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Effect of dosing with different levels of nano-zinc oxide particles with by-products of the molasses industry on the productive performance of Awassi lambs

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***Abstract*---**This experiment conducted to study the effect of a doscing three levels (0,15 and 30)mg /h/day of Nano zinc oxid particles (NP-Zn)] and two kind of by-products date (nucle or peels) in feed intake, digestibility and live weight of Awassi lambs . Twenty four Awassi lambs averaged 23.31±0.74 kg live body weight and aged 3- 4 months. Animal allotted randomly in to six similar groups (4 animals each) to receive one of the experimental diets. The control ration (CR) consisted 68% concentrate + 30 % nucle date or peels date feed mixture (CFM) and alfalfa hay. Experimental treatments were T1, T2 and T3 (nucle date + 0 , 15 and 30 mg Nzo) and T4, T5and T6 (peels date + 0, 15and 30 mg Nzo) respectively. Results indicated that there were no significant differences in the total intake when dosing different levels of nano-zinc oxide with the exception of the intake of ether extract was significantly increased for the diets of date nucel compared to date peels .Also significantly increased ($p \leq 0.05$) in digestibility of crude protein reached to 63.68%with the dose of 15mg/d/day. Interaction appeared significantly increased ($p \leq 0.05$) T2in dry and organic matter digestibility , significant differences ($p \leq 0.01$), as the diets of date nucle outperformed diets of date peels of daily and total weight gain, which were (204.23 gm and 12.86 kg) and (183.46 gm and 11.55 kg), respectively. The experiment showed that dosing different levels of nanozinc has no side effects on animal performance.

***Keywords*---**Awassi lambs, nanozinc oxid, intake, digestibility, gain.

Introduction

Zinc is one of the minerals that is added to animal feed, its proportion in the body is small. It can be a good alternative to traditional sources of zinc in livestock feed. Nano Zn can be used in lower doses in traditional livestock feed to provide better results than zinc sources and prevent pollution indirectly also (Partha,et.al.,2016) .In animals, zinc deficiency causes abnormal corneal formation and limited limb bone growth Nano-zinc oxide (nZnO) is the third highest nano-metal produced globally after nano-SiO2 and nanoTiO2 (Piccinno et al., 2012). nano form of Zinc improved the digestion coefficients of nutrients and feeding values better than the normal particles of LP-Zn(Mohamed,. et al., 2017). Wang et al. (2011) who reported that supplementation of nano -zincoxide can improve the growth of ruminal microorganisms, increase the ruminal microbial.

Material and Methods

Studying the effect of dosing different proportions of (Nzo) Nano zinc oxide 0, 15 and 30 mg / head / day with rations consisting of 30% date seed or 30% date seed, using nano zinc oxide manufactured in the United States of America CAS 1314-13 -2) with a purity of 99.5% and a nano size of 50 nanometers.The experiment was conducted in Al-Hamza Agricultural High School. Twenty four Awassi lambs of 3-4 months of age were purchased, with an average weight of 23.31 ± 0.74 kg lambs were randomly distributed to six experimental treatments T1 T2 T3 (30% date nuclei + 30.15,0 mg Nzo) and T4 T5 T6 (30% in dates + 15.0, 30 mg Nzo)/animal/day four lambs per treatment. Provide concentrate feed with 3% of the body weight and provide roughage feed (alfalfa hay) freely. Ingredients of experimental treatments (%)DM basis (table 1) .The components and chemical composition of the concentrate treatments (dry matter%) (table 2). The chemical analysis of the experimental relationships was carried out (AOAC, 2005). Data statistically analyzed using the general linear model procedure (SAS, 2002).The differences among means tested using Duncan's Multiple-rang test (Duncan, 1955).

