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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.

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ABSTRACT

Twenty buffalo calves of 10-month of age and an average initial live body weight (LBW) 235 kg were chosen and divided into five similar groups (4 animals in each), based on their LBW. Animals were used in 220- days randomized complete block design for feeding trial. This study aimed to evaluate the effect of feeding rations contained different levels from iodine (I) on productive performance of fattening buffalo calves. Concentrate feed mixture (CFM), berseem hay (BH) and rice straw (RS) were given to animals as a control ration (I_0) without supplementation, while the other groups I_1 , I_2, I_3 and I_4, received the control ration supplemented with iodine at the levels of 0.5, 1.00, 1.50 and 2.00 mg I per kg DM intake/h/d, respectively. Five digestibility trials were carried out to determine the digestibility coefficient and nutritive values of experimental rations. Blood samples were collected from all animals at 4 hrs post feeding to measure some blood parameters.

Results obtained could be summarized as follows:

1- Supplementing buffaloes ration with different levels of I improved the digestibility coefficient of all nutrients shown the adding 2 mg I was the best. TDN were 62.22, 64.99, 67.68, 69.71 and 72.64% for I_0, I_1, I_2, I_3 and I_4 respectively; the respective values of DCP were 7.01, 7.99, 8.59, 9.25 and 10.00% at the same treatments.
2- Average daily gain were 960, 1045, 1105, 1156 and 1270 gm/h for animals feed I_0, I_1, I_2, I_3 and I_4 respectively, showing the best daily gain with animals feed 2 mg I/kg DMI (I_4).
3- Animals fed ration I_4 were the best feed conversion expressed as kg DM, TDN and DCP per kg gain, being 4.96, 3.61, and 0. 50 kg, respectively.
4- Also, animals fed I_4 appeared to the best economical efficiency (1.91) with the lowest feed cost/kg gain (12.02 LE).
5- Iodine supplementation significant improved the blood contents of RBC, WBC, Hb, PCV, total protein, globulin, glucose, triiodothyronine (T_3) and thyroxin (T_4).

Generally, it could be concluded that I supplementation for ration of growing Egyptian buffalo calves considerably improved nutrients digestibilities, nutritive values and economic efficiencies, showing the level with 2 mg I/kg DMI was the best treatment.

Keywords: buffalo, iodine, performance, blood components, digestibility, feed efficiency.

INTRODUCTION

One of the most important pillars of the Egyptian economy is livestock production, in which milk and meat have the key concern. The great adaptive capacity of Egyptian water buffaloes (*Bubalus bubalis*) to tropical climates and excellent nutritional efficiency, resistance to diseases, together with the good productive and reproductive potential make buffalos the main source for milk (about 60 % of total milk production) and meat (about 40% of total red meat production) in Egypt. However, this production is still not enough for our consumption.

Iodine is an essential trace element for animals and humans. The only known role of iodine in the body metabolism is the incorporation into the thyroid hormones such as thyroxin (T_4) and triiodothyronine (T_3). Both hormones have multiple functions as regulators of cell activity (energy metabolism), growth and as an important factor for brain development. Therefore, the EFSA (2005) expressed the need for more and updated data on iodine requirements and tolerance studies in animals, the transfer of iodine from feed into food of animal origin as well as on the actual impact of iodine supplements in feeds on total dietary iodine intake of humans. Mc Dowell, (2003) and Underwood and Suttle (2001) reported that more than 95 % of total iodine is accumulated in the thyroid gland. Meyer *et al*. (2008) found that the increasing iodine supplementation of feed significantly heightened I-concentration in the meat and organ samples. Zeedan *et al*. (2010) reported that using iodine supplementation at level (0.5mg I per kg DM intake /h/d)) in female buffaloes ration tended to improve the digestibility, nutritive values, and reproductive parameters. Moreover, Zeedan *et al*. (2012) indicated that using iodine supplementation at level (0.8 and1.5 mg I per kg DM intake /h/d)) in Egyptian buffaloe ration tended to improve the digestibility, nutritive values, daily gain of calves, feed efficiency and some reproductive parameters with higher economic efficiency than unsupplemented ones.

In perspective, Hoption (2006) reported that thyroidal hormones play a major role in the growth, development of brain and central nervous systems and control of several metabolic processes including carbohydrate, fat, protein, vitamin and mineral. In this respect, Georgievskii *et al.* (1990) reported that the principal function of iodine is determined by its presence in the thyroid hormones. These hormones are known to regulate basic metabolism, consumption of carbohydrates, proteins and fats. The effect of hormones on metabolism involves synthesis of respiratory and other enzymes, which affect intracellular processes of oxidation, oxidative phosphorylation and protein synthesis. Also, Lawrence and Fowler (1997) reported that thyroid hormones influence the function of most organs and stimulate the basic metabolic rate through regulation of the metabolism of carbohydrates, proteins and lipids.

