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THE IMPACT OF DIETARY SUPPLEMENTATION OF IODINE AND SELENIUM ON NUTRIENTS DIGETIBILITY AND PRODUCTIVE PERFORMANCE OF EWES AND THEIR SUCKLING LAMBS

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SUMMARY

A total number of 32 Ossimi pregnant ewes averaged 50.77 ± 2.29 kg and 2.5 years old at 4-6 weeks of late-gestation were used to assess the effect of dietary supplementation of iodine (I) and selenium (Se) on nutrients digestibility and productive performance of ewes and their suckling lambs. The ewes were allocated into four equal groups (8 ewes in each). The ewes were fed on basal diet containing 0.048 mg I and 0.19 mg Se/kg DM (control) supplemented with 0.6 mg I (T1), 0.2 mg Se (T2) and 0.6 mg I plus 0.2 mg Se (T3) /kg DM. The results showed that digestibility of DM, OM, EE, CF and NDF were higher ($P<0.05$) for ewes fed T2 and T3 diets than those fed control or T1. Digestibility of CP increased ($P<0.05$) with feeding T3 diet vs. each of T1 or T2. The ADF digestibility was greater ($P<0.05$) for ewes fed T1, T2 and T3 diets than those fed control. The nutritive value (DCP and TDN) increased ($P<0.05$) with feeding T1, T2 and T3 diets *vs.* control. The improving in DCP and TDN was higher ($P<0.05$) with feeding T3 diet than each of T1 or T2. No significant differences was detected in all productive performance for ewes fed on T1, T2 and T3 diets *vs*. control. While, the digestible crude protein intake (DCPI) increased ($P<0.05$) for ewes fed T1, T2 and T3 diets *vs*. control. The total digestible nutrients intake (TDNI) was higher ($P<0.05$) for ewes fed T2 and T3 diets compared to control or those fed T1. The averages of DCPI and TDNI were greater ($P<0.05$) for ewes fed T3 than those fed T1 or T2. Data of lambs showed that the birth weight increased ($P<0.01$) for lambs born to ewes fed T2 or T3 diets compared to those born to ewes fed control or T1 diet. Lambs born to ewes fed T1, T2 and T3 diets had higher ($P<0.01$) averages of FBW and daily gain (ADG) *vs*. control. Averages of final body weight (FBW) and average daily gain (ADG) were improved ($P<0.01$) for lambs born to ewes fed T3 diet *vs*. control or fed on T1. This study demonstrated that the combined I and Se dietary supplementation led to positive effects on nutrients digestibility, nutritive values of ewes diet and enhancing growth performance of their suckling lambs.

Keywords: *Iodine, Selenium, nutrients digestibility, productive performance and ewes.*

INTRODUCTION

Trace elements are essential part involved in multiple physiological processes including protein, carbohydrate and lipid metabolism. They improve feed intake, nutrients digestibility, feed conversion and improving growth production (Yatoo *et al.,* 2013). Iodine (I) and selenium (Se) are micronutrients essential for normal thyroid function and play a vital role in maintaining good health in animals (Roman *et al.,* 2015). The iodine (I) is necessary for thyroid hormone synthesis. Thyroid hormones play a significant role in most of the body's biological processes; development includes carbohydrate metabolism, oxygen consumption, and synthesis of protein (Medrano *et al.,* 2016). So, deficiency of I reduces production of T_3 and T_4, leading to morphological and functional changes of the thyroid gland (Yatoo *et al*., 2013). Higher I intake indicates a potential risk associated with changes in the thyroid activity in ewes and their lambs (Dusova *et al.,* 2014). Also, Se is an essential part of enzymes called glutathione peroxidases (GSH-Px) and thioredoxin reductases, which are important for neutralizing free radicals or oxidants (Huang *et al*., 2012). Se function in animal nutrition was detected by McDowel (1992). He observed that Se supplementation avoided liver necrosis and prevents muscular dystrophy in bovine and sheep. Deficiency of Se also depressed the activities of type I and type II, 5-iodothyronine deiodinase in animal tissues and may exaggerate the I deficiency through impairing the conversion of T_4 to T_3 (Yuming *et al*., 1995).

The mechanistic aspects interacted between I and Se are not fully understood. Such interactions between I and Se, that affect animal performance, would have important implications for livestock feeding on forages with low concentrations of both micronutrients.

This study aimed to assess the combined effect of dietary supplementation of I and Se, during late-gestation and suckling period, on nutrients digestibility, nutritive value and productive performance of ewes and their suckling lambs.

