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EFFECT OF IODINE DOSES ON HEMATOLOGICAL AND ENZYMES PARAMETERS OF BLACK GOATS DURING LATE PREGNANCY PERIOD

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ABSTRACT

The aim of the present study was to evaluate the effect of Iodine supplementation in drinking water on blood hematology and enzyme parameters in Black goats during late pregnancy. Twenty-four pregnant local black goats were used in the present study. Each goat's was drenched with potassium iodide with 0 mg I/day (control; C), 0.50 mg I/day (treatment one; T1) as low iodine group and 1.00 mg I/day (treatment two; T2) as high iodine group. Blood samples were collected weekly from six weeks before parturition from goats and 1st week of ages of kids. Blood samples were analyzed for hematology and enzymes parameter. Hematological parameters of goats include RBC (10^6/µL), WBC (10^3/µL), HB (g/dL), PLT (10^3/µL), HCT (%), GRA (10^3/µL), Lymph (10^3/µL; P=0.005) and MCV were significantly affected by I drenching. There was also a significant effect of I drench on enzyme parameters; alanine transaminase (ALT), alkaline phosphatase (ALP), aspartate transaminase (AST) and creatinine kinase (CK) of goats. In conclusions, I drenching had an impact on the most of the blood hematology and enzymes parameter of the goat throughout the time of the study.

KEYWORDS: Iodine drenching; Late pregnancy; Black goats; Hematology; Enzymes

INTRODUCTION

Minerals are naturally present in food or they may be added as dietary supplementation to meet the requirement of animals. Iodine is considered one of the essential trace minerals in animals due to their needs for synthesis of thyroid hormones including thyroxine (T4) and triiodothyronine (T3); (Nudda et al., 2009) and it is involved in a number of biological functions of the organism (Miller, 2006; Ares et al., 2008).

The higher animal body requirement of iodine which exceeds the availability of iodine from environmental sources (i.e. food, and water) in many regions of the world especially in mountain areas (high altitude); (De Benoist et al., 2008), due to the effect of heavy rains, soil on the high altitude areas are poor in iodine and replace the soil with new soil made of iodine poor crystalline rocks which lead to swept away the iodine in these areas (Omar et al., 2015) resulting in the development of iodine deficiency disorders (IDD) especially in goats and newborn goat kids (Kadum et al., 2017).

In pregnant goats, a deficiency of iodine causes hypothyroidism, which leads to retardation of growth, reduced immunity and inhibits physiological statuses such as un effect on blood hematology and liver enzymes (Sokkar et al., 2000). In gestating goats, also iodine deficiency reduces fetal brain body weight resulting in low body weight of newborn kids (Potter et al., 1982).

Meschy (2000) reported that the iodine requirement is usually higher in goats than other ruminants, a dietary iodine concentration considered inadequate for goats. Even though the use of an iodine supplement in dairy goats should be a common practice, a large database on iodine requirements in goats is not available (Nudda et al., 2009). The concentration of dietary iodine recommended by the NRC (2007) is 0.5 mg/kg of DM in the diet of growing and non-lactating goats and 0.8 mg/kg of DM for goats, however, these recommendations are based on a limited number of data (Nudda et al., 2009). Genetically native black goats are raised primarily for meat and milk, in addition to secondary importance for hair

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production (Zebari et al., 2013; Juma and Al Kass, 2005). As we are aware that there is a limited published study on the effect of Iodine supplementation on local native black goats raised under traditional conditions. Therefore the present study aimed to evaluate the effect of Iodine supplementation on blood hematology and enzyme parameters in black goats during late pregnancy.

MATERIALS AND METHODS

The present study was conducted between November the 15th of 2021 and January the 20th of 2022 at one of the commercial goat farms, Zawita, Duhok, Kurdistan Region-Iraq. The Research Ethics Committee of the Animal Production Department, College of Agricultural Engineering Sciences, University of Duhok approved the research protocol.

Experimental animal, housing and management

Twenty four pregnant black native goats with body weight (34.81±2.4 kg) and ages (3.15±1.2) at six weeks before parturition were enrolled in the present study at one of the traditional Goat farm, Zawita, Duhok, Kurdistan Region-Iraq. At the start of the study, the goats were submitted for the detection of any disease. The goats were kept with the main flock. The g flock were put out to graze during the day from 06:00 am to 06:00 pm and housed in a free stall yard during night. During housing total mixed ration (TMR; hay, barley and wheat barn) was provided daily, sufficient for *ad libitum* availability. Water was also provided *ad libitum* from water troughs at the free stall yard.