NRC (1998 and 2001) reported that iodine requirements for beef cattle are 0.4 mg/kg dry matter (DM). GfE (2004 and 2006) reported that the iodine requirements for beef cattle are 0.3 mg/kg dry matter (DM). Severe iodine deficiency may reduce growth rate. Sokkar *et al*. (2000) reported that in growing lambs, iodine deficiency reduces growth and interferes with sexual Maturity.

Therefore, the present work aimed to study the effect of different levels of iodine supplementation on nutrient digestibilities, feeding value and performance of Egyptian buffalo calves. Some blood constituents, feed efficiency and economic efficiency were also determined.

MATERIALS AND METHODS

Experimental procedures:

This study was carried out at Mehalet-Mousa Experimental Station belonging to Animal Production Research Institute, Agricultural Research Centre. Twenty buffalo calves of 10-month of age were used in this study. Animals were divided according to their body weight into five comparable groups, 4 animals in each group, using the randomized complete bloke design. Average body weight at the beginning of the experiment was 235 kg for the five groups to study the effect of using iodine levels in feeding buffalo calves on nutrient digestibilities, some blood parameters and economic efficiency. The control group were fed ration consisted of concentrate feed mixture (CFM), berseem hay (BH) and rice straw (RS) without additives (I_0), while the other groups (I_1, I_2, I_3 and I_4) fed the control ration supplemented with four levels of iodine: 1st was 0.78 mg sodium iodide (0.5 mg I per kg DM intake /h/d), 2nd was 1.56 mg sodium iodide (1.0 mg I per kg DM intake /h/d), 3rd was 2.34 mg sodium iodide (1.5 mg I per kg DM intake /h/d) and 4th was 3.12 mg sodium iodide (2.0 mg I per kg DM intake /h/d), respectively. Sodium Iodine was well mixed with some of the ground concentrates feed mixture **before feeding. Animals were individually fed according to Kearl (1982) and** they were left for 4 weeks as a preliminary period. The experimental treatments lasted seven months approximately (220 days).

Management and feeding:

Through the feeding trial, full hygienic care was secured approximately on 21-d preliminary period and along the whole experiment as well. Sodium iodide was add to a portion of fine CFM and then mixed thoroughly with the rest of the daily intake of the ground CFM before feeding. The subsequent daily requirements of CFM, BH and RS were adjusted each 2 weeks according the changes of body weight and daily gain of experimental calves. Rations were offered twice a day at 8 am and 3 pm. Water was available at all time. Digestibility trials were carried out at the middle of the feeding trials using four buffalo calves from each group to determine the nutrient digestibilities and nutritive values of the experimental rations. Acid insoluble ash (AIA) (Van Keulen and Young, 1977) was used as a marker for the determination of the nutrient digestibility. Digestibility of DM as well as all nutrientes was determined with the following equations:

% Nutrient digestibility=100- (%DM digestibility x %Nutrient in feces / % Nutrient in feed).

At the mid-term of the experimental fecal samples were collected from the rectum twice daily every 10 h at 7:00 and 17:00 h hr starting at the 3rd day of the collection period. Feed and fecal samples were dried to a constant weight in a forced air oven, ground and kept for later analysis. Chemical composition of the different ingredients and feces samples were analyzed according to AOAC (1990).

Blood sampling:

Blood samples were collected once weekly via the jugular vein from each buffalo calves at 4-hrs after feeding. Blood plasma was carefully separated after (adding ethylene diamine tetra acetic acid (EDTA) and centrifugation at 4000 r.p.m. for 15 minutes, and then stored at -20C^o until analysis for the different blood parameters. Non-coagulated blood was tested shortly after collection for estimating blood pictures. White blood cells and red blood cells were counted according to Feldman *et al.* (2000). Packed cell volume (PCV %) was estimated using micro-hematocrit tube and micro hematocrit centrifuge at 10000 rpm for 5 min, while concentration of hemoglobin (Hb) was carried out using (Super+Ior®, Sahli's method) according to Sahli (1905). Plasma was used for determination of glucose, total protein, albumin, alanine amino transferase (ALT), aspartate amino transferase (AST), cholesterol, triiodothyronine (T_3) and thyroxin (T_4) hormones in plasma were determined using commercial kits.

Statistical analysis:

Data were statistically analyzed according **to** SAS (1996) computer program using the following fixed model:-

$$Y_{ij}=\mu + T_i + e_{ij.}$$

Where: Yij = the observation. μ = Overall mean.T_i = Effect of the treatments. e_{ij} = Random error component assumed to be normally distributed.

Ducans's multiple range tests was performed (Duncan, 1955) to detect significant differences among means.

RESULTS AND DISCUSSION

Chemical composition of feedstuffs:

The chemical composition of CFM, BH and RS (Table 1) are within the normal ranges reported in Egypt by several workers (El–Hosseiny, *et al*., 2008, Zeedan *et al.,* 2010 and 2012).