MATERIALS AND METHODS

Animals:

A total number of thirty two of Ossimi pregnant ewes averaged 50.77 ± 2.29 kg and 2.5 years old at 4 -6 weeks of late-gestation were used in this experiment, which carried out during 2014 at the Farm of Animal Production Department., Faculty of Agriculture, Minia University, El-Minia, Egypt.

Experimental design:

Animals were fed on concentrate feed mixture (CFM) to cover their nutrients requirements according to their live body weight (NRC, 1985). The ewes were randomly divided into four equal groups (8 ewes each) of similar initial body weights. The ewes were fed on basal diet containing 0.048 mg I and 0.19 mg Se/kg DM (control) supplemented with 0.6 mg I as potassium iodide (T1), 0.2 mg Se as sodium selenite (T2) and 0.6 mg I plus 0.2 mg Se (T3) /kg DM. The concentrate feed mixture (CFM) contained 37 % wheat bran, 30 % sugar beet pulp, 15 % yellow corn, 15 % soybean meal, 2 % calcium carbonate and 1 % sodium chloride. In this experiment, rice straw (RS) as roughage source was offered *ad libitum*.

The animals were housed inside window stables for feeding lot groups. The calculated concentration of I and Se in the CFM were 0.048 mg/kg DM and 0.19 mg/kg DM, respectively. The requirements of sheep for I and Se are between 0.1-0.8 ppm and 0.1-0.3 ppm, respectively (NRC, 1985). The ewes were fed on supplemented diet treatments starting at 4 – 6 weeks of late-gestation and during the suckling period for three months. Feed was offered twice a day at 8 a.m. and 2 p.m and fresh water was available to the animals all times. The mean dry matter intake (DMI) in the last week of each month was considered in calculation of digestibility and feeding value of dietary treatments. Body weights of ewes in different experimental groups were recorded at the beginning of experiment during late-gestation and at lambing and then at every month during sucking period. Body weights of lambs born from ewes in each group were recorded within 24 hours from birth and then biweekly during suckling period for three months. And the average of daily weight gain of lambs were calculated.

Dietary Sampling and laboratory analysis:

Dietary samples were collected daily in the last week of each month along the experiment period and a composite sample was performed. A portion of the composite sample was dried at 105 °C in a forced air oven till constant weight for DM determination. The rest of composite sample was dried at 70 °C for a constant weight, ground and kept in closely tied jars for laboratory analysis. Diets were analyzed for dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE) and ash according to AOAC (2003). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined according to Goring and Van Soest (1970). Daily grab fecal samples of each month were collected before feeding at 7 am and 2 pm for each ewes on last week of each month and mixed together, dried on 70 °C till constant weight and analyzed for DM, OM, CP, CF, NDF, ADF, EE and ash. Total tract digestibility of DM, OM, CP, CF, NDF, ADF, EE and NFE were determined using acid insoluble ash as an internal marker according to Van Keulen and Young (1977). Approximate analysis of concentrate feed mixture (CFM), rice straw (RS) and total mixed ration (TMR) are presented in Table (1).

Statistical analysis:

The data were analyzed by least square means analysis of variance using General Linear Models procedure of the statistical analysis system (SAS, 2000). The model used to analyze the different traits studied for ewes or lambs was as follows:

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

Where: Y_{ij}: ij observation, µ: Population mean; T_i: Effect of i^{th} treatments and e_{ij}= random error. Duncan's Multiple Range test was used to detect differences between means of the experimental groups (Duncan, 1955).

Table (1): Proximate analysis of concentrate feed mixture, rice straw and total mixed ration fed to Ossimi ewes (% on DM basis).

Item	CFM	RS	TMR
DM	89.93	89.50	89.80
OM	91.29	91.28	91.29
CP	17.67	3.03	13.27
EE	2.46	1.79	2.26
CF	12.09	44.86	21.92
NFE	59.07	41.60	53.84
NDF	40.53	94.97	56.87
ADF	19.30	60.34	31.62
Ash	8.71	8.72	8.71

CFM: Concentrate feed mixture contained 37 % wheat bran, 30 % sugar beet pulp, 15 % yellow corn, 15 % soybean meal, 2 % calcium carbonate and 1 % sodium chloride.