Pregnancy Diagnoses and Treatments

At the start of the study pregnant goats were selected from the main herd using veterinary ultrasound scanner (CD66V, Zhuhai Carellfe Medieal Technology Co., Ltd, China). The goats were randomly divided into three experimental homogeneous groups (n=8 per group) on the basis of live body weight (35.66±2.1 kg), (34.66±2.1 kg) and (34.11±2.1 kg).

Goats were randomly divided into three groups: group one as control (0 mg I/day) and each goat's of the other two groups were supplemented with potassium iodine (KI; Chem-Lab NV, Industriezone, B-8210 Zedelgem, Belgium) with 0.50 mg I/day (Treatment one; T1) as low iodine group and 1.00 mg I/day (Treatment two; T2) as high iodine group. The dose of potassium iodine (76.5% of iodine) was orally administrated daily for six week before parturition (late pregnancy period). The potassium iodine was dissolved in water then drenched to each goats at 4:00 pm by using a manual syringe gun.

Blood Collection

Blood samples were collected, from each goat at the weekly intervals. Blood samples were collected from jugular venipuncture using a 20 G needles syringe, into 5 mL vacutainer K3 ethylene diamie tetraacetic acid (EDTA) tubes. Samples were gently mixed by rolling several times to ensure enough mixing with anticoagulant. Then blood samples were centrifuged at 6,000 g for 12 minutes using a SIGMA centrifuge (SIGMA Osterode am Harz, Germany). Serum was frozen at -20C° for further laboratory analysis.

Serum analytical techniques

The parameters of blood hematology were laboratory analyzed using a hematology analyzer (Medonic M-series M32M, Boule Medical, Spånga, Sweden). Serum enzyme parameters were analyzed by cobas 6000 (Hitachi High-Technology Corporation, Tokyo, Japan).

Statistical analyses of data

The data were Statistical analyses using Genstat statistical analyses software package (Genstat V 14th.19.1.14713 provided by VSN International Ltd, UK). Repeated measures ANOVA was used to analyse the data of blood hematology and enzyme parameters of goats and to compare between treatments. Factorial one-way ANOVA analyses were used to compare between the datasets of Kids. The comparison between T1, T2 and T3 was analysed by the Tukey test. Differences were reported as significant at $P<0.05$ and trends were reported when the P value is between <0.1 and >0.05.

RESULTS AND DISCUSSIONS

Blood hematology parameters of black native goats

Regarding the effect of I drenching (treatments) on blood hematology, there was a significant ($P<0.001$) effect of I drenching on RBC, WBC, HB, PLT, HCT and GRA. In addition the results showed that I supplementation had a significant impact on lymph ($P=0.005$) and MCV ($P=0.019$) see **Table 1**. A significantly higher RBC, HB, PLT and GRA were recorded in T2 group compared to C group,

while there was no significant between T2 and T1 groups. However, a significantly higher number of WBC were recorded in the C group compared to T1 and T2 groups. This may be due to that group C of goats had more stress during late pregnancy compared to T1 and T2 groups which were supplemented with KI, because I can improve immunity system (McClure, 2008). Leukocyte myeloperoxidase enzyme uses I in cell-mediated immunity, where I is used to produce iodine-free radicals (Tay et al., 1998). The current study found higher RBC and Lymph in T2 group than the results of the previous study conducted on the Kacang crossed breed of the goat by Aghwan et al. (2013) of RBC (13.05 10^6/µL) and lymph (6.15 10^3/µL). While, WBC and HB in the present study of T1 and T2 were within the normal ranges that were recorded by Aghwan et al. (2013) of 4-13 (10^3/µL) and 6.6-14.6 g/L, respectively. Pattanaik et al. (2011) found that dietary I supplementation (0.1 mg I/d) had a significantly higher HB concentration compared to control group of indigenous goats. Concerning HCT and lymph, a significantly higher percentage of HCT was recorded in T1 compared to C and T2 groups, there was also a significantly higher MCV in T1 compared to C and T2 groups. In contrast to the results of the present study, Rajendran et al. (2001) and Aghwan et al. (2013) found that I supplementation had no significant (P>0.05) effect on both HB and HCT levels in goats. This may due to that Rajendran et al. (2001) and Aghwan et al. (2013) used goats during normal physiological status, while in the present study, iodine was supplemented during the late pregnancy period. Higher HB concentration in I drenched goats may due to their superior protein status, as a result of enhanced consumption of more crude protein digestible, not only utilization of better nitrogen (Pattanaik et al., 2011).