Nutrient digestibility and nutritive values:

Digestion coefficients of all nutrients and nutritive value (TDN and DCP) at the middle of the feeding trials (Table 2) tended to increase significantly (P<0.05) for the I_1, I_2, I_3 and I_4 compared to the I_0. These results are in agreement with those obtained by Gaffarov and Saliev (1979). Lenina (1986) indicated that supplement of iodine increased digestion coefficients compared with the control ration. Pattanaik *et al*. (2001) found that digestibility of DM, OM, CP and EE was not influenced by I supplementation and it was comparable to the control values during the first metabolism trial (90 days). Also, they added that during the second trial, conducted at 165 days post-feeding, the digestibility of nutrients tended to increase for the I supplemented group I_{50} compared to the control, but the differences were not significant. Pattanaik *et al*. (2004) found that supplement of iodine increased digestion coefficients of DM, OM, EE and CP compared with the control ration. El–Hosseiny, *et al*. (2008) found that adding iodine to young camel ration, the digestibility of nutrients and nutritive values (TDN and DCP) tended to increase, but the differences were not significant.

Hoption (2006) reported that thyroidal hormones play a major role in the growth and development of brain and central nervous systems, control of several metabolic processes including carbohydrate, fat, protein, vitamin and mineral metabolism. Georgievskii *et al.* (1990) reported that the principal function of iodine is determined by its presence in the thyroid hormones. These hormones are known to regulate basic metabolism, consumption of carbohydrates, proteins and fats. Also, Lawrence and Fowler (1997) reported that thyroid hormones influence the function of most organs and stimulate the basic metabolic rate through regulation of the metabolism of carbohydrates, proteins and lipids. Improvement of TDN and DCP might be due to the higher values of digestibility of all nutrients by supplementation with different levels of I supplementation. Zeedan *et al*. (2010) reported that digestibilities of DM, OM, CF and EE were not influenced by I supplementation at 60 days; while digestibilities of CP and NEF appeare to higher ($P<0.05$) significantly for I_2 than I_0. Also, they reported that nutritive value as TDN was higher ($P<0.05$) for I_2 than I_1 and I_0. At 120 days the digestibility of all nutrients and nutritive value (TDN and DCP) tended to be higher ($P<0.05$) for the I_2 compared to the I_0. Zeedan *et al*. (2012) reported that digestibilities of DM, OM,CP, CF, NFE , EE and nutritive value (TDN and DCP) tended to be higher ($P<0.05$) for the I_2 (1.5 mg I per kg DM intake /h/d) compared to the I_0 at 60 days and 120 days. The improvement of digestibility of most nutrients may be due to its effect on rumen bacteria especially rumen proteolytic bacteria and increasing the number of rumen cellulolytic bacteria. Improvement percentages were (4.45%, 8.78%, 12.04% and 16.75%, TDN) and (13.98%, 22.54%, 31.95% and 42.65%, DCP) for I_1, I_2, I_3 and I_4, respectively compared with I_0 (Table 2). Also, Improvement of TDN and DCP might be due to the higher values of digestibility of all nutrients for supplemented ration with different levels of I supplementation. On the other hand, Feng Qin *et al*. (2011) found that Supplemental I had no effect on nutrient digestibility and nitrogen metabolism. Sawal *et al.* (1996) found that digestibility of all organic nutrients decreased with female Gaddi sheep receiving iodine.

Table (1): Chemical composition of feed ingredients and the calculated composition of the experimental diets.

Items	Chemical composition on DM basis (%)						
	DM	OM	CP	CF	EE	Ash	NFE
Chemical composition of the ingredients :							
CFM*	90.19	92.46	15.63	11.43	3.95	7.54	61.45
BH	90.40	84.19	12.73	26.19	1.86	15.81	43.41
RS	91.08	81.57	2.59	42.13	1.73	18.43	35.12
Calculated chemical composition of tested rations:							
I_0	90.41	88.63	12.44	20.52	3.09	11.37	52.58
I_1	90.39	88.84	12.74	19.87	3.13	11.16	53.10
I_2	90.37	89.05	13.03	19.23	3.17	10.95	53.62
I_3	90.34	89.42	13.54	18.11	3.24	10.58	54.53
I_4	90.34	89.42	13.54	18.11	3.24	10.58	54.53

***CFM; concentrate feed mix contained in percentage ; yellow corn ,37; undecortecated cotton seed cake , 30;wheat bran,20; rice bran,6.5 ; molasses ,3 ; limestone,2.5; common salt,1.**

BH, Berseem hay. RS, Rice straw.

I_0 = control, I_1= 0.5 mg I, I_2=1.00 mg I, I_3=1.5mg mg I and I_4=2.00mg I per kg DM intake /h/d.

Table (2): Digestibility and nutritive values of the experimental rations.