RS: Rice straw

TMR: Total mixed ration

RESULTS AND DISCUSSION

Nutrients digestibility and nutritive value of experimental diets:

Data presented in Table (2) showed that digestion coefficients of DM, OM, EE, CF and NDF were higher (P<0.05) for ewes fed Se and I plus Se supplemented diets than those fed control or I alone. Digestibility of CP increased (P<0.05) with feeding I plus Se-supplemented diets than each of I alone or Zn alone. Also, there was an increase (P<0.05) in ADF digestibility for ewes fed I, Se and I plus Se supplemented diets than those fed control. The results of nutritive value as DCP and TDN values were greater (P<0.05) with feeding I, Se and I plus Se supplemented diets than control. Such improve in DCP and TDN were significantly (P<0.05) with feeding I plus Se supplemented diets than each of I alone or Zn alone.

Table (2): Effects of iodine and selenium dietary supplementation on nutrients digestion coefficients and nutritive value of experimental diets (Mean ± SEM).

Parameters	Treatments				SEM	Sig.
	Control	T1	T2	T3		
Nutrients digestibility (%):						
DM	76.08^{c}	76.81^{c}	81.34^{b}	85.50^{a}	0.37	*
OM	77.58^{c}	78.16^{c}	82.51^{b}	86.75^{a}	0.34	*
CP	71.33^{c}	75.36^{b}	76.55^{b}	78.61^{a}	0.12	*
EE	68.43^{c}	68.82^{c}	72.37^{b}	75.31^{a}	0.31	*
CF	67.93^{c}	68.89^{c}	70.13^{b}	72.59^{a}	0.34	*
NDF	53.02^{c}	53.47^{c}	55.16^{b}	56.97^{a}	0.11	*
ADF	41.54^{b}	49.84^{a}	$50\ 46^{a}$	51.59^{a}	0.25	*
Nutritive value (%):						
DCP	9.47^{c}	10.16^{b}	10.20^{b}	10.43^{a}	0.03	*
TDN	65.32^{c}	67.53^{b}	68.93^{b}	70.76^{a}	0.39	*

a, b and c :Means within the same row having different superscripts significantly different at (P<0.05).

**: Significant at P<0.05.*

T1: I (0.6 mg/kg DM). *T2: Se (0.2 mg/kg DM).* *T3: I (0.6 mg/kg DM) + Se (0.2 mg).*

The present study illustrated that, dietary supplemental I alone at 0.6 mg/kg DM improved ($P<0.05$) the digestibility of CP, ADF and the nutritive values as DCP and TDN, with no significant changes in digestibility of DM, OM, EE, CF and NDF in Ossimi sheep. Similar effect of I supplementation was also let to significantly increase CP digestibility in goats fed I at 0.04 mg/head/day, with no significant effect on digestibility of DM and OM as reported by Pattanaik *et al*. (2000). While, they found EE digestibility to be increased with supplemental I, which contradicts with the present study. In another study, Pattanaik *et al*. (2001) found that digestibility of DM, OM and EE was not influenced by I supplementation. To support the presented results, it has also been observed that digestibility of DM, OM, CF and EE was not influenced by I supplementation, while digestibility of CP, NDF and nutritive values of DCP and TDN were significantly higher for buffalo cows fed supplemental I at 0.5 mg/kg DM at pre- and post-partum periods (Zeedan *et al*., 2010). The positive effect of supplemental I on nutrients digestibility and nutritive values (DCP and TDN) could be discussed in the light of the view that iodine could affect rumen bacteria especially rumen proteolytic bacteria and increasing the number of rumen cellulolytic bacteria (Zeedan *et al*., 2010). In young camel fed supplemental I, the digestibility of nutrients and nutritive value (TDN and DCP) tended to increase, but the differences were non-significant (El–Hosseiny *et al*., 2008). Furthermore, thyroid function, which requires iodine as a structural component of its hormones, plays a significant role in regulating most of the metabolic processes including protein, carbohydrate and lipid metabolism (Yatoo *et al.*, 2013). The presented study elevated that, dietary supplemental Se (0.2 mg/kg DM) improved ($P<0.05$) all nutrients digestibility (DM, OM, CP, EE, CF, NDF and ADF) and the nutritive values (DCP and TDN). These results are consistent with a report by Alimohamady *et al*. (2013). They showed that digestibility of DM, OM, CP, NDF and ADF were increased with feeding supplemental Se at 0.2 mg/kg DM (as sodium selenite) in sheep. In the same way, supplemental Se at 0.3, 0.6 and 0.9 mg/kg DM had increased digestibility of OM and NDF in male lambs, suggesting that dietary supplementation of Se, as sodium selenite, improved Se absorption and availability, and such Se availability in the rumen facilitates its use by the ruminal microorganisms (Del Razo-Rodriguez *et al*., 2013). Improving of nutrients digestibility in the present study due to supplemental Se are in agreement with Alimohamady *et al*. (2013) and Del Razo-Rodriguez *et al*., (2013) on sheep as well as in dairy cows (Wang *et al*., 2009). This improving may be due to positive effects of Se on rumen microorganisms rather than the host in ruminants (Wang *et al*., 2009). In contrast, Kumar *et al*. (2008) showed no significant effect of supplemental Se at 0.15 or 0.30 mg/kg DM on nutrient digestibility (DM, OM, CP, EE, NDF) and intake of DCP and TDN in sheep. The current results clearly indicated that supplemental Se was more effective ($P<0.05$) than supplemental iodine in enhancing digestibility of DM, OM, EE, CF and NDF, however their effect to increase ($P<0.05$) digestibility of CP and ADF was similar. The combined effect of both micronutrients (I plus Se) was more ($P<0.05$) potent than each of I or Se alone in improving the digestibility of all nutrients as well as the nutritive value. Thus, these findings may point out a positive interactive effect of dietary I plus Se regarding nutrients digestibility. There is a lack in information about the interactive effect of dietary I plus Se on nutrients digestibility in sheep. A study on goats showed that high levels of supplemental I (4.0 mg/kg DM) and Se (1.0 mg/kg DM) alone did not affect all nutrients digestibility. However, there was an interaction between I and Se to improve ADF digestibility (Qin *et al*., 2011). To the point, dietary combined supplementation of I plus Se (each at 0.6 mg/kg DM) markedly increased the concentrations of free T3 hormone, which is the biologically active form of thyroid hormones, compared to I or Se alone, suggesting possible synergistic effects of combined Se and I in improving metabolism (Aghwan *et al*., 2013).