Concerning the effect of period of treatment of I on hematological parameters, the time period had a significant effect on RBC (P=0.04), PLT (P<0.001), GRA (P=0.035) and Lymph (P=0.005) **Table 1.** The overall means of the hematological parameters of the current study are within the normal ranges which were reported previously by Manohar et al. (2021), Arfuso et al. (2016) and Panadi et al. (2018). Studies concerned the effect of period of treatment of I drenching on hematological parameters in goats during late pregnancy are rather limited. Furthermore, both WBC and HB were tended to be effected by time of I drenching (P=0.094) and (P<0.06), respectively. However, there was no significant effect of treatment and time interaction on blood hematological parameters.

Regarding the effect of time on Hematological parameters, the results observed in the present study were close to those reported in the previous studies (Waziri et al., 2010; Cepeda-Palacios, 2011). The significant increase in some blood hematology count observed during the late pregnancy period is consistent with another study conducted by Fortagne and Schafer (1989) who showed an increase in the total hematological parameter during late pregnant period of goats and around parturition. Sandabe and Yahi (2000) also showed a significant changed in the hematological parameters of pregnant Sahel goats during different weeks of gestation period. This could be due to an increase in the activity of bone marrow as well as, the stress of the late pregnancy period (Waziri et al., 2010; Cepeda-Palacios, 2011).

Blood enzymes parameters of black native goats

The data relating to the level of serum enzymes are illustrated in **Table 2**. The overall means of ALT in serum was higher (P<0.001) in T2 (20.4±0.5 U/L) compared to C (19.62±1.6 U/L) groups. While there was no significant difference between T1 and C groups. However, significantly higher levels of ALP and AST were recorded in T1 groups of goats compared to the C group, while there were no significant (P<0.05) differences between T1 and T2 groups. Regarding the level of CK enzyme, a significantly higher level CK enzyme was recorded in C compared to the T2 group, while there was no significant difference between the C and T1 group of goats. The results of the present study are similar to those reported by Shi et al. (2018) who found that ALT, ALP, AST and CK enzymes were significantly (P≤0.05) affected by dietary Se in goats. However, the overall means of ALT and AST in all groups of the present study were higher than that reported by Sarker et al. (2020) of ALT (16.57±0.35 U/L) and AST (12.63±0.33 U/L). Higher level of Serum CK in

SEM=standard error of means, C=control (0 mg I/day), T1=treatment one (0.5 mg I/day), T2=treatment two (1.0 mg I/day), W=week, Tr.= treatments, T=time, RBC=red blood cells, WBC=white blood cells, HB=hemoglobin, PLT= platelet, HCT=hematocrit, GRA=Granulocytes, Lymph= lymphocyte and MCV= mean corpuscular volume. Means with different superscript letters in overall means columns differ (P<0.05).

Table (1):- Blood hematology parameters (Means ± SEM) in response to Potassium Iodine (KI) drenching from week -6 to parturition in black native goat.