Ration	Digestibilities %						Feeding values %	
	DM	OM	CP	CF	EE	NFE	TDN	DCP
I_0	65.12^{e}	68.53^{d}	56.38^{e}	51.54^{e}	87.29^{d}	73.33^{e}	62.22^{e}	7.01^{e}
I_1	67.36^{d}	70.03^{c}	62.71^{d}	54.37^{d}	88.67^{d}	75.24^{d}	64.99^{d}	7.99^{d}
I_2	69.61^{c}	71.24^{c}	65.91^{c}	56.82^{c}	90.34^{c}	77.81^{c}	67.68^{c}	8.59^{c}
I_3	71.45^{b}	73.55^{b}	68.32^{b}	58.40^{b}	92.90^{b}	79.08^{b}	69.71^{b}	9.25^{b}
I_4	74.60^{a}	76.17^{a}	73.83^{a}	61.89^{a}	95.38^{a}	81.59^{a}	72.64^{a}	10.00^{a}
SEM	1.50	0.45	0.67	0.70	0.52	0.60	0.55	0.12

a, b,..etc. means within the same column with different superscripts are significantly different (P < 0.05).
Means bearing different superscripts in the same raw are significantly different (P < 0.05).
I_0 = control, I_1= 0.5 mg I, I_2=1.00 mg I, I_3=1.5mg mg I and I_4=2.00mg I per kg DM intake /h/d.

Performance of buffalo calves:

The change in total body weight, total gain and daily gain of buffalo calves fed different levels of I are presented in Table (3). It is obvious that calves fed the iodine supplementation gained significantly (P<0.05) more than the I_0 group. Improvement of growth performance with I may be due to its positive effect of I on rumen microbial activities, increase in T_3, T_4 and improved all nutrient digestibilities. Improvement was 8.85, 15.10, 20.42 and 32.29% for daily gain of calves fed I_1, I_2, I_3 and I_4, respectively. These results are in agreement with those obtained by Zeedan *et al*. (2010 and 2012) who reported that using iodine supplementation increased weaning weight, total gain and daily gain of calve. Sultana *et al*. (2006) found that the highest live weight gain was recorded with Lugol's iodine treated group (7.09 %) followed by iodide salt treated group (5.28 %) and common salt treated group (4.94 %) and the lowest live weight gain was recorded with control group. They added that this might have been due to anabolic effect of iodine on weight gain.

These results are generally supported by the findings obtained by Georgievskii *et al.* (1990), Georgievskii *et al.* (1990) and Hoption (2006),who emphasized that the importance role of I supplementation to the diets of animals which stimulated and activated the functions of body organs and the basic metabolic processes including carbohydrate, fat and protein and consequently positively affect on growth performance. Moreover Pattanaik *et al*. (2004) found that average daily gain of the goats at the end of 210 days of study was higher (P<0.01) in the I supplemented (25.5 g) than non-supplemented (10.9 g) goats, ration. On the other hand, Meyer *et al*. (2008) found that I-supplementation decreed of daily weight gain but did not significantly influence daily weight gain.

Data in Table (3) showed that the DMI was insignificantly decreased with animal groups fed I_1, I_2, I_3 and I_4. Decreasing DMI might have been due to decrease intake of rice straw as an ingredient. It could be shown that I supplementation make a favorable effect for animals to get the best ingredient from ration, and also tended to improve digestibility and nutritive value for experimental rations and also increase in T_3 and T_4, thus led to an increase in utilization of rations. These results are in agreement with those obtained by Allam *et al*. (2003), El–Hosseiny *et al*. (2008), Meyer *et al*.

(2008), Franke *et al.* (2009), Moschini *et al.* (2010) and Borucki Castro *et al*. (2012).Norouzian *et al*. (2009) and Zeedan *et al*. (2010 and 2012) who reported that using iodine supplementation decreasing DMI compared to the control groups. On the other hand, Pattanaik *et al* (2004) found that the DM intake significantly (P<0.05) increased with extra iodine (556.2 versus 448.9 g per day) in goats. Total intake from both TDN and total DCP showed no significant differences with I supplementation. Results obtained herein are in agreement with that of El–Hosseiny, *et al*. (2008), Allam *et al*. (2003) and Zeedan *et al*. (2010 and 2012),

Table (3): Effect of iodine supplementation on feed intake and productive performance.

