.35	107.48 ± 10.78
	Sig.	*	*
At 2 months	Control	3.38 ± 0.43	59.11 ± 7.84
	Treatment	5.36 ± 0.50	106.21 ± 12.17
	Sig.	**	**

These results may be due to maternal iodine supplementation which improved the metabolism which therefore improved the general performance of ewes during pregnancy and weights of fetuses in addition to the beneficial effect on the lactational performance, which also improved their lambs' survival.

Thermal responses, respiratory activities and metabolic rate

The effects of iodine supplementation on thermal response parameters are shown in Table (3). Rectal temperature and skin temperature of lambs at birth in control group were significantly (P<0.01) lower than in treated group. Also, similar trend of results was noticed at 2 weeks, 1 month and 2 months. While at 3 hrs., 12 hrs., 36 hrs., 1st, 2nd and 3rd days, thermal response parameter did not significantly differ between groups. Also, the results presented in Table (4) showed that respiratory rate almost did not affected but GV and TV tended to increase in lambs of iodine-supplemented ewes and the obvious significant increase was noticed in metabolic rate at all measurement periods in these lambs. These results revealed that lambs of treated ewes have the ability to maintain body temperature during these cold conditions compared to those of untreated ones "due to increased metabolic rate". Hereby, it is important to mention that gas volume per minute, tidal volume and metabolic rate values of iodine treated ewes (mothers of the lambs of the treated group) were significantly higher compared to control group (Abozed *et al.,* 2020).

Studies that investigated the effect of iodine supplementation on sheep metabolic rate are rather limited. Kerslake *et al., (2010)* reported that newborn lambs of iodine-supplemented ewes had higher basal heat production than those born to un-supplemented ewes. It has been reported that iodine supplementation enhances thyroid function that increases the metabolic rate and heat production *(Silva, 2001)*. The thyroid hormones regulate body temperature by rising available energy in the body, besides increasing appetite, pulse, in addition to the amount of oxygen delivered to different body parts and fat buildup *(Silva, 2006)*. In addition, *Dunn, (1998)* reported that low body temperature may indicate iodine deficiency and or some other metabolic abnormality also, the rising of body temperature and the increase in cold tolerance suggest some metabolic effects of increased iodine intake. Furthermore, it has been reported that iodine is included in thyroid hormones synthesis that play important role in controlling a new-born lamb's basal metabolism and its ability to face cold stress (Barrett, 2017 and Zarbalizadeh-Saed *et al.,* 2020).

Blood metabolites and hormones

No significant differences were found in PCV levels at birth, 24 hrs. and 48 hrs. while, at 1 and 2 weeks and 1 and 2 months, it was significantly higher in the iodine-supplemented group compared to control (Table 5). Similar results were found in lambs by Hana *et al.,* (2014). Also, Zeedan *et al.,* (2010) found that PCV increased significantly (P< 0.05) in iodine-supplemented buffaloes during late pregnancy and postpartum period compared to controls. On the other hand, Aghwan *et al.,* (2013) illustrated that iodine supplementation did not significantly affect PCV levels of male goats.

Serum glucose concentrations of treated lambs were significantly higher at all periods of measurement compared to the control group (Table 5). Similarly, *Kerslake et al., (2010)* reported that lambs born to iodine-supplemented ewes had greater glucose levels at 24 and 36 hrs. of age than those born to un-supplemented ones. Also, *(Zeedan et al., 2010 & Abd El-Salaam et al., 2018)* found similar results. It is important to mention that the mothers of the iodine-supplemented group had higher serum glucose levels at late pregnancy compared to control *(Abozed et al., 2020)*. These results were expected because iodine supplementation enhances thyroid function which improved appetite and raise energy and metabolism in the body which consequently increase blood glucose level *(Silva, 2006)*.

Total protein (TP) and albumin (Alb) tended to increase significantly in the treated group compared to the control group almost at all periods of measurement (Table 5). Similar results were found in lambs by *Hana et al., (2014)*. In addition, *Abd El-Salaam et al., (2018)* found that TP and its fractions were higher pre- and post-partum periods in iodine-supplemented pregnant camels compared to un-supplemented ones. Also, the mothers of the iodine-supplemented group had higher serum TP levels at late pregnancy compared to control *(Abozed et al., 2020)*. It has been reported that increasing thyroid hormones stimulate the metabolism of carbohydrates and proteins *(Lawrence and Fowler, 1997)*.

Serum T3 and T4 concentrations were significantly higher in lambs of the iodine-supplemented group compared to the control at all periods of measurements (Table 6). Similar results were obtained by *Rose et al., (2007)*, they found that plasma concentrations of T3 and T4 at birth and at 24 hrs. were significantly higher in the lambs from ewes given iodine. Also, *Caple et al., (1982)* found that newborn lambs of iodine-treated ewes had significantly higher serum T4 concentrations than lambs of control ewes. In addition, *Aghwan et al., (2013)* sound similar results in goat kids. It is important to mention that the mothers of lambs of the treatment group had higher ($P<0.05$) serum T3 and T4 concentrations compared to the untreated group *(Abozed et al., 2020)*. Also, *Abd El-Salaam et al., (2018)* found that iodine supplementation increased significantly T3 concentration during pre- and post-partum periods. It has been reported that iodine supplementation enhanced thyroid function and increased thyroid hormones production *(Zimmerman 2009)*.

