RABBIT GROWTH PERFOMANCE AS AFFECTED BY DIETARY LEVELS OF DATE WASTE MEAL

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SUMMARY

This study was performed during the period from April to June 2014 (90 days), at Maryout Research Station belongs to Desert Research Center (DRC), Ministry of Agriculture and Land Reclamation, in cooporation with Environmental Sustainable Development Department, Environmental Studies & Research Institute (ESRI), University of Sadat City, Menofiea Governorate, Egypt. It was conducted to investigate the effect of incorporating different levels of dietary date waste meal (DWM) at 0.0, 10, 20, 30 and 40% of the diet with or without adding zylam (Z) on feed intake and body weight gain of New White Zealand (NZW) rabbits. Sixty growing NZW rabbits (30 males and 30 females) aged 8 weeks with anaverage weight 1.530±0.36 kg for both two sexes were used in this study. Both sexes were divided into five equal groups (6 in each) according to the level of DWM replacement (0.0 C, 10 T_1, 20 T_2, 30 T_3 and 40 T_4%). Each group was divided into two groups (3 in each) according to adding enzyme (with or without). Group T_2Z significantly ($p<0.05$) recorded the best digestion coefficient values (74.66; 74.91; 87.64; 52.8; 83.18 and 79.46 % for DM; OM, CP, CF; EE and NFE, respectively) comparing with control and other experimental diets, while at 40% DWM with zylam (T_4Z group) was the worst one. Digestibility of DM, OM, CP, EE and NFE significantly ($p<0.05$) decreased by increasing dietary DWM levels. Group fed 20% dietary DWM with zylam (T_2Z) significantly ($p<0.05$) recorded a best digestible nutrients and nutritive values [TDN (66.88 %) and NB (2.7%)] compared with control and other experimental groups. Inclusion of date waste meal (DWM) at 10% recorded significantly ($p<0.05$) an increase in final live body weight (LBW) compared with 30% and 40%. Insignificant ($p>0.05$) differences were detected between treated and control group for feed conversion ratio (FCR). Insignificant differences were observed for different dietary levels of DWM on cholesterol, triglycerides, ALT, AST.and not negatively affected liver activity or rabbit's health**.** Conclusively, it could be concluded that diets containing up to 20% of date waste meal (DWM) and supplemented with 1g zylam during growing period could be used safely in rabbit diets during growing period.

Keywords: *Date palm, digestibility, growing rabbits, performance and blood parameters*

INTRODUCTION

Rabbits have high efficiency in the meat production compared to other farm animals. Rabbits provide an excellent source of protein for human consumption and may play an important role in solving the meat shortage problem in developing countries (Abdel-Azeem *et al.,* 2007). According to Jiao *et al.* (2014), there is a moderate positive genetic correlation between growth and feed intake as well as average daily gain and feed conversion ratio. It is well known that large number of factors can affect the dry matter intake of animals. These include breed, age, physiological status, palatability of the feed and others. Dates, the fruits of the date palm tree (*phoenix dactylifera*) are major staple food in arid areas of North Africa and Middle East, as the date crop plays role in the economy and social life in these regions (FAO, 2007). Whole dates contain approximately 15% pits, and their value of energy is significantly lower than that of pitted dates and date pulp (Jassim and Naji, 2010). Exogenous enzymes bind temporally to one or more of the reactants which they catalyze and so lower the amount of energy needed thereby, speeding up the reaction (El-Deek *et al.,* 2008 and Ibrahim *et al.,* 2010). Ogunsipe (2014) found that enzyme supplemented diets of cross-breed rabbits improved nutrients digestibility and utilization as evidenced in the feed conversion ratio and weight gain of the experimental rabbits. Although the use of date waste has been mainly in ruminant feeds, many studies have been conducted on feeding broiler on date waste meal (DWM) and led to an improvement in broiler performance (Al-Harthi *et al.,* 2009; El-Sheikh *et al.* 2013 and Fadare, 2015). The current study aimed to investigate the effects of incoporating DWM at different

levels (0.0, 10, 20, 30 and 40%) with or without Zylam (0.1%) in rabbit's diets on growth performance, nutrients digestibility, blood serum parameters and economical efficiency under desert environmental conditions.

