

THE EFFECTS OF DATE STONE MEAL WITH OR WITHOUT ENZYMES SUPPLEMENTATION ON GROWTH PERFORMANCE, NUTRIENT DIGESTIBILITY AND ECONOMICAL EFFICIENCY OF RABBITS

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SUMMARY

A total seventy-five New Zealand White (NZW) weaned rabbits, four weeks age with average body weight 491 ± 2.77 g, were used to investigate impact of multienzymes (EZ) addition to diets containing date stone meal (DSM) on growth performance traits, nutrient digestibility coefficient and economical efficiency of growing rabbits. Rabbit randomly allotted into five experimental groups; each experimental group contains 15 rabbits. The 1st group was fed basal diet and used as control group, which was contained 0% date stone. Rabbits in the 2nd and 3rd groups were fed diets contained 10% DSM (low density diets) either without or with EZ addition, respectively. Rabbits in the 4th and 5th groups were fed diets contained 20% DSM (low density diets) either without or with EZ addition, respectively. Body weight (BW) and feed intake (FI) were weekly recorded and body weight gain (BWG), feed conversion ratio (FCR), production index and economical efficiency were calculated. At the 12 weeks of age, 5 rabbits from each experimental group were taken for the digestibility trial. The results revealed that supplementation of EZ to 10% DSM diets increased significantly ($p < 0.05$) BW, BWG, FI, FCR, economic efficiency and production index compared to control diet. In addition, the groups on the control diet and 10% DSM with EZ group exhibited significantly ($p < 0.05$) greater BW, BWG, FI and better FCR, economic efficiency and production index than the other DSM groups, during periods 4-8 and 4-12 weeks of age. On the other hand, the group on 20% DSM with EZ group showed significantly ($p < 0.05$) greater BW, BWG, FI, FCR, economic efficiency and production index than the 20% DSM without EZ group. Enzyme supplementation to 10% and 20% DSM diets improved significantly ($p < 0.05$) nutrients digestibility coefficient compared to control group. From the present results it can be concluded that date stone meal can be inclusion in rabbit diets up to 20% with adding EZ without adverse effect on rabbit performance and up to 10% with adding EZ to achieve good performance, economical efficiency comparable to control group, under Egyptian environmental conditions.

Keywords: *Rabbits, enzymes, date stone meal, growth performance, digestibility coefficient and economic efficiency.*

INTRODUCTION

In Egypt, there is a serious problem of feed shortage for rabbits. There are also, continuous increases in the prices of the traditional feed ingredients (El-Adawy *et al.*, 2005). Rabbits are herbivores and consume high fiber diets with useless (Cheeke *et al.*, 1982).

Dates are strategic for Egypt, which is the world's top producer of the crop, outranking Iran, Iraq and Saudi Arabia. Egypt's production estimated at 1,465,030 tons of dates yearly, or 17.7% of world production of 7.5 million tons (FAO Statistics, 2014). Depending on variety and quality grade, date fruit contains about 6 to 12% date stones, which is also known as pits, seeds or kernels of date (Masoudi *et al.*, 2011). Date stone has some advantage, as available in Egypt, is cheap and high in energy content. The chemical compositions of date stone include 3.1-7.1% moisture, 2.3-6.4% protein, 5.0-13.2% fat, 0.9-1.8% ash and 22.5- 80.2% dietary fiber. Also, seeds contain high levels of phenolics, anti-oxidants and dietary fibre (Al-Farsi *et al.* 2007 and Masoudi *et al.*, 2011). At the same time is contain 12.53 MJ metabolisable energy (Al-Hiti, 1978).

The date stone meal (DSM) is plentiful in Egypt and can give a potential alternative for energy source in feed ingredients of poultry (Tareen *et al.*, 2017). Dietary inclusion of date stone significantly improved the performance and feed utilization of poultry (Tareen *et al.*, 2017). Furthermore, Soliman *et al.* (2009) reported that DSM might be utilized as a part of rabbit diets without adverse impact on production performance of rabbits. The production performance, feed cost and feed utilization in poultry were improved when included date palm kernel or seed in diets (Zanu *et al.*, 2012 and Abdollahi *et al.*, 2016).

Recently, multienzymes (EZ) were utilized in feed industry to improve nutrient digestibility with considerable success (Shaw *et al.*, 2010; Attia *et al.*, 2014a.; b and El-Kelawy and El-kelawy, 2016). The addition of EZ to diet inclusion of DSM has been shown to be beneficial in poultry (Sundu *et al.*, 2006; Al-Saffar *et al.*, 2013, Attia, and Al-Harhi, 2015) and rabbit diets (Soliman *et al.*, 2009; Ibrahim *et al.*, 2010, El-Manylawi and El-Banna, 2013)

In Egypt, the date palm fruit is abundantly produced especially in the Governorate New Valley. In light of these reports, the present study was carried out to investigate impact of enzymes addition to diets containing date stone meal on some growth performance, nutrient digestibility coefficient and economic efficiency of growing rabbits, under Egyptian environmental conditions.