Parameters	Treatments	Overall means	Time/weeks						*P* value		
			-6	-5	-4	-3	-2	-1	Tr.	T.	Tr. x T.
RBC (10^6/µL)	C	17.21±0.8^{b}	16.95±2.3	16.95±2.0	16.38±2.04	17.38±1.9	16.8±1.8	18.8±1.9	<.001	0.04	0.469
	T1	18.54±1.5^{ab}	20.83±4.0	17.69±2.9	17.83±3	17.26±2.4	17.69±2.1	19.97±2.9			
	T2	19.51±1.3^{a}	20.94±3.1	19.08±3.4	18.94±3.1	20.65±3.2	17.51±2.8	19.94±2.5			
WBC (10^3/µL)	C	12.78±0.7^{a}	10.38±1	14.35±0.7	12.76±0.8	13.18±0.9	12.66±0.6	13.34±0.7	<.001	0.094	0.365
	T1	12.39±0.1^{b}	12.46±1.3	12.37±1.3	11.53±1	13.09±2.3	10.77±0.8	14.13±1.7			
	T2	12.29±0.1^{b}	12.92±1.4	13.32±1.6	12.18±1.7	12.22±1.4	10.59±1.4	12.5±0.8			
HB (g/dL)	C	9.02±0.3^{b}	8.788±0.3	9.174±0.2	9.174±0.2	9.202±0.2	9.716±0.2	9.388±0.2	<.001	0.06	0.097
	T1	9.16±0.3^{a}	9.646±0.4	9.032±0.2	8.875±0.2	8.918±0.4	9.361±0.4	9.146±0.4			
	T2	9.24±0.3^{a}	9.566±0.3	8.937±0.3	8.709±0.4	8.88±0.4	9.123±0.4	8.94±0.4			
PLT (10^3/µL)	C	123.99±1.2^{b}	122.99±2.2	123.14±2.2	123.14±2.2	123.71±2.1	124.99±2.1	125.99±2.2	<.001	<.001	0.972
	T1	125.06±1.3^{a}	124.2±3.7	124.35±3.5	123.92±3.6	124.49±3.3	126.2±3.5	127.2±3.7			
	T2	125.29±1.1^{a}	124.38±3.1	124.38±3.1	124.66±3	125.52±2.7	125.66±2.9	127.15±2.7			
HCT (%)	C	24.9±1.1^{b}	25.74±2.1	26.17±2.0	25.31±2.2	23.17±2.1	24.88±1.9	24.45±2.1	<.001	0.362	0.292
	T1	26.7±1.6^{a}	26.64±3.5	24.93±3.3	25.78±3.7	27.93±3.5	25.78±2.4	29.21±4			
	T2	24.6±1.2^{b}	27.34±4.1	26.48±4	23.91±4.5	20.91±4.8	24.34±4.4	24.77±3.9			
GRA(10^3/µL)	C	6.63±0.7^{b}	7.25±0.6	6.69±0.5	7.31±0.3	9.44±0.6	6.37±0.2	8.71±0.8	<.001	0.035	0.695
	T1	7.63±1.2^{a}	7.44±1.1	6.11±0.2	6.01±0.1	7.58±0.8	5.95±0.3	6.71±0.4			
	T2	7.48±1.2^{a}	7.52±1.1	8.25±1.4	6.25±0.4	9.22±1.1	6.24±0.3	7.36±0.9			
Lymph (10^3/µL)	C	7.31±1.1^{b}	5.86±0.6	8.81±0.4	7.21±0.5	6.3±0.6	7.7±0.3	7.96±0.4	0.005	0.005	0.267
	T1	7.63±0.5^{a}	7.3±0.8	8.15±0.7	7.61±0.7	7.28±1.2	7.01±0.3	8.42±0.6			
	T2	7.14±0.9^{b}	7.43±0.9	7.7±0.9	8±1.1	5.68±1	6.39±0.8	7.62±1			
MCV (fL)	C	15.4±0.1^{ab}	13.808±0.5	15.589±0.2	15.641±0.2	16.074±0.2	15.75±0.8	15.484±0.2	0.019	0.121	0.207
	T1	15.6±0.2^{a}	15.649±0.5	15.958±0.3	15.53±0.4	15.415±0.5	15.844±0.3	15.344±0.3			
	T2	15.3±0.1^{b}	15.12±0.4	15.487±0.5	15.458±0.3	15.339±0.2	15.348±0.3	15.187±0.3			

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he C groups in the current study may due to the negative relationship between TH (T3 and T4) and serum I level as described in earlier studies (Smith, 1976; Peschke et al., 1988; Khalid, 2015).