Productive performance of ewes and their suckling lambs:

Data presented in Table (3) showed no significant differences in all productive performance as averages of final body weight (FBW) and feed intakes of rice straw, concentrate feed mixture and total dry matter for ewes fed on I, Se and I plus Se-supplemented diets *vs*. control ewes. However, the digestible crude protein intake (DCPI) increased ($P<0.05$) for ewes fed I, Se and I plus Se-supplemented diets *vs*. control ewes. Also, the total digestible nutrients intake (TDNI) was higher ($P<0.05$) for ewes fed Se- and I plus Se supplemented diets compared to control or those fed I supplemented diet ewes. The averages of DCPI and TDNI were greater ($P<0.05$) for ewes fed I- plus Se supplemented diets than those fed I alone or Se alone ewes. The birth weight was increased ($P<0.01$) by 16.7 and 22.2 % for lambs born to ewes fed Se or I plus Se supplemented diets in comparison with control. Also, birth weight tended to improve by 6.7 % for lambs born to ewes fed I-supplemented diet *vs.* respective control. Lambs born to ewes fed on I, Se and I plus Se-supplemented diets had higher ($P<0.01$) averages of FBW and average daily gain (ADG) *vs*. control. Averages of FBW and ADG were improved ($P<0.01$) for lambs born to ewes fed I plus Se supplemented diet *vs*. respective control or those fed on I alone.

Table (3): Effect of dietary supplementation of iodine and selenium on productive performance of ewes and their sucking lambs (Mean ± SEM).

Parameters	Treatments				SEM	Sig
	Control	`T1	T2	T3		
Ewes						
IBW (late-gestation), kg	51.28	49.84	50.54	51.41	2.29	NS
FBW (kg/day)	48.42	48.37	47.98	50.70	2.39	NS
RSI (kg/day)	0.52	0.51	0.51	0.53	0.01	NS
CFMI (kg/day)	1.21	1.19	1.20	1.24	0.04	NS
TDMI (kg/day)	1.73	1.70	1.71	1.77	0.06	NS
DCPI (g/head/day)	163.83^{c}	170.00^{b}	173.74^{b}	184.61^{a}	0.49	*
TDNI (g/head/day)	1130.0^{c}	1148.0^{c}	1178.7^{b}	1252.5^{a}	6.28	*
Lambs						
Birth weight (kg)	3.42^{b}	3.65^{b}	3.99^{a}	4.18^{a}	0.11	**
FBW (kg)	16.49^{c}	20.15^{b}	21.94^{ab}	23.27^{a}	0.65	**
ADG (g/day)	145.22^{c}	183.33^{b}	199.44^{ab}	212.11^{a}	7.83	**

a, b and c:Means within the same row having different superscripts significantly different at (P<0.05).