Items	I_0	I_1	I_2	I_3	I_4	SEM
No. of animals	4	4	4	4	4	-
Duration (day)	220	220	220	220	220	-
Initial weight (Kg)	235.80	235.59	235.77	235.92	236.02	-
Final weight (Kg)	447^{e}	465.40^{c}	478.81^{bc}	490.28^{b}	515.38^{a}	11.20
Total gain (Kg)	211.20^{d}	229.81^{c}	243.04^{bc}	254.36^{b}	279.36^{a}	12.00
Daily gain (g/h/d)	960^{e}	1045^{d}	1105^{c}	1156^{b}	1270^{a}	5.70
Improvement %	-	8.85	15.10	20.42	32.29	
Daily feed DM intake (Kg /h/d)						
CFM	4.2	4.2	4.2	4.2	4.2	-
BH	1.4	1.4	1.4	1.4	1.4	-
RS	1.4	1.2	1.0	0.7	0.7	-
Total DMI	7.00	6.80	6.60	6.30	6.30	1.5
Total TDNI	4.36	4.42	4.47	4.39	4.58	1.00
Total DCPI	0.50	0.54	0.57	0.58	0.63	0.31
Feed conversion (Kg/kg gain)						
DM	7.29^{a}	6.51^{b}	5.97^{c}	5.45^{d}	4.96^{e}	0.05
TDN	4.54	4.23	4.05	3.80	3.61	0.20
DCP	0.52	0.52	0.52	0.50	0.50	0.02

a, b,…etc. means within the same row with different superscripts are significantly different (P < 0.05).
I_0 = control, I_1= 0.5 mg I, I_2=1.00 mg I, I_3=1.5mg mg I and I_4=2.00mg I per kg DM intake /h/d.

Regarding feed conversion values presented in Table (3) showed that feed conversion expressed as kg feed unite intakes (DM, TDN or DCP) per kg gain were the best values with animals fed I_4 being 4.96, 3.61 and 0.50 kg, respectively. The differences in feed conversion as kg DM/ kg gain was significant (P<0.05), while differences in kg TDN or DCP/kg gain was not significant as shown in Table (3). Improvement in feed conversion for animals fed I_4 might be due to the higher daily gain and lower feed intake in this group. It was attributed to palatable of rations supplemented with I. In contrast El–Hosseiny, *et al*. (2008) found that supplement of iodine for young camel, the feed conversion DM (Kg/kg gain) tended to decrease, but the differences were non-significant. On the other hand, Meyer *et al*. (2008) indicated that iodine supplementation increased the feed amount per kg weight gain but no significant. Also, there were no significant differences between feed conversion as kg TDN and kg DCP / kg gain in all treatments.

Blood parameters:

Data in Table (4) illustrated that count of RBC and WBC, Hb and PCV were significantly (P< 0.05) increased by supplementation of iodine compared with control group. These results are in accordance with Zeedan *et* *al*. (2010 and 2012). Also, Sultana *et al*.(2006) reported that the TEC (Total Erythrocyte Count), hemoglobin percent and PCV were increased at 60 days of post-treatment in all groups (common salt, iodide salt and Lugol's iodine) compared with control group. They added that the variation might be due to effect of iodine formulation on hemopoiesis.

Table (4): Effect of iodine supplementation on some blood plasma parameters of buffalo calves.

Item	I_0	I_1	I_2	I_3	I_4	SEM
RBC count x10^6/mm^3	6.19^e	6.43^d	6.92^c	7.75^b	8.79^a	0.10
WBC count x10^3/mm^3	5.21^e	5.94^d	6.46^c	7.03^b	8.30^a	0.11
Hemoglobin (Hb) g/dl	6.87^e	7.14^d	7.83^c	8.69^b	9.87^a	0.07
PCV (%)	29.45^d	30.50^c	32.44^b	33.19^{ab}	34.68^a	1.63
T. protein (g/dl)	6.31^e	6.77^d	7.54^c	8.26^b	8.89^a	0.18
Albumin (A) (g/dl)	2.98^e	3.07^d	3.35^c	3.64^b	3.91^a	0.02
Globulin (G) (g/dl)	3.33^e	3.70^d	4.19^c	4.62^b	4.98^a	0.01
A / G ratio	0.89	0.83	0.80	079	0.78	0.12
ALT (IU/L)	7.21	7.35	7.48	7.50	7.53	0. 12
AST (IU/L)	8.11	8.24	8.43	8.49	8.52	0.10
Glucose(mg/dl)	53.58^e	56.27^d	59.81^c	63.40^b	68.55^a	1.50
BUN (mg/dl)	31.05^a	29.24^b	27.53^c	24.63^d	21.84^e	1.55
Cholesterol (mg/dl)	82.03^a	80.41^{ab}	78.24^{bc}	76.58^c	73.21^d	2.00
T_3 (ng/dl)	205.21^d	207.11^{cd}	211.43^{bc}	215.92^b	220..67^a	3.01
T_4 (µg/dl)	5.41^e	6.18^d	6.82^c	7.91^b	8.87^a	0.01

Means bearing different superscripts in the same raw are significantly different (P < 0.05).
I_0 = control, I_1= 0.5 mg I, I_2=1.00 mg I, I_3=1.5mg mg I and I_4=2.00mg I per kg DM intake /h/d.