MATERIALS AND METHODS

The rabbit trial was conducted at Damanhour University, Faculty of Agriculture from Mid-December 2016 to Mid-February 2017 and the chemical analysis was conducted at Assiut University.

Experimental design:

Seventy-five NZW weaned rabbits, four weeks age and 491±2.77g average body weight, were randomly allotted into five experimental groups, each experimental group contains 15 rabbits distributed among 5 replicates (each containing 3 rabbits in cage). The 1st group was used as control and fed control diet contained 0% date stone. Rabbits in the 2nd and 3rd groups were fed diets contained 10% DSM (low density diets) either without or with EZ addition, respectively. Rabbits in the 4th and 5th groups were fed diets contained 20% DSM (low density diets) either without or with EZ addition, respectively. The experimental basal diet was formulated to meet the nutrient requirements of rabbits according to NRC (1977). Ingredients and chemical analysis of the experimental diets are presented in Table (1).

Date stones were obtained from El-Wadi El-Gaded Governorate and processed according to (Al-Harhi *et al.*, 2006) by sun-drying for 72 hours and ground in a heavy-duty high rotation hammer mill to pass through 1 mm. mesh sieve, producing a fine powder suitable for chemical analysis before mixing to the diets. The diets, DSM, barley and wheat bran samples were chemically analyzed for measuring dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF), ash and nitrogen free extract (NFE) according to Association of Official Analytical Chemists (AOAC, 2004).

The rabbits were housed in wire cages (60 × 55 × 40 cm) provided with galvanized feeders and automatic nipple drinkers. The experimental diets were offered to rabbits *ad libitum* and fresh tap water was available to rabbits all the time. Rabbits were kept under the same hygienic and environmental conditions during the experimental period. At 12 week of age, 5 rabbits from each experimental group were taken for the digestibility trial. A total number of 25 male rabbits were housed individually in metabolic cages. Feces and urine were collected separately for four consecutive days. The composite samples of the offered diet and dried feces of each rabbit were chemically analyzed for CP, EE, CF and NFE according to the method of AOAC (2004). During the growing period from 4 to 12 weeks, rabbit BW(g), BWG (g), FI (g), feed conversion ratio (g feed / g gain) were weekly recorded. Economical evaluation for all experimental rations was calculated as described by Zeweil (1996). Production index was calculated as cited by Attia *et al.* (2012) as follows:-

$$PI = \frac{BW(Kg) \times SR}{PP \times FCR} \times 100$$

Where:

PI = Production Index. BW = Body Weight (kg), SR = Survival Rate (100% - mortality) PP = Production Period (days)

Table (1): Ingredients and chemical analysis of the experimental diets.

Ingredients	Control (Diet A)	10%DSM (Diet B)	10%DSM+EZ (Diet C)	20%DSM (Diet D)	20%DSM+EZ (Diet E)
Yellow Corn	11.22	11.22	11.22	11.22	11.22
Barley	15.00	10.00	10.00	10.00	10.00
Wheat bran	23.33	18.33	18.30	8.33	8.30
Alfalfa hay	30.12	30.12	30.10	30.12	30.10
Soya bean meal	17.33	17.33	17.33	17.33	17.33
Date stone meal	0.00	10.00	10.00	20.00	20.00
Vit. + Min. Premix*	0.30	0.30	0.30	0.30	0.30
Salt (NaCl)	0.50	0.50	0.50	0.50	0.50
Dicalcium Phosphate	1.20	1.20	1.20	1.20	1.20
Limestone	1.00	1.00	1.00	1.00	1.00
Enzyme	0.00	0.00	0.05	0.00	0.05
TOTAL	100.00	100.00	100.00	100.00	100.00
Chemical analysis					
Dry matter	87.63	87.18	87.08	87.53	87.53
Ash	6.27	6.54	6.57	6.33	6.30
Crude protein	17.69	17.31	17.36	16.87	16.75
Crude fat	2.91	3.09	3.13	3.55	3.58
Crude fiber	12.78	13.25	13.22	14.07	14.00
NDF	37.02	37.73	37.73	38.29	38.28
ADF	20.67	21.65	21.65	22.43	22.42
Hemicellulose	16.35	16.08	16.08	15.86	15.86
Digestible energy	2542	2508	2508	2480	2480