Table 1
Ingredients of experimental treatments (%)DM basis

Ingredients	Treatments					
	T1	T2	T3	T4	T5	T6
Date nucle	30.00	30.00	30.00	0.00	0.00	0.00
Date peels	0.00	0.00	0.00	30.00	30.00	30.00
Straw	50.00	50.00	50.00	50.00	50.00	50.00
Yellow corn	8.00	8.00	8.00	8.00	8.00	8.00
Soya bean meal	10.00	10.00	10.00	10.00	10.00	10.00
Salt	1.00	1.00	1.00	1.00	1.00	1.00
Vitamin	1.00	1.00	1.00	1.00	1.00	1.00
All	%100	%100	%100	%100	%100	%100

Table 2
The components and chemical composition of the concentrate treatments (dry matter%)

chemical composition	T1	T2	T3	T4	T5	T6
DM	91.00	91.00	91.00	90.00	90.00	90.00
OM	86.00	86.00	86.00	84.00	84.00	84.00
CP	12.25	12.25	12.25	12.30	12.30	12.30
EE	4.01	4.01	4.01	3.49	3.49	3.49
CF	11.00	11.00	11.00	12.01	12.01	12.01
NFE	58.74	58.74	58.74	56.20	56.20	56.20
ASH	5.00	5.00	5.00	6.01	6.01	6.01
ME/mg/kg *DM	11.48	11.48	11.48	11.02	11.02	11.02

Metabolizable energy (ME) values are estimated according to the following equation of 0.012×CP+0.031×EE+0.005×CF+0.014×NFE MAFF (1975): * T1 T2 T3 (30% date nuclei + 30.15,0 mg Nzo) and T4 T5 T6 (30% in dates + 15.0, 30 mg Nzo)/animal/day :OM=DM-ASH :NFE=OM-(CP+CF+EE).

Result and dissection

The total feed intake and its components based on the body's metabolic weight (g/kg 0.75 weight/day). Table 3 revealed that the interaction between nano zinc oxide particles and ration increased significantly ($p<0.01$) crud protein with T1+T2+T3 and T4 ether extract ,additionally ash with T3+T4+T5respectively . Alimohamady ,et.al(2019) results indicated that, supplementation of Zn in growing lambs improved growth performance, blood antioxidants, and thyroid hormone levels. This is similar to what he found by Aliarabi, et.al.(2015) daily feed intake, Average daily gain and feed efficiency were improved by Zn supplementation . Mallaki et al. (2015) indicated that supplemental 20 mg Zn/kg of DM from Zn peptide (ZnP) significantly increase dry matter intake of lambs. Where, In a later study, Mohamed and Mohamed, (2018) found no effect of zinc in DM intake was not affected by supplementation of different sources of Zn as well as a method of administration. This result was agreed with Nagalakshmi and Himabindu, (2013) on lambs.

Table 3
Effect of dosing at different levels of Nzo (0, 15, and 30 mg/head/day) on the total nutrients intake from total forage based on body metabolic weight (gm/W0.75/day) ± standard error

Treatments	Dry matter	Organic matter	Crud protein	Ether extract	Crud fiber	Nitrogen free extract	Ash	Metabolism energy
T1	87.99 ±2.15	74.00 ±1.79	11.03 ±0.27	3.20 ±0.07a	13.01 ± 0.37b	46.73 ±1.07	3.91 ±0.08 b	9.51 ±0.22
T2	86.61 ±1.03	72.85 ±0.84	10.86 ±0.13	3.15 ±0.03a	12.79 ± 0.20 b	46.03 ±0.49	3.86 ± 0.04b	9.36 ±0.10
T3	88.12 ±2.56	74.11 ±2.10	11.05 ±0.33	3.21 ±0.08a	13.04 ± 0.4b	46.80 ±1.20	3.92 ± 0.09b	9.52 ±0.25
T4	87.34 ±1.75	72.06 ±1.43	11.00 ±0.22	2.83 ±0.05b	13.74 ±0.31 ab	44.48 ±0.85	4.52 ± 0.08a	9.41 ±0.18
T5	88.50 ±1.97	73.03 ±1.61	11.14 ±0.25	2.88 ±0.06b	13.88 ±0.35 ab	45.12 ±0.95	4.59 ± 0.09a	9.54 ±0.20
T6	90.84 ±1.69	74.95 ±1.39	11.44 ±0.21	2.95±0.05b	14.29 ± 0.29a	46.25 ±0.83	4.70 ± 0.08 a	9.79 ±0.17
significant	NS	NS	NS	**	**	NS	**	NS

Different letters within the same column mean the presence of significant differences, GM = no significant differences within the same column * There is a significant difference at the level (0.05) ** There is a significant difference at the level (0.01) T1 = 30% date nucle + 0 mg (Nzo) T2 = 30% date nucle +15 mg (Nzo) T3 = 30% date nucle + 30 mg (Nzo) T4 = 30% date nucle + 0 mg (Nzo) T5= 30% of datepeels + 15 mg (Nzo) T6 = 30% of date peels + 30 mg (Nzo):