Concerning the effect of the period of treatment of I drenching on serum enzymes, there was a significant effect ($P<0.001$) of time on the level of serum ALT and ALP enzymes. As the increased activity of ALT and ALP is associated with changes in the thyroid activity (Brunova, 2008). There was a significantly increase in the level of AST ($P=0.049$) and CK ($P=0.009$) enzymes with the progress in the pregnancy time with the regarding the effect of the period of treatment of I drenching also affected. However, there were no treatments and time interaction's effect on the level of ALT ($P=0.101$), ALP ($P=0.281$) and AST ($P=0.427$) enzymes, while there was a significant impact ($P=0.025$) of time and treatment interaction on the level of CK enzyme in serum which were increase by the time in C group of goats. A previous study carried out by Shi et al. (2018) found that Se supplementation had no significant effects on the activity of ALT and CK, while showed that the activity of AST was significantly increased in the Se treatment group of Taihang black goats compared control group. It has been reported that any stress on the liver leads to dramatically elevated level of serum ALT, AST and CK activities (Nyblom et al., 2004; Oramari et al., 2014; Arain et al. 2021). It has been also reported that I and Se supplementation or an increase in their level could lead to an increase in serum AST activities (Kim and Mahan, 2001; Djuricic et al. 2011). In the current study, although the higher activity of AST was found in the I drenching groups of goat compared to the control group. It could be that I drenching indirectly enhanced the basic metabolic function of the treated goats, which accordingly results in the metabolic stress of the liver. Creatinine kinase is mainly expressed in skeletal muscle and is routinely used as an indicator to diagnose white muscle diseases caused by I and Se deficiency before clinical signs appear (Shi et al, 2018).

Table(2):- Blood enzyme parameters (Means ± SEM) in response to Potassium Iodine (KI) drenching from week -6 to parturition in black native goat.

Parameters	Treatments	Overall means	Time/week						*P* value		
			-6	-5	-4	-3	-2	-1	Tr.	T.	Tr. x T.
ALT U/L	C	19.62±1.6^{b}	16.69±0.6	18.69±0.7	21.12±0.8	20.55±0.8	19.26±0.8	21.12±0.8	0.001	0.001	0.101
	T1	20.1±1.5^{ab}	17.17±1.2	19.34±1.5	22.19±1.4	20.05±1.6	20.34±1.6	20.91±1.1			
	T2	20.4±0.5^{a}	19.83±0.7	20.54±1.0	20.83±1.2	20.26±1.3	20.11±1.6	20.83±1.6			
ALP U/L	C	73.2±4.4^{b}	73.18±5.1	72.61±5.3	7347±5.6	83.18±4.8	68.47±5.9	68.47±5.5	0.001	0.006	0.281
	T1	77.6±6.5^{a}	82.41±7.6	83.84±9.4	81.55±10.1	78.98±7.8	70.69±10.8	68.41±6.6			
	T2	75.1±4.5^{ab}	83.27±8.6	76.27±8.5	72.56±6.8	75.84±4.6	74.41±7.7	68.41±10.2			
AST U/L	C	48.1±5.6^{b}	38.8±2.0	46.2±2.9	47.6±3.4	49.4±3.7	51.1±1.8	55.4±3.4	0.049	0.385	0.427
	T1	55.6±8.4^{a}	44.7±6.0	42.1±6.6	52.6±4.4	59.5±4.4	66.6±3.6	68.1±6.0			
	T2	51.3±8.4^{ab}	40.8±6.0	46.5±7.0	47.8±8.6	47.1±3.8	60.9±2.3	64.9±2.7			
CK U/L	C	172.3±18.6^{a}	140.4±13.4	155±18	192.3±9.6	124.6±14.1	214.3±19.1	207±17.1	0.009	0.001	0.025
	T1	167.9±16.1^{ab}	150.4±10.4	176.6±5.8	173.9±15.0	185.5±15.2	132.7±8.7	138.2±6.8			
	T2	159.55±14.6^{b}	109±19.4	131.7±19.9	106.3±10.6	110.6±55.1	116.9±8.1	141.9±7.7			

SEM=standard error of means, C=control (0 mg I/day), T1=treatment one (0.5 mg I/day), T2=treatment two (1.0 mg I/day), W=week, Tr.=treatments, T=time, ALT=Alanine transaminase, ALP=Alkaline phosphatase, AST=Aspartate transaminase and CK=Creatinine kinase. Means with different superscript letters in overall means columns differ ($P<0.05$).

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CONCLUSIONS

Iodine drenching had an impact on most of the blood hematology and enzymes parameters of the goat throughout the time of the study. Iodine supplementation was also increased lymphocytes and granulocytes cells of T1 and T2 groups of goat. The period of treatment of I drenching had also an effect on hematological parameter from week -6 to week -1 during the late pregnancy of the goat. Bothe AST and CK enzymes increased with advance pregnancy to parturitions especially in the C group of the goats.

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