* Each 3 Kg contain: Vitamin A = 12,000,000 IU, D₃ = 2,200,000 IU, E = 10,000 mg, K₃ = 2,000 mg, B₁ = 1,000 mg, B₂ = 5,000 mg, B₆ = 1,500 mg, B₁₂ = 10 mg, Niacin = 30,000 mg, Biotin = 50 mg, Folic acid = 1,000 mg, Pantothenic acid = 10,000 mg, Zinc = 50,000 mg, Manganese = 60,000 mg, Iron = 30,000 mg, Copper = 4,000 mg, Iodine = 1,000 mg, Selenium = 100 mg, Cobalt = 100 mg, Calcium carbonate to 3 Kg.

**According to feed composition Tables for rabbits (NRC 1977) and Cheeke (1987). [NDF% = 28.924 + 0.657 (%CF), ADF= 9.432+0.912 (CF%)]. Hemicellulose = NDF% - ADF%, according to Cheeke (1987)
DE (M Cal /Kg)=(4.36-0.0491*NDF)].

DSM= Date stones meal.

EZ= Enzyme complex (Kemzyme) contains 300 µg beta-glucanase , 5000 µg cellulase, 450 µg alfa amylase and 450 µg protease and lipase.

Diet A = Basel diet without DSM

Diet B = Died composed of 10%DSM without adding EZ

Diet C = Died composed of 10%DSM plus EZ

Diet D = Died composed of 20%DSM plus EZ

Diet E = Died composed of 30%DSM plus EZ

Statistical analysis

Data were statistically examined by analysis of variance (ANOVA) according to Snedecor and Chochran (1982) using SPSS system (2006). The differences between means were tested by using Duncan's New Multiple Range test, (Duncan, 1955).

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

Where: μ = Overall mean of Y_{ij}, T = Effect of treatment, i = (1, 2, ..., etc) and e_{ij} = Experimental error.

RESULTS AND DISCUSSION

Chemical composition of date stone meal, barley and wheat bran:

Chemical analysis of date stone meal (DSM), barley and wheat bran are presented in Table (2) chemical analysis of DSM showed that the moisture content was 8.23% which may be indicating the ability of store to be as untraditional feed stuff for a longtime without any deleterious effects. Also, previous results illustrated that DSM might be considered as a promising source of energy in poultry feed, as it contained about 88.14 % of the energy content of yellow corn. Al-Harathi *et al.* (2009) and El-Sheikh *et al.* (2013) reported that dietary date is considered as a good source of energy for poultry. However, the remarkable high contents of CF in DSM (17.94%) might be considered as a limiting factor in formulating poultry diets (Sawaya *et al.*, 1984) especially regarding the availability of amino acids (Babatunde *et al.*, 1975). The obtained results agree with those analyzed by Soliman *et al.* (2009); Ibrahim *et al.* (2010); Masoudi *et al.* (2011) and El-Sheikh *et al.* (2013) where they reported nearly same results. Also, Attia and Al-Harathi (2015) showed that the chemical composition of date waste suggests that it's a suitable source of nutrients and energy for chickens. The differences in chemical composition of date stone in comparison with the data shown in literature could be attributed to the variety, maturation stage, dryness degree and agronomic conditions.

Table (2): The chemical analysis of the date stone, barley, and wheat bran.

Composition	Moisture	Crude protein	Ether extract	Crude fiber	Ash	Nitrogen free extract
DSM	8.23	6.38	7.41	17.94	1.42	58.62
Barley	12.20	10.30	1.97	4.60	2.22	68.71
Wheat bran	11.50	14.97	3.40	9.48	4.92	58.40

The apparent digestibility coefficient of the nutrients:

The results for apparent digestibility coefficient of nutrients of NZW rabbits as affected by supplementation of EZ to diets contain DSM are presented in Table (3).

Table (3): Apparent nutrients digestibility coefficient of NZW rabbits fed diets containing different levels of date stones meal (DSM).