As shown in Table (4) total protein, albumin and globulin concentrations in blood plasma of I_1, I_2, I_3 and I_4 groups were significantly (P<0.05) greater than of I_0. However, albumin to globulin ratio (A/G) was decreased with the addition of I which may be due to the increased globulin as a result of treatment. A/G ratio has been used as an indicator of immune responses so that high globulin level and low A/G ratio signify response. On my opinioned the increasing in total protein, albumin and globulin with I addition may be due to the improving microbial activity in rumen in term of increasing the concentration of ruminal TVFA's and microbial protein yield, then increased total protein synthesis, increase in T_3 and T_4 and increase in digestion of protein. These results are in accordance with Zeedan *et al*. (2010 and 2012) who reported that total protein, albumin and globulin concentrations in blood plasma of I_1 and I_2 groups were significantly (P<0.05) greater than of I_0 within two stages LP (60 days) and PP (160 days). Shetaewi *et al*. (1991) found that serum proteins tend to be higher in high treatment of KI than low of KI or control treatments. Moreover, El–Hosseiny *et al*. (2008) showed that serum total protein significantly increased by supplement of iodine. They added that globulin was significant by iodine supplementation. Hoption (2006) reported that thyroidal hormones play a major role in the growth and development of brain and central nervous systems, control of several metabolic processes including carbohydrate, fat, protein, vitamin and mineral metabolism. Georgievskii *et al.* (1990) reported that the principal function of iodine is determined by its presence in the thyroid hormones. These hormones are known to regulate basic metabolism, consumption of carbohydrates, proteins and fats the effect of hormones on metabolism involves synthesis of respiratory and other enzymes, which affect intracellular processes of oxidation, oxidative phosphorylation and protein synthesis. Also, Lawrence and Fowler (1997) reported that thyroid hormones influence the function of most organs and stimulate the basic metabolic rate through regulation of the metabolism of carbohydrates, proteins and lipids. On the other hand, Pattanaik *et al*. (2004) found that serum concentration of total protein, albumin and globulin was not affected by the I dose and it was within the normal range for goats.

No significant differences (P<0.05) were observed in AST and ALT among the all groups (Table 4).Values of AST and ALT were within the normal range and indicated that animals were generally in a good nutritional status and their livers were in a normal health condition. These results may explain that I treatment is safe with liver functions and so it had not any harmful effect on liver tissues.

Data in Table (4) illustrated that glucose was significantly (P< 0.05) increased with groups fed I_1, I_2, I_3 and I_4 groups. These results are in agreement with those found by Kobeisy and Shetaewi (1992) and Zeedan *et al*. (2010 and 2012). Also, Bedi *et al*. (2000) reported that serum glucose level was significantly (P<0.01) in goats by using level of KI. Nudda *et al*. (2013) found that serum glucose concentration was higher in high level than in low level of iodine addition. On the other hand, Pattanaik *et al*. (2004) found that serum glucose concentration was not affected by the I supplementation.

Significant lower blood urea nitrogen (BUN) was observed among treatments, as shown in Table (4). Deferens in BUN could be due to increase thyroid hormone in treated buffaloes which in turn result in a slight increase in protein catabolism. These results are in accordance with Nudda *et al*. (2013) who found that BUN was significantly lower by iodine supplementation. Previous observations Pattanaik *et al*. (2001) reported that a greater retention of absorbed nitrogen in iodine-supplemented goats were observed. Therefore, it could be argued that the increase T_3 in animals supplemented with KI might have increased the body metabolic activity and the rate of protein synthesis to some degree. On my opinion, a possible explanation of the observed decreases in BUN with increasing iodine level may be an interaction between iodine and the activity of some ruminal microbial strains. It can be hypothesized that iodine might have interfered to some extent on rumen microbial protein degradation with a consequent reduction in ammonia production and/or utilization. In contrast, Pattanaik *et al*. (2004) found that serum urea of concentrations was not affected by the I dose and were within the normal range for goats. On the other hand, Zeedan *et al*. (2010 and 2012) demonstrated that serum urea nitrogen tended to be slightly higher in buffaloes treated with iodine in later pregnancy (60 days) and post partum (160 days) and Kobeisy and Shetaewi (1992) mid- lactation period compared with control group.

Data in Table (4) showed that cholesterol concentration was gradually lower in plasma of animals fed I_1, I_2, I_3 and I_4 respectively. It is interest to notice the reverse relationship between T_3 and cholesterol concentrations that occurred during treatments. Similar results were reported by Zeedan *et* *al*. (2010 and 2012). Shetaewi *et al*. (1991) found that serum cholesterol concentration was 15% lower in lambs received 80 mg KI /head/wk compared with controls. On the contrary, Kobeisy and Shetaewi (1992) showed that cholesterol concentration was 20% less in iodine- treated group than that control group for buffaloes in mid lactation period. Pattanaik *et al*. (2004) found that serum concentrations of cholesterol were lower in goats diet that supplemented with-iodine. Kaneko (1980) reported that serum cholesterol was previously used as an index of thyroid function because hypothyroidism is generally associated with an elevation in serum cholesterol. Generally, Bergersen (1979) suggested that thyroid hormones were increased cholesterol synthesis and enhance the liver ability to excrete cholesterol in the bile. But the effect on cholesterol excretion is greater than that on cholesterol synthesis so the net result is a decrease in plasma cholesterol concentration. However, serum cholesterol varies with a variety of factors unrelated to thyroid activity such as the nature of the diet, hepatic function and other factors (Kaneko, 1980).