Digestion Coefficient

Table 4 shows the interaction between nano zinc oxide and date(nucle and peels) increased significantly ($p<0.05$) in with T2(30% date nucle +15 mg (Nzo) of all nutrients digestibility (table 4) . This is due to the effect of zinc oxide

nanoparticles, which led to an increase in the rumen bacteria, which in turn led to an increase in the digestion coefficient of the diet. This similar to what was found (Wang et al., 2013). Riazi et.al., (2019) showed that adding ZnO or nano-ZnO increase the digestibility of organic matter. Hassan and Abbas(2014) showed that a significant increase in the digestibility of crude protein, crude fiber, nitrogen-free extract and total digested nutrients, the improvement in the coefficient of digestion was positively reflected in the rate of weight gain, which led to an increase in the total and daily weight gain of lambs as shown in (Table 5).

Table 4
Effect of dosing at different levels of Nzo (0, 15, and 30 mg/head/day) on Digestion Coefficient

Treatments	Dry matter	Organic matter	Crud Protein	Ether extract	Crud fiber	Nitrogen free extract	Ash	Metabolism energy	TDN
T1	73.86±0.58ab	74.32 ±0.72ab	57.65 ±2.11b	85.58± 0.69b	67.37 ±1.12 b	79.44 ±.44ab	26.68 ±2.76b	71.30±. 62ab	54.88±0.60ab
T2	78.62 ±1.88a	78.91 ±1.98a	67.14 ±4.15a	89.86 ±1.27a	75.77 ±1.06 a	81.80 ±1.86a	41.15 ±3.49a	76.15 ±2.56a	59.20 ±1.58a
T3	72.45 ±1.39b	73.26 ±1.30b	58.02 ±.83ab	85.08 ±.24ab	68.91 ±1.25 b	77.25 ±.03ab	17.96 ±5.04b	69.80 1.41ab	54.06 ±1.62b
T4	72.35 ±1.39b	72.38 ±1.41b	55.70 ±2.15b	80.04 ±.49bc	68.41 ±2.52 b	77.39 ±.34ab	30.39 ±3.59ab	67.79 ±1.91b	53.92 ±1.25b
T5	72.47 ±2.06b	72.20 ±2.01b	57.47 ±.26b	78.08 ±3.70c	68.87 ±1.99 b	76.71 ±1.62b	34.29 ±7.15ab	67.38 ±2.55b	55.14 ±.23ab
T6	73.09 ±2.13b	73.14 ±2.07b	60.22 ±.96ab	81.17 ±1.83bc	67.27 ±2.38 b	77.78 ±.97ab	32.26 ±6.13ab	68.81 ±2.62b	55.06 1.89ab
Significant	*	*	*	*	*	*	*	*	*

Different letters within the same column mean the presence of significant differences, GM = no significant differences within the same column * There is a significant difference at the level (0.05) ** There is a significant difference at the level (0.01) T1 = 30% date nucle + 0 mg (Nzo) T2 = 30% date nucle +15 mg (Nzo) T3 = 30% date nucle + 30 mg (Nzo) T4 = 30% date nucle + 0 mg (Nzo) T5= 30% of datepeels + 15 mg (Nzo) T6 = 30% of date peels + 30 mg (Nzo):

Weight gain

Table 5 showed the interaction Table (5) showed an increased significant ($p \leq 0.05$) for the live weight gain and total weight gain, as the T2 date nucle treatment with a level of 15 mg/day nano-zinc (222 g/day and 14.02 kg) respectively . This is due to the synergistic action between the ration of date nucleus and the nano-zinc, which led to achieving the best response by the experiment animals, which led to an increase in the digestion coefficient and an increase in the utilization of the ration to lambs as in Table (4). The reason for this may be attributed to the fact that the addition of zinc oxide nanoparticles led to an increase in the coefficient of digestion of food compounds and thus led to a higher daily weight gain for the lambs. Anil et al., (2019) found that adding different sources of zinc of 25 mg of zinc sulfate , 5 mg/kg of nano-zinc oxide and 10 mg/kg of nano-zinc oxide. The

results showed that adding 10 mg/kg of nano-zinc oxide led to a highly significant (P<0.01) increase in total and live weight gain for calves. Pei et al. (2019) mentioned, adding zinc supplements leads to an increase in the length of the villi, which leads to an increase in absorption within the gastrointestinal tract.