Item	Group 1	Group 2	Group 3	Group 4	Group 5	SEM	Sig.
Dry matter	61.7 ^b _c	59.8 ^b _c	68.0 ^a	59.1 ^c	63.2 ^b	1.156	0.002
Organic matter	65.1 ^{abc}	62.8 ^{bc}	68.1 ^a	60.5 ^c	65.5 ^{ab}	1.492	0.019
Crude protein	72.2 ^a	67.5 ^{ab}	73.9 ^a	63.6 ^b	72.3 ^a	2.106	0.014
Crude Fiber	42.4 ^a	36.6 ^{ab}	41.0 ^{ab}	33.1 ^b	42.7 ^a	2.64	0.045
Neutral detergent fiber	35.1 ^{bc}	29.4 ^{cd}	41.3 ^a	28.4 ^d	36.5 ^{ab}	1.97	0.001
Acid Detergent Fiber	31.5 ^{ab}	28.0 ^{bc}	34.5 ^a	25.2 ^c	32.0 ^{ab}	1.942	0.025
Ether extract	46.7	45.6	47.6	43.4	45.6	2.246	0.076
Nitrogen free extract	68.7 ^b	68.1 ^b	73.5 ^a	68.1 ^b	70.3 ^b	0.761	0.003
Digestible crude protein (DCP)	11.7 ^{ab}	10.9 ^{bc}	12.0 ^a	10.3 ^c	11.7 ^{ab}	0.347	0.016
Total digestible nutrients (TDN)	56.7 ^{ab}	54.5 ^{bc}	59.3 ^a	53.3 ^c	57.6 ^a	1.02	0.003

^{a,b} Values within a row with different superscripts differ significantly at $P < 0.05$.

SEM: Standard error of means.

Group 1= Fed diet A (Control) is a basal diet without DSM.

Group 2= Fed diet B composed of 10% DSM without adding enzyme complex (Kemzyme, EZ).

Group 3= Fed diet C composed of 10% DSM plus EZ.

Group 4= Fed diet D composed of 20% DSM without EZ.

Group 5= Fed diet E composed of 20% DSM plus EZ.

The results indicated that EZ supplementation to 10% and 20% DSM contained diets significantly ($p < 0.05$) improved OM, CP, CF, NDF, ADF, TDN and DCP digestibility compared to control diet.

Furthermore, EZ supplementation to 10% DSM contained diet resulted in a significant ($p < 0.05$) greater DM and NFE digestibility than control and other DSM groups. However, difference between the 10% DSM without EZ and 20% DSM with EZ groups was not significant in DM, OM, CP, CF, ADF, NFE, TDN and DCP digestibility.

The result showed the adverse effect on digestion coefficient of nutrients by increasing DSM levels, which may be due to the high CF content which in consequence may reduce digestibility and availability of nutrients (El-Sheikh *et al.*, 2013).

El-Deek *et al.* (2008) and Attia, and Al-Harhi (2015) found that the birds fed diet with 200 g/kg date waste was lower protein digestibility than those fed diets with other minimal levels of date waste. Similarly, apparent ash retention significantly ($p < 0.05$) decreased with the inclusion of different concentrations of date waste in broiler diets compared to controls. However, AL-Harhi (2006) found that replacing maize with date waste in broiler diets significantly decreasing CF digestibility. Moreover, El-Sheikh *et al.* (2013) showed that hens fed on the control group led to significantly improved digestibility of OM, CP, EE and NFE than those fed diets with Azzawi date meal, while digestibility of DM and CF were not significantly affected by Azzawi date meal levels. This finding was disagreement with those obtained by Suliman and Moustafa (2008) They found that digestibility of CP, CF and NFE were significantly ($P < 0.05$) increased for diets containing date pits than control diet. Moreover, Alhomidy *et al.* (2011) found that digestibility of EE, DM, and CP were significantly ($P < 0.05$) higher in the diet containing 30% discarded dates than in the control diet in sheep. However, Al-Harhi *et al.* (2009) revealed that no significant difference in digestibility of CP among the control and all the studied levels of date waste meal. While the lowest value of CF digestibility was noticed for group fed 16% and 20% date waste meal containing diet as compared to that of the control. In addition, incorporating 4% date waste meal resulted in the highest ($P \leq 0.05$) OM and EE digestibility compared with those of the other levels of the tested material and that of the control. Improving EE digestibility may be attributed to the improvement in fatty acid profile of date meal (Mahmoud, 2005). However, Mousa (2013) found that incorporate of date pits in the diet at the rate of 20% did not significantly affect DM, OM, CP, CF and NFE digestibilities. While, increasing the proportion of date pits in the diet to 30% significantly ($P < 0.05$) decreased DM, OM, CP and CF and significantly ($P < 0.05$) increased EE digestibilities compared with control.