As shown in Table (4) T_3 and T_4 concentrations in blood plasma of I_1, I_2, I_3 and I_4 groups were significant ($P< 0.05$) higher than those of I_0. It could be noticed that, with increasing iodine levels was significant ($P< 0.05$) increased in T_3 and T_4 concentrations. These results are in harmony with Zeedan *et al*. (2010 and 2012). They reported that T_3 and T_4 concentrations in blood plasma of I_1 and I_2 groups were significantly ($P<0.05$) higher than of I_0 within two stages LP (60 days) and PP (160 days). Feng Qin *et al* (2011) found that T_3 was significantly increased with I supplementation ($P < 0.05$). Pattanaik *et al*. (2004) found that serum triiodothyronine concentration was similar between the groups, I supplementation increased ($P<0.01$) serum thyroxine from 21.43 to 29.72 ng ml. Nudda *et al*. (2013) found that the T_3 and T_4 serum concentration was higher ($P<0.01$) in H_I than in L_I. The T_4 serum concentration tended to be higher ($P=0.059$) in blood animals fed high level HI than in L_I. Guyot *et al.* (2011) found that T_4 concentration was lower and T_3 higher ($P< 0.05$) at 120 days in HISe (I 5.45 ppm) compared to LISe (I 0.45 ppm) group. Pattanaik *et al*. (2001) found that T_3 and T_4 increased by I supplementation compared to control. Kobeisy and Shetaewi (1992) showed that iodine treated buffaloes had 40% higher ($P<0.02$) serum triiodothyronine than control buffalos. Kaur and Randhawa (2004) found that a significant elevation of plasma T_4 concentration in buffaloes treated with 2 ml of iodized (containing 375 mg iodine / ml) subcutaneously in the brisket region. Also, Rose *et al*. (2007) found that supplementation with I was associated with higher levels of triiodothyronine and thyroxin in the lambs at birth. Recently, Norouzian *et al*. (2009) found that average of T_3 was 90.75, 91.125, 99.50 and 104.75 with animals fed zero, 2.5, 5 and 7.5 mg Potassium Iodide/kg diet DM, respectively, while corresponding values of T_4 were 3.00, 2.675, 3.237 and 2.80 mg respectively. On the other hand, Borucki Castro *et al*. (2012) found that thyroxin levels were not affected by the treatments (0.3, 0.6 and 0.9 mg of dietary I/kg of dry matter). In this study the increase in T_3 and T_4 concentrations with animals fed I_1, I_2, I_3 and I_4 may be due to increase the availability of I to the thyroid to meet the increasing demand of thyroid hormone during experiment period.

Generally the increase in blood constituents may be due to the role of iodine in improving all nutrient digestibility especially CP. Also, it may be probably led to an increase in the absorption rate from the digestive tract, thus blood constituents of the supplemented animals reflected a corresponding to increase of these values. These results are in agreement with Zeedan *et al*. (2010 and 2012) who found that supplementary iodine improved chemical composition of blood in cows compared with the control diet.

Economic efficiency:

Data in Table (5) showed that animals fed rations supplemented with I gave more daily gain than the control group. Also, data indicated that I supplementation of I_1, I_2, I_3 and I_4 decreased the cost of feed / kg gain (LE) by 8.59, 13.91. 18.42 and 25.71%, respectively while economic efficiency values were raised by 12.67, 16.20, 22.54 and 34.51% respectively as compared with control group. Economical results in this study are in agreement with those reported by El–Hosseiny, *et al*. (2008).

Table (5): Economic efficiency of buffalo calves as affected by the iodine supplementation levels.

Items	I_0	I_1	I_2	I_3	I_4
Daily feed consumption (kg)					
CFM	4.61	4.61	4.61	4.61	4.61
BH	1.53	1.53	1.53	1.53	1.53
R.S	1.52	1.32	1.10	0.76	0.76
Sodium iodide(mg)	-	5.30	10.30	14.74	19.72
Total cost LE.	15.53	15.46	15.39	15.26	15.27
Price of daily gain (LE/day)	22.08	24.04	25.42	26.59	29.21
*Feed cost / Kg gain (LE)	16.18	14.79	13.93	13.20	12.02
*Net revenue (LE/h/d)	5.90	9.25	11.49	13.39	17.19
**Economic efficiency	1.42	1.56	1.65	1.74	1.91
Improvement %	-	12.67	16.20	22.54	34.51

Price of feedstuffs (LE / ton) for 2013: concentrate feed mixture (CFM) 2800, berseem hay (BH) 1350, and rice straw (RS) 365 and sodium iodide (85 LE per 100g), wherever kilogram of live body weight of buffalo was 23 LE.