**: Significant at (P<0.05).*

**: Significant at (P<0.01).*

NS: Not significant.

T1: I (0.6 mg/kg DM). T2: Se (0.2 mg/kg DM). T3: I (0.6 mg/kg DM) plus Se (0.2 mg).

Supplemental I alone, in the current study improved (P<0.05) the averages of FBW and ADG and tended to increase birth weight for lambs born to ewes fed I-supplemented diet. This improvement could be attributed to the increase (P<0.05) in maternal CP digestibility, DCPI and nutritive value as DCP and TDN, which reflected on their lambs' performance. In this respect, some reports are going together with the presented results, which showing the positive affect of supplemental I on animal performance. In a study on buffalo cows, supplemental I had no effect on their BW at pre- and post-partum periods, but increased birth weight, total gain, daily gain and weaning weighs of their calves (Zeedan *et al*., 2010). They came to conclusion that such improvement in calves' performance could be attributed to the significant improvement in protein digestion and TDN. Also, supplemental I was effective to enhance BW and ADG in beef cattle calves as reported by Sultana *et al*. (2006). They reported that this positive effect may be due to anabolic effect of iodine on weight gain. The role of I supplementation is essential to activate the basic metabolic processes including carbohydrate, fat and protein, which consequently improve on animal performance (Hoption, 2006).

As regard to supplemental Se, some works supported the presented results. For instance, Gabryszuk and Klewiec (2002) found that maternal Se supplementation, at late-gestation and during lactation and suckling periods had no significant effect on maternal BW, but significantly improved reproductive performance of ewes and ADG of their offspring. In the present study, the maternal supplemental Se increased (P<0.05) their all nutrients digestibility and nutritive value as DCP and TDN, thus consequently reflected on the improvement (P<0.05) gained in their lambs' performance (birth weight, FBW and ADG). The beneficial effects of supplemental Se on animal performance was reported to improve birth weight of lambs (Ali *et al*., 2004) and averages of BW for newborn lambs (Hefnawy *et al*., 2014). In addition, dietary supplemental Se significantly improved the feeding efficiency and ADG (Yue *et al*., 2009), and the final BW and ADG (Shi *et al*., 2011) of growing male goats. Practically, Se supplementation may indirectly improve animal performance possibly by strengthening the immunity of the animals (Milad *et al*., 2001).

Maternal supplementation of I plus Se in the current study had positive (P<0.05) interactive effect in improving DCPI and TDMI when compared to feeding I alone or Se alone, which reflected on the significant improvement (P<0.05) gained in their lambs' performance. The increases in birth weight, FBW and ADG for lambs born from ewes fed I plus Se were significant (P<0.05) *vs*. those born from ewes fed I alone and tended to be increased comparing with those born from ewes fed Se alone. This favorable effects on lambs performance could be related to the significant (P<0.05) increases in nutrients digestibility and nutritive value as DCP and TDN for ewes fed I plus Se-supplemented diets compared to those fed I alone or Se alone. So, the enhanced growth performance for lambs following a combination of maternal I plus Se supplementation, observed in this study, could be related to the role of both micronutrients in metabolism. In goats fed I plus Se-supplemented diet (each at 0.6 mg/kg DM), animals exhibited higher total gain, ADG and better feed conversion ratio than those fed I alone or Se alone (Aghwan *et al*., 2016). The combined effect of I plus Se in animal performance could not be explained away from the thyroid activity hormones (T_3 and T_4) and its controlling role on metabolism. It is well known that these hormones regulate energy metabolism, growth and development and thyroid activity, to synthesize its hormones, requires both I and Se. Pechova *et al.* (2012) and Aghwan *et al*. (2013) related the significant increase in ADG and total weight gain in goats fed supplemental I to their higher T_4 concentrations. At this point, it was noticed that maternal-supplemental I plus Se in pre-partum cows can improve their calves performance and immune status via improving the maternal mineral status (Gilles *et al*., 2009). In contrast, other studies failed to show any significant effect of maternal Se supplementation on either birth weight or growth of their lambs (Rodinova *et al.*, 2008 and El-Shahat and Abdel Monem, 2011).