The present data demonstrated EZ addition improved ($p < 0.05$) digestibility of nutrients at inclusion levels of 10% and 20% DSM. This finding was agreement with Deek *et al.* (2008) They reported that kemzyme supplemented diets numerically increased the digestibility of nutrients. The benefit gained by the kemzyme addition is largely due to the partial degradation of the soluble β -glucan, which reducing the viscosity of intestinal contents and improving nutrients absorption (Hesselman and Aman, (1986); Rotter *et al.* (1989). Also, these findings agree with El-Manylawi and El-Banna (2013). They reported that adding Allzyme® SSF to the rabbit diets containing 10 or 20% DSM led to numerical increases in the digestibilities of most nutrients compared to the control diet. The reduction in digestibility of the DSM experimental diets without EZ could be due to the high level of non-starch polysaccharides (NSPs). Fasiullah *et al.* (2010) reported that exogenous microbial EZ enhanced digestion of (NSP) breaking down cellulose, hemi-cellulose, pectins and lignified complexes. Thus, leading to improved feed utilization and growth performance. Also, reports by Garcia *et al.* (2005), Falcao-e-Cunha *et al.* (2007) and Bawa *et al.* (2009) showed that EZ supplementation in rabbit diet significantly improved performance and nutrient digestibility. Also, Ibrahim *et al.* (2010) revealed that the addition of a commercial EZ complex slightly improved digestibility coefficients of DM, CP, CF, EE and NFE of date stone. Abaza and Omara (2011) and El-Kelawy and El-Kelawy (2016) revealed that digestibility coefficient of DM, CP, NFE and DCP were significantly ($P < 0.01$) higher with rabbits fed multienzymes diet compared with those fed the control diet. The improvement in rabbits performances with multienzymes can be ascribed to improved nutrient supply to the animal (Gracia *et al.*, 2009); to a reduction in digesta viscosity (Cowan, 2002); and to an improvement in the gut absorptive capacity (Wu *et al.*, 2004).

Growth performance:

Data presented in Table (4) showed the effects of supplementation of EZ to diets contain DSM on growth performance of growing NZW rabbits. The results that the birds fed diet containing 10 and 20% DSM without EZ supplementation had lower ($p < 0.05$) BW and BWG. Supplementation of EZ to 10% DSM contained diets significantly ($p < 0.05$) increased BW at 8 and 12 weeks of age and BWG in all periods in comparison with control diet. In addition, the groups on the control diet and 10% DSM with EZ group exhibited significantly ($p < 0.05$) greater BW and BWG than the other DSM groups during

periods 4-8 and 4-12 weeks of age. On the other hand, the groups on 20% DSM with EZ group showed significantly greater BW and BWG than the 20% DSM without EZ group.

The negative effects of DSM level on rabbit's performance may be due the low protein level of diets and the high fibre level of DSM. Therefore, reduce the digestibility and availability of nutrients. Similarly, Perez *et al.* (2000) and Masoudi *et al.* (2011) indicated that the birds fed diet containing date stone had lower final weight and BWG than control group. This could be because of the high fibre level of DSM and its gritty nature, which diminish digestibility and therefore reduce the availability of nutrients particularly amino acids (Yeong, 1983 and Onwudike, 1986). In addition, Ezieshi and Olomu (2008) found that final BWG of broiler chickens was significantly lower than control when palm kernel meal was included in the diet. Also, Al-Saffar *et al.* (2013) found that adding date stone to laying diets led to decrease performance. However, El-Sheikh *et al.* (2013) reported that final BW and BWG were not significantly affected by Azzawi date meal levels. This finding was inconsistency with Vandepopuliere *et al.* (1995). They found that untreated date stone from 5 to 27% could be supplemented to broiler diets for improve growth performance. Also, Attia and Al-Harhi (2015) reported that diets containing date waste improved broiler performance while the best performance was gotten when adding 50 g/kg of date waste to diet. Tareen *et al.* (2017) who noted that BW of broiler increased significantly with increasing level of date palm kernel.

The present data demonstrated a BW and BWG response to dietary EZ addition. Generally, Enzyme supplementation improved the growth at inclusion levels of 10% and 20% DSM. This may be due to that EZ addition, led to increase digestibility and the availability of nutrients in the low-density diets therefore improved the growth. This finding was agreement with El-Manylawi and El-Banna (2013). They found that this positive impact may be due to the beneficial role of Allzyme® SSF in improving the digestibility of date stones in the experimental diets. Similarly, Soliman *et al.* (2009) and Ibrahim *et al.* (2010) noted that adding EZ to diets contain DSM led to improved rabbit's growth performance. Also, Al-Saffar *et al.* (2013) showed that EZ supplementation improved laying hens' performance which fed diets with different date stone levels. The present results were in concurrence with Ibrahim *et al.* (2010), Abaza and Omara (2011) and El-Kelawy and El-Kelawy (2016). They reported that EZ mixture supplementation improved BWG of rabbits. Enzyme mixture could support the endogenous EZ of the poultry & rabbits (amylase and protease), break down some components of cell wall, which cannot be broken down into absorbable nutrients by endogenous EZ (Tawfeek, 1996 and Tabook *et al.* 2006), reduced nutrient entrapment and releasing other nutrients like minerals (Al-Harhi *et al.*, 2009; Soliman *et al.*, 2009; Ibrahim *et al.*, 2010 and Attia *et al.*, 2012; Attia *et al.*, 2014a and 2014b), which improved the growth performance.