Table 5
Effect of dosing at different levels of Nzo (0, 15, and 30 mg/head/day) on the final average weight and total weight gain (kg) and daily (g/day) ± standard error

Effects	initial weight (kg)	final weight (kg)	Live weight gain (g/day)	total gain (kg)
T1	22.95±1.16	35.27±1.33	195±6.36 b	12.32±0.40 b
T2	23.05±1.15	37.2±1.29	222± 2.27 a	14.02±0.14 a
T3	23.25±0.94	35.50±1.17	194± 13.16b	12.25±0.82 b
T4	23.02±0.81	34.52±1.11	182± 5.06b	11.50±0.31 b
T5	23.87±0.82	34.90±1.15	175± 8.20 b	11.02± 0.51 b
T6	23.75±2.78	35.90±2.91	192 ±6.39b	12.15± 0.40 b
significant	NS	NS	*	*

Different letters within the same column mean the presence of significant differences, GM = no significant differences within the same column * There is a significant difference at the level (0.05) ** There is a significant difference at the level (0.01) T1 = 30% date nucle + 0 mg (Nzo) T2 = 30% date nucle +15 mg (Nzo) T3 = 30% date nucle + 30 mg (Nzo) T4 = 30% date nucle + 0 mg (Nzo) T5= 30% of date peels + 15 mg (Nzo) T6 = 30% of date peels + 30 mg (Nzo)

Feed conversion efficiency

There is no significant effect of dosing different levels of nano-zinc oxide in the amount of concentrate feed, total feed, protein and metabolic energy table (6). While showed that there were highly significant differences (p≤0.01), between treatments of dates were superior to treatment T2, but they did not differ significantly from treatments T1 and T3 for the efficiency of food transfer from concentrated and total feed and crude protein (g/day)/weight gain daily (gm/day), and this indicates that the second treatment achieved the highest growth response and the least consumption of food compounds. And the addition of zinc ZnO supplementation with doses less than 50-100 mg/kg dry matter leads to a significant increase in the total bacterial count with an increase in beneficial intestinal bacteria with a significant increase in volatile fatty acids. Pieper et al. (2012). It may be a result of what Garg et al. (2008) mentioned that adding zinc supplements leads to an improvement in the efficiency of food conversion due to the availability of zinc in the digestive system and an increase in the total numbers of bacteria and an increase in the efficiency of benefiting from the ingested ration.

Table 6
Effect of dosing at different levels of Nzo (0, 15, and 30 mg/head/day) on food conversion efficiency, energy conversion efficiency and protein intake for diets (g/day) ± standard error

Effects	Concentrate ration	Total ration	Crude protein(gm) /dily gain (gm)	Metabolism energy(MJ/kg) /crud protein(gm)
T1	4.29 ±0.10ab	5.63±0.13b	0.70 ±0.01 ab	0.07 ±0.00
T2	3.81 ±0.08b	5.00 ±0.12b	0.62 ±0.01b	0.07 ±0.00
T3	4.41±0.31ab	5.79 ±0.41ab	0.72 ±0.05ab	0.07 ±0.00
T4	4.46 ±0.11a	5.95 ±0.16a	0.74 ±0.02a	0.07 ±0.00
T5	4.83 ±0.22a	6.43 ±0.32a	0.80 ±0.04a	0.07 ±0.00
T6	4.49 0.23a	5.98 ±0.29a	0.75±0.03a	0.07 ±0.00
significant	**	**	**	NS

Different letters within the same column mean the presence of significant differences, GM = no significant differences within the same column * There is a significant difference at the level (0.05) ** There is a significant difference at the level (0.01) T1 = 30% date nucle + 0 mg (Nzo) T2 = 30% date nucle +15 mg (Nzo) T3 = 30% date nucle+ 30 mg (Nzo) T4 = 30% date nucle + 0 mg (Nzo) T5= 30% of date peels + 15 mg (Nzo) T6 = 30% of date peels + 30 mg (Nzo)

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