***Net revenue (LE/h/d) = Price of daily gain (LE/day) – Feed cost / Kg gain (LE).**

****Economic efficiency = Price of daily gain (LE/day) / Total cost LE.**

I_0 = control, I_1= 0.5 mg I, I_2=1.00 mg I, I_3=1.5mg mg I and I_4=2.00mg I per kg DM intake /h/d.

CONCLUSION

It could be recommended that using iodine supplementation at levels (0.5. 1.00, 1.50 and 2.00 mg I per kg DM intake /h/d)) in ration of Egyptian buffalo calves tended to improve the digestion, nutritive values, daily gain**,** feed and economic efficiencies. Moreover, the highest level of iodine (2 mg/kg DMI) was the best level owing to give the highest nutritive value and daily gain with the lowest feed cost /kg gain

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دراسات غذائية على استخدام بعض مصادر ومستويات مختلفة من اليود على الأداء الانتاجى وتخمرات الكرش وبعض مكونات الدم في الجاموس.

٣- تأثير مستويات مختلفة من اليود على الاداء الانتاجى للعجول الجاموسى

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قسم بحوث تغذية الحيوان- معهد بحوث الإنتاج الحيواني - مركز البحوث الزراعية – الدقي – الجيزة - ج م ع.

تهدف هذه الدراسة إلى تقييم تأثير تغذية مستويات مختلفة من اليود (I) على الأداء الإنتاجي لعجول التسمين الجاموسى. أجريت هذه التجربة في محطة بحوث الإنتاج الحيواني بمحلة موسى , تم اختيار عدد عشرون عجل جاموسى عمر ١٠ شهور وقسمت إلى خمس مجموعات متماثلة (٤ حيوانات في كل مجموعة) .وكان متوسط وزن الجسم في بداية التجربة ٢٣٥ كجم لكل مجموعة تقريبا. استمرت التجربة لمدة ٧ أشهر تقريبا (220 يوم) و غذيت الحيوانات على علف مركز ودريس البرسيم، وقش الأرز بدون اضافة اليود I_0 (كنترول) ، في حين أن المجموعات الأخرى (I_1) ، (I_2) ، (I_3) و (I_4) ، تغذت على عليقة الكنترول مضاف اليها اليود بنسبة ٠,٥، ١,٠٠ ، ١,٥٠ و ٢,٠٠ ملجم / كجم مادة جافة /رأس / يوم على التوالي . أجريت خمس تجارب هضم لتقدير القيمة الغذائية والهضمية للعلائق التجريبية .تم جمع عينات الدم من جميع الحيوانات بعد ٤ ساعات من التغذية لتقدير بعض قياسات الدم.

ويمكن تلخيص أهم النتائج المتحصل عليها كما يلي :

١- أن إضافة اليود الى العلائق ادت إلى تحسن فى هضم جميع المواد الغذائية وكانت المجموعة I_4 هى الافضل. وسجلت القيمة الغذائية معبرا عنها بال TDN بقيم 62.22 ، 64.99 ، 67.68 ، 69.71 و ٧٢,٦٤ ٪ فى المجموعة التجريبية I_0 ، I_1 ، I_2، I_3او I_4على التوالي ، وسجلت قيم DCP 7.01 ، 7.99 ، 8.59 ، 9.25 و ١٠,٠٠ ٪ لنفس المعاملات السابقة على التوالى.

٢- سجلت قيم الزيادة اليومية ٩٦٠, ١٠٤٥, ١١٠٥, ١١٥٦, ١٢٧٠ جم نمو فى اليوم/ حيوان للمجموعات ، I_1 ، I_2، I_3او I_4 على التوالي وكانت المجموعة الاخيرة التى تغذت على ٢ مللجرام يود/ كجم مادة جافة مأكولة افضل وزن يومى.

٣- سجلت المجموعة I_4 افضل كفاءة غذائية معبرا عنها بكمية المادة الجافة او مجموعة المركبات الكلية المهضومة او البروتين المهضوم اللازم لكل كيلوجرام نمو وكانت هذة القيمة تساوى ٤,٩٦, ٣,٦١, ٠,٥ كجم على التوالى.

٤- ايضا سجلت المجموعة I_4 افضل كفاءة اقتصادية مع اقل تكلفة اقتصادية لانتاج كيلو جرام نمو حيث كانت الكفاءة الاقتصادية تساوى ١,٩١ بينما تكلفة التغذية كانت تساوى ١٢,٠٢ جنيها لكل كيلوجرام نمو.

٥- أن إضافة اليود ادت إلى تحسن فى RBC ، WBC ، HB ، PCV ، البروتين الكلي ، الجلوبيولين ، الجلوكوز ، ثلاثي يودوثيروني (T_3)التيروكسين (T_4).

قام بتحكيم البحث

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