Table (4): Growth performance of NZW rabbits fed diets containing different levels of date stones meal (DSM).

Item	Group 1	Group 2	Group 3	Group 4	Group 5	SEM	Sig.
Body weight (g) at:							
4 weeks	492	496	489	490	486	6.31	0.842
8 weeks	1045 ^a	966 ^b	1054 ^a	930 ^c	975 ^b	7.85	0.008
12 weeks	1885 ^a	1731 ^c	1898 ^a	1656 ^d	1790 ^b	18.6	0.001
Body weight gain (g) from:							
4-8 weeks	553 ^a	470 ^c	565 ^a	440 ^d	489 ^b	4.93	0.002
8-12 weeks	841 ^a	765 ^b	844 ^a	726 ^c	815 ^a	10.79	0.005
4-12weeks	1393 ^a	1235 ^c	1409 ^a	1166 ^d	1304 ^b	13.92	0.006

^{a,b} Values within a row with different superscripts differ significantly at $P < 0.05$.

SEM: Standard error of means.

Group 1= Fed diet A (Control) is a basal diet without DSM.

Group 2= Fed diet B composed of 10% DSM without adding enzyme complex (Kemzyme, EZ).

Group 3= Fed diet C composed of 10% DSM plus EZ.

Group 4= Fed diet D composed of 20% DSM without EZ.

Group 5= Fed diet E composed of 20% DSM plus EZ.

Feed intake and feed conversion ratio:

Data presented in Table (5) showed the effects of supplementation of EZ to diets contain DSM on FI, feed conversion ratio of growing NZW rabbits. The results were indicated that the rabbits fed diet containing 10 and 20% DSM without EZ supplementation had lower FI and less feed conversion ratio

than control group. Supplementation of EZ to 10% DSM contained diets significantly ($p < 0.05$) increased FI and improved feed conversion ratio in all periods compared to control diet. In addition, the groups on the control diet and 10% DSM with EZ group exhibited significantly ($p < 0.05$) greater FI and better feed conversion ratio than the other DSM groups during periods 4-8 and 4-12 weeks of age. On the other hand, the groups on 20% DSM with EZ group showed significantly greater FI and better feed conversion ratio than the 20% DSM without EZ group.

Table (5): Feed intake and feed conversion ratio of NZW rabbits fed diets containing different levels of date stones meal (DSM).

Items\	Group 1	Group 2	Group 3	Group 4	Group 5	SEM	Sig.
Feed intake (g/day) from:							
4-8 weeks	1747 ^a	1617 ^c	1758 ^a	1583 ^d	1655 ^b	1.30	0.005
8-12 weeks	3518 ^a	3503 ^a	3561 ^a	3267 ^b	3498 ^a	30.88	0.019
4-12weeks	5264 ^a	5120 ^b	5319 ^a	4850 ^c	5153 ^b	37.21	0.018
Feed conversion ratio (g feed/g gain) from age:							
4-8 weeks	3.16 ^c	3.44 ^b	3.12 ^c	3.60 ^a	3.39 ^b	0.025	0.002
8-12 weeks	4.19 ^d	4.59 ^a	4.22 ^d	4.51 ^b	4.30 ^c	0.02	0.007
4-12weeks	3.78 ^c	4.15 ^a	3.78 ^c	4.16 ^a	3.96 ^b	0.016	0.001

^{a,b} Values within a row with different superscripts differ significantly at $P < 0.05$.

SEM: Standard error of means.

Group 1= Fed diet A (Control) is a basal diet without DSM.

Group 2= Fed diet B composed of 10% DSM without adding enzyme complex (Kemzyme, EZ).

Group 3= Fed diet C composed of 10% DSM plus EZ.

Group 4= Fed diet D composed of 20% DSM without EZ.

Group 5= Fed diet E composed of 20% DSM plus EZ.

The negative effects of DSM level on rabbits feeding are similar to the reports by Masoudi *et al.* (2011). They revealed that fed date pits to broiler chickens diets decreased FI and increased FCR which indicated poor utilization of diets by the birds, probably due to higher CF levels of the diets containing date stone compared with the control diet. Similarly, Deek *et al.* (2008) found that date waste meal addition in diets impaired FCR of Lohmann White Layers. Also, Attia and Al-Harhi (2015) showed that chicken fed date waste at 50 g/kg lowest FI than control. This finding was dissension with those obtained by Ezieshi and Olomu (2008) and Tareen *et al.* (2017). They showed that date palm kernel addition in diets improved FCR of broilers considerably, which was mainly associated with lower FI to produce highest BW.