CONCLUSION

In conclusion, the present study demonstrated that dietary combined supplementation of I at 0.6 mg/kg DM plus Se at 0.2 mg/kg DM during late-gestation and suckling period led to positive effect on all nutrients digestibility and nutritive value for ewes diet and enhancing growth performance of their suckling lambs. These results may suggest possible synergistic effects of combined I and Se on metabolism and lambs performance.

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تأثيرالإمدادالغذائى باليود والسلينيوم على معاملات الهضم والأداء الإنتاجى للنعاج وإنتاجها من الحملان

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أستخدم فى هذه الدراسة عدد إثنان وثلاثون من النعاج الأوسيمى فى الفترة الأخيرة من الحمل بمتوسط وزن 50.77 ± 2.29 كجم ، 2.5 عاماً من العمر لتقييم تأثير الإمداد الغذائى باليود والسلينيوم على الأداء الإنتاجى ومعاملات الهضم للنعاج الأوسيمى والأداء الإنتاجى لحملانها الرضيعة. تم تقسيم النعاج إلى أربعة مجموعات متساوية (8 نعاج في كل منها). غذيت الحيوانات على عليقة أساسية تحتوى على 0.048 ملجم يود و 0.19 ملجم سلينيوم/ كجم مادة جافة (كنترول)، ثم تم إمدادها بـ 0.6 ملجم يود (T1) ، 0.2 ملجم سلينيوم (T2) و 0.6 ملجم يود + 0.2 ملجم سلينيوم / كجم مادةجافة (T3). وقد أظهرت النتائج مايلى كانت معاملات الهضم أعلى معنوياً ($P<0.05$) للنعاج التى غذيت على المعاملات T3, T2 بالمقارنة بالكنترول أو المعاملة T1. زاد معنوياً ($P<0.05$) معامل هضم البروتين الخام بالتغذية على المعاملة T3 بالمقارنة بالمعاملة T1 أو T2، كما كان معامل هضم الألياف المستخلصه بالمحاليل الحامضيه أعلى معنوياً ($P<0.05$) للنعاج التى غذيت على المعاملات T1, T2 , T3 بالمقارنة بالكنترول. زادت القيم الغذائيه (البروتين المهضوم والمركبات الكليه المهضومه) معنوياً ($P<0.05$) بالتغذية على المعاملات T1, T2 , T3 بالمقارنة بالكنترول ، كما كان التحسن فى قيم البروتين المهضوم والمركبات الكليه المهضومه أعلى معنوياً ($P<0.05$) بالتغذية على المعاملة T3 بالمقارنة بالمعاملة T1 أو T2 كل على حده. كما لم تلاحظ إختلافات معنوية فى الأداء الإنتاجى للنعاج بين المعاملات مقارنه بالكنترول، بينما زاد معنوياً ($P<0.05$) المأكول من البروتين المهضوم للنعاج التى غذيت على المعاملات T1, T2 , T3 بالمقارنة بالكنترول. كان المأكول من المركبات الكليه المهضومه أعلى معنوياً ($P<0.05$) للنعاج التى غذيت على المعاملات T3, T2 بالمقارنة بالكنترول أو المعاملة T1. كما كانت متوسطات المأكول من البروتين المهضوم والمأكول من المركبات الكليه المهضومه أعلى معنوياً ($P<0.05$) للنعاج التى غذيت على المعاملة (T3) بالمقارنة بالمعاملة T1 أو T2 كل على حدى. أظهرت نتائج الحملان زيادة معنوية ($P<0.01$) فى وزن الميلاد للحملان المولودة للنعاج التى غذيت على المعاملات T2 , T3 بالمقارنة بتلك المولودة للنعاج الكنترول أو المعاملة T1. كانت متوسطات وزن الجسم النهائى ومعدل الزيادة اليومية فى الوزن أعلى معنويا ($P<0.01$) للحملان المولودة للنعاج التى غذيت على المعاملات T1, T2 , T3 بالمقارنة بتلك المولودة للنعاج الكنترول ، كما تحسن معنوياً ($P<0.01$) متوسط وزن الجسم النهائى ومعدل الزيادة اليومية فى الوزن للحملان المولودة للنعاج التى غذيت على المعاملة T3 بالمقارنة بتلك المولودة للنعاج الكنترول أو المعاملة T1.

أوضحت هذه الدراسة أن الإمداد الغذائى بكلا من اليود والسلينيوم أدي إلى زيادة معنوية في كلا من معاملات الهضم و القيمة الغذائية لعلائق النعاج مما أدى إلى تعزيز أداء النمو لحملانها الرضيعة.