In conclusion, iodine supplementation for ewes during late pregnancy and lactation periods have beneficial effects on thermoregulation of newborn lambs (by improving physiological responses and metabolic rate) which enhanced their ability to face cold conditions and improved their performance and survivability.

References

Abd El-Salaam A. M.; A. A. H. El-Tahan and A. A. Bakr (2018). Impact of dietary iodine supplementation on productive and reproductive performance of Maghrebian She-camels. IOSR Journal of Agriculture and Veterinary Science, 11 (3): 59-69.

Abozed G. F.; A. A. K. Saleh; Eitedal H. El-Sayed; T. M. M. Abdel Khalek and H. Hamdon (2020). Effect of iodine supplementation on physiological responses and metabolic rate of saidi pregnant ewes and the performance of their lambs. J. of Animal and Poultry Production, Mansoura Univ., Vol. 11 (8): 303-307.

Aghwan Z. A.; A. Q. Sazili; A. R. Alimon; Y. M. Goh and M. Hilmi (2013). Blood haematology serum thyroid hormones and glutathione peroxidase status in kacang goats fed inorganic iodine and selenium supplemented. Asian Australas. J. Anim. Sci., 26 (11): 1577-1582.

Armstrong, W.D. and C.W. Carr (1964). Physiological chemistry: Laboratory directions. 3rd Ed. U.S.A. Bunges Publishing Co. Minneapolis, Minnesota, pp. 75.

Barrett E. J. (2017). The Thyroid Gland. Medical Physiology Third Edition. Chapter 49, 1006-

1017.e2

Boland TM, Guinan M, Brophy PO, Callan JJ, Quinn PJ, Nowakowski P & Crosby TF (2005) The effect of varying levels of mineral and iodine supplementation to ewes during late pregnancy on serum Ig G concentrations in their progeny. Anim Sci 80, 209–218

Boland T. M.; L. Hayes; T. Sweeney; J. J. Callan; A. W. Baird; S. Keely and T. F. Crosby (2008). The effects of cobalt and iodine supplementation of the pregnant ewe diet on immunoglobulin G, vitamin E, T3 and T4 levels in the progeny. Animal, 2 (2): 197-206.

Campbell A. J. D.; E. L. Croser; M. E. Milne; P. J. Hodge and J. K. Webb Ware, (2012). An outbreak of severe iodine-deficiency goitre in a sheep flock in north-east Victoria. Aust. Vet. J., 90: 235-239.

Caple I. W.; G. F. Nugent; J. K. Azuolas; J. Z. Foot And R. L.Thompson (1982). Effects of iodine supplementation of ewes on survival and growth of lambs. Proceedings of Australian Society of Animal Production 14: 535-538.

Delange F. (1996). Endemic cretinism. In: Braverman LE, Utiger RD eds. The thyroid. A fundamental and clinical text. 7th ed. Philadelphia: Lippincott: 756-767.

Doumas, B. T; W. A. Watson and Hg. Biggs (1971). Albumin standards and measurement of serum albumin with bromocresol green. Clin. Chim. Acta., 31: 87-96.

Dunn JT and Delange F. (2001). Damaged reproduction: the most important consequence of iodine deficiency. J Clin Endocrinol Metab, 86: 2360-2363.

Dunn, J. T. (1998). What's happening to our iodine? [editorial]. J Clinical Endocrinology and Metabolism, 83(10), 3398-3400.

El- Hommosi F. F. and G. E. Abdel- Hafiz (1982). Reproductive performance of Ossimi and Saidi sheep under two pre- pubertal planes of nutrition. Assiut Vet. Med. J., 10 (19): 61-66.

Elshazly A. G. and C. R. Youngs (2019). Feasibility of utilizing advanced reproductive technologies for sheep breeding in Egypt. Part 1. Genetic and nutritional resources. Egyptian Journal of Sheep & Goat Sciences, 14 (1): 39 - 52.

Ferri N.; S. Ulisse; F. Aghini-Lombardi; F. M. Graziano; T. Di Mattia F. P. Russo; M. Arizzi; E. Baldini; P. Trimboli; D. Attanasio; A. Fumarola; A. –Pinchera and M. D'Armiento, (2003). Iodine supplementation restores fertility of sheep exposed to iodine deficiency. J. Endocrinol. Invest., 26: 1081-1087.

Galal E. S. E. (1987). Sheep and goat production and research in Egypt. In: Small Ruminants in the Near East. FAO Animal Production Health Bulletin, 54 (1): 117- 155.

Hana D.; T. Jan; P. Zdeněk; Š. L. Kristyna; Š. Anna; F. Daniel and Š. Kateřina (2014). The influence of high iodine intake on chosen blood parameters of sheep. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 62 (1): 71–79.

Hetzel BS. (1983). Iodine deficiency disorders (IDD) and their eradication. Lancet: 1126-1129.