The present data demonstrated that enzyme supplementation increased FI and improved FCR at inclusion levels of 10% and 20% DSM. The increase in FI by EZ supplementation led to increased CP intake and associated essential amino acids that were necessary for the optimum performance of birds (Masoudi *et al.*, 2011). These observations coincided with those reported by Al-Saffar *et al.* (2013) showed that EZ supplementations improved FCR of laying hens fed diets with different date stone levels. Also, Deek *et al.* (2008) found that overall kemzyme addition improved FCR by about 5.24% over the kemzyme un-supplemented diets. Furthermore, Ibrahim *et al.*, 2010 indicated that 50% replacement of yellow corn ground date stone (with or without kemzyme) significantly improved FCR of male rabbits during the trial period. Similarly, Abaza and Omara (2011) and El-Kelawy and El-Kelawy (2016) reported that multienzymes supplementation increased FI and improved FCR of rabbits.

Economic efficiency and production index:

Data presented in Table (6) showed the effects of supplementation of EZ to diets contain DSM on economic efficiency and production index of growing NZW rabbits. The results indicated that the rabbits fed diet containing 10 and 20% DSM without EZ supplementation had less economic efficiency and production index than control group. On the other hand, the birds fed diet containing 10 without EZ and 20% DSM with or without EZ had lower feed cost than control and 10% DSM with EZ supplementation groups. Supplementation of EZ to 10% DSM contained diets significantly ($p < 0.05$) improved total revenue, net revenue, economic efficiency and production index in all periods compared to control diet. In addition, the groups on the control diet and 10% DSM with EZ group exhibited significantly better total revenue, net revenue, economic efficiency and production index than the other DSM groups. On the

other hand, the groups on 20% DSM with EZ group showed significantly better total revenue, net revenue, economic efficiency and production index than the 20% DSM without EZ group.

Table (6): Economic efficiency and production index of NZW rabbits fed diets containing different levels of date stones meal (DSM).

Item	Group 1	Group 2	Group 3	Group 4	Group 5	SEM	Sig.
Feed cost	15.79 ^a	14.90 ^b	15.55 ^a	13.68 ^c	14.60 ^b	0.110	0.001
Total revenue	39.70 ^a	34.62 ^c	39.96 ^a	33.12 ^d	35.80 ^b	0.372	0.002
Net revenue	13.91 ^a	9.72 ^c	14.41 ^a	9.44 ^c	11.20 ^b	0.264	0.007
Economic efficiency	53.87 ^b	38.97 ^d	56.37 ^a	39.85 ^d	45.47 ^c	0.846	0.001
Production index	62.56 ^a	46.39 ^c	63.30 ^a	44.23 ^d	50.58 ^b	0.668	0.004

^{a,b} Values within a row with different superscripts differ significantly at $P < 0.05$.

SEM, Standard error of mean's.

Group 1= Fed diet A (Control) is a basal diet without DSM.

Group 2= Fed diet B composed of 10% DSM without adding enzyme complex (Kemzyme, EZ).

Group 3= Fed diet C composed of 10% DSM plus EZ.

Group 4= Fed diet D composed of 20% DSM without EZ.

Group 5= Fed diet E composed of 20% DSM plus EZ.

The present results were indicated that diets containing DSM had less economic efficiency, but lower feed cost than control. This finding was agreement with Abd El-Rahman *et al.* (2003); Abou El-Naser and El-Kerdawy (2003); Masoudi *et al.* (2010) and Mousa (2013). They reported that the total cost of the diet decreased by increasing the portions of date pits in diets. Also, This findings are in agreement with Gaber *et al.* (2012) and El-Manylawi and El-Banna (2013). These decreased in feed cost may be attributed to the inclusion of DSM in the diets due to its low price. Furthermore, El-Sheikh *et al.* (2013) showed that hens fed diet with 40% Azzawi date meal had significantly greater economical efficiency than the control group. Improvement of the economical efficiency values may be attributed to decreased price of Azzawi date meal and the highest BW. However, Toson *et al.* (1995) reported that the inclusion of DSM to replace up to 20% of rabbits basal diet has no adverse impact on economic efficiency of rabbits. This findings are in contradiction with Tareen *et al.* (2017). They noted that the inclusion of date palm kernel in broilers basal diet increased net profit.