Kerslake J. I.; P.R. Kenyon, K. J. Stafford, S.T. Morris and P. C. H. Morel, (2010). Can maternal iodine supplementation improve twin- and triplet-born lamb plasma thyroid hormone concentrations and thermoregulation capabilities in the first 24–36 h of life? J. Agric. Sci., 148: 453-463.

Knowles SO, Grace ND (2015) Serum total iodine concentrations in pasture-fed pregnant ewes and newborn lambs challenged by iodine supplementation and goitrogenic kale. J Anim Sci 93:425–432.

Le Traon G.; S. Burgaud and L. J. I. Horspool (2008). Pharmacokinetics of total thyroxine in dogs after administration of an oral solution of levothyroxine sodium. J. Vet Pharmacol Ther. 31: 95-101.

McGovern F M , D A Magee, J A Browne, D E MacHugh, T M Boland . Iodine supplementation of the pregnant dam alters intestinal gene expression and immunoglobulin uptake in the newborn lamb. Animal, 2016 Apr; 10(4):598-606.

McGovern F M, T Sweeney, M T Ryan, S Lott, F P Campion, T M Boland. An investigation into the effects of maternal supplementation with excess iodine on the mechanisms and impacts of reduced IgG absorption in the lamb postpartum. Br J Nutr. 2017

Apr;117(7):951-963.

NRC (2007). National Research Council. Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids and new world Camelids. National Academy of Sciences. Washington, DC.,USA.

Parker W.J. & S. N. McCutcheon (1989) Effects of iodine supplementation on the productivity of Romney ewes in the Wairarapa region of New Zealand, New Zealand Journal of Agricultural Research, 32:2, 207-212.

Pattanaik A. K.; S. A.Khan; V. P. Varshney and S. P. S. Bedi, (2001). Effect of iodine level in mustard (Brassica juncea) cake-based concentrate supplement on nutrient utilisation and serum thyroid hormones of goats. Small Ruminant Research, 41 (1): 51-59.

Rose M. T.; B. T. Wolf and W. Haresign, (2007). Effect of the level of iodine in the diet of pregnant ewes on the concentration of immunoglobulin G in the plasma of neonatal lambs following the consumption of colostrums. British J. Nut., 97: 315-320.

Rowan T. G. (1992). Thermoregulation in neonatal ruminants. BSAP Occasional Publication 15: 13-24.

Sargison ND, West DM, Clark RG. The effects of iodine deficiency on ewe fertility and perinatal lamb mortality. New Zealand Veterinary Journal 1998, 46, 2, pp 72-75.

Silva J. E. The multiple contributions of thyroid hormone to heat production. J Clin Invest. 2001 Jul 1; 108(1): 35–37.

Silva JE. Thermogenic Mechanisms and Their Hormonal Regulation, 2006

Smallridge RC, and Ladenson PW. (2001). Hypothyroidism in pregnancy: consequences to neonatal health. J Clin Endocrinol Metab, 86: 2349-2353.

SPSS (2012). IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.

Trinder P. (1969). Ann. Clin. Biochem. Biochem., 6, 24 March 26th (9)VI.I.

Yan Jin, Lin Zhu, Xiaofeng Li, Heming Zheng, *et al.*, Maternal iodine status during lactation and infant weight and length in Henan Province, China. BMC Pregnancy and Childbirth (2017) 17:383

Yousef, M. K. and D. B. Dill (1969). Resting energy metabolism and cardiorespiratory activity in the burro, Equus asinus. J. Appl. Physiol., 27: 229-232.

Zarbalizadeh-Saed, A., Seifdavati, J., Abdi-Benemar, H. *et al.*, Effect of Slow-Release Pellets of Selenium and Iodine on Performance and Some Blood Metabolites of Pregnant Moghani Ewes and Their Lambs. Biol Trace Elem Res 195, 461–471 (2020).

Zeedan Kh. I. I.; O. M. El-Malky; Kh. M. M. Mousa; A. A. El.Giziry and K. E.I. Etman, (2010). Nutritional studies on some different sources of iodine on productive performance, ruminal fermentation and blood constituents of Buffalo. 1 - Effect of two different iodine levels on productive and reproductive performance of buffalo cows. Journal of American Science, 6 (10): 1090-1106.

Zeedan, Kh. I. I.; S. I. Weld Abd-Elkader; Kh. M. M. Mousa and K.E.I. Etman, (2014). Nutritional studies on some different sources and levels of iodine on productive performance, ruminal fermentation and blood constituents of buffalo. 3 - Effect of different levels of iodine on productive performance of buffalo calves. J.Animal and Poultry Prod., Mansoura Univ., 5 (3): 143-156.

Zimmerman M. B. (2009). Iodine deficiency. Endocr. Rev. 30: 376-408.

How to cite this article:

Saleh, A. A. K., G. F. Abozed, H. Hamdon, M. Hayder, Eitedal H. El- Sayed and Abdel Khalek, T. M. M. 2021. Effect of Maternal Iodine Supplementation on Thermoregulation and Performance of Saidi Newborn Lambs. *Int.J.Curr.Microbiol.App.Sci.* 10(03): 298-308.
doi: https://doi.org/10.20546/ijcmas.2021.1003.040