The present data demonstrated EZ supplementation improved economic efficiency and production index at inclusion levels of 10% and 20% DSM. This finding was agreement with El-Manylawi and El-Banna (2013) who revealed that adding Allzyme® SSF to the rabbit diets under each experimental tested DSM (10 or 20%) improved the economic efficiency. Furthermore, Ibrahim *et al.* (2010) demonstrated that DSM could be utilized rather than yellow corn (50% substitution) either without or with special kemzyme addition, which lead to best economic efficiency. Also, Abaza and Omara (2011) found that economic efficiency of rabbits was better with EZ addition in diets than without EZ addition. Similarly, El-Kelawy and El-Kelawy (2016) who reported that multienzymes supplementation improved economic efficiency and production index of rabbits.

CONCLUSION

It could be postulated that date stone meal can be inclusion in rabbit diets up to 20% with adding EZ without adverse effect on rabbit performance and up to 10% with adding EZ to achieve good performance and economic efficiency comparable to control group, under Egyptian environmental conditions.

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تأثير مسحوق نوى البلح مع أو بدون إضافة الإنزيمات على الأداء الإنتاجي وهضم العناصر الغذائية والكفاءة الاقتصادية للأرانب النامية

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استخدم عدد خمسة وسبعون أرنب نيوزيلندي أبيض عمر أربع أسابيع ومتوسط وزن 491 جم±2.77 لتقييم تأثير إضافة الإنزيمات لعلائق محتوية على مسحوق نوى البلح على الأداء الإنتاجي وهضم العناصر الغذائية والكفاءة الاقتصادية للأرانب النامية. تم توزيع الأرنب بالتساوي وبشكل عشوائي إلى خمس مجموعات تجريبية، كل مجموعة تحتوي على 15 أرنب. المجموعة الأولى استخدمت كمجموعة كنترول وغذيت على العليقة الكنترول التي لا تحتوي على مسحوق نوى البلح. المجموعة الثانية والثالثة غذيت على عليقة تحتوي على 10% مسحوق نوى البلح بدون أو مع إضافة الإنزيمات على التوالي. المجموعة الرابعة والخامسة غذيت على عليقة تحتوي على 20% مسحوق نوى البلح بدون أو مع إضافة الإنزيمات على التوالي. تم التسجيل الأسبوعي لوزن الجسم والعلف المأكل وتم حساب الزيادة في وزن الجسم ومعامل التحويل الغذائي ودليل الإنتاج والكفاءة الاقتصادية. وعند عمر 12 أسبوع تم أخذ خمسة أرانب من كل مجموعة لإجراء تجربة الهضم. أوضحت النتائج أن إضافة الإنزيمات للعليقة المحتوية على 10% من نوى البلح أدت إلى زيادة معنوية في وزن الجسم وزيادة في وزن الجسم المكتسب والعلف المأكل وتحسن في معامل التحويل الغذائي ودليل الإنتاج والكفاءة الاقتصادية بالمقارنة بعليقة الكنترول بالإضافة إلى أن المجموعة المغذاه على العليقة الكنترول والعليقة المحتوية على 10% مسحوق نوى البلح مع إضافة الإنزيمات أظهرت أعلى وزن للجسم وزيادة في وزن الجسم المكتسب والعلف المأكل وأفضل معامل تحويل غذائي ودليل إنتاج وكفاءة اقتصادية بالمقارنة بالمجموعات المغذاه على مسحوق نوى البلح خلال الفترات من 4-8 و 4-12 أسبوع من العمر. من ناحية أخرى أظهرت المجموعة المغذاه على عليقة تحتوي على 20% نوى البلح مع إضافة الإنزيمات سجلت أعلى وزن للجسم وزيادة في وزن الجسم المكتسب والعلف المأكل وأفضل معامل تحويل غذائي ودليل إنتاج وكفاءة اقتصادية بالمقارنة بالمجموعة المغذاه على عليقة تحتوي على 20% مسحوق نوى البلح بدون إضافة الإنزيمات. وأدت إضافة الإنزيمات للعليقة المحتوية على 10 و 20% من مسحوق نوى البلح إلى تحسين معامل هضم العناصر الغذائية بالمقارنة مع عليقة الكنترول .

من هذه الدراسة يمكن ان نستنتج أن إضافة مسحوق نوى البلح في علائق الأرانب حتى 20% مع إضافة الإنزيمات بدون أي آثار سلبية على أداء الأرانب وأدت إضافة 10% مسحوق نوى البلح مع إضافة الإنزيمات للعلائق إلى أفضل أداء وكفاءة اقتصادية مقارنة بالمجموعة الكنترول تحت الظروف البيئية المصرية.