MATERIALS AND METHODS

The present study was carried out from April to June 2014 at Maryout Research Station (Poultry Production Sector), which belongs to Desert Research Center, Ministry of Agriculture and Land Reclamation, Egypt.

Animals, housing and experimental design

The study involved sixty growing White New Zealand (NZW) rabbits (30 males and 30 females), aged 8 weeks with initial mean weight 1.530±0.36 kg for both two sexes. The animals divided on the basis of their sex into two main equally groups. Each gender was divided into five equal groups (0.0, 10, 20, 30 and 40% of date waste meal) according to the replacement level of date waste meal (DWM) in diet then each group was allotted into two sub-groups (3 replicates of each) according to adding Zylam to diets (with or without). The study lasted three months period (from April till June, 2014), All animals were individually housed in galvanized wire cages (50 x 55 x 39 cm) provided with a feeder and automatic nipple drinker, and were kept under the same managerial conditions.

Five formulated diets of 17% crude protein contained 0.0, 10, 20, 30 and 40% of date waste meal in diet with or without Zylam supplementation (0.1%) were investigated on growth performance, some blood biochemical parameters and nutrients digestibility of NZW rabbits as follows (Table 1):

Table (1). Experimental design of the study.

Experimental groups in both males (30) and females (30)	
3 replications in each	3 replications in each
0.0% DWM without Zylam (CC)	0.0% DWM with Zylam (CZ)
10% DWM without Zylam (T_1C)	10% DWM with Zylam (T_1Z)
20%, DWM without Zylam (T_2C)	20% DWM with Zylam (T_2Z)
30% DWM without Zylam (T_3C)	30% DWM with Zylam (T_3Z)
40% DWM without Zylam (T_4C)	40% DWM with Zylam (T_4Z)

DWM= date waste meal, Zylam was added at level of 0.1%.

Date waste male (DWM) preparation

Low quality of date palm had been used as a source of energy, protein and fiber at 0.0, 10, 20, 30 and 40% of the diet. Date palm was obtained through a dealer in Siwa Oasis that collecting different varieties of date palm, which classified as a by- product feedstuff according to palatability (less for human). The whole date palm was sun dried to reduce moisture content, and then ground by electrical mill with stones. Water content of dry date flesh and date pits was determined according to the methods of Official Analytical Chemists (AOAC, 2000). Ash and minerals contents in powdered flesh or pit were determined using muffle furnace at about 530°C for 5 hours. Ashes were expressed as percent of dry weight.

Experimental diets

Table (2) shows the composition of experimental diets which were used for feeding. Date waste male (DWM**)** was incorporated in diets at 0.0, 10, 20, 30 and 40% replacing clover hay, wheat bran and yellow corn. The diets were kept iso-nitrogeneous and isocaloric in the experiment. Dates were dried in an automatic oven at (60 ºC) for 24 hours, after that dates were ready to be grinded with crushing.

It is well known that ,enzymes are added to animal ration with the goal of increasing its digestibility, removing anti-nutritional factors, improving nutrient availability as well for environmental issues (Al-Harthi, 2006 and El-Deek *et al*., 2003), therefore Zylam that contain Amylase 160.000, Xylanase 1.500.00, Cellulase 1.000.000, B. Glucanase 100.000 U/g are added to the above diets.

Table (2). Formulation and chemical analysis of the experimental diets.

Ingredients	Control (CC) 0.0% DWM	T_1 10% DWM	T_2 20% DWM	T_3 30% DWM	T_4 40% DWM
Clover Hay	25.00	25.00	30.00	22.00	07.50
Wheat bran	26.00	30.00	25.50	04.00	-
Date Waste meal	-	10.00	20.00	30.00	40.00
Barley grains ,Ground	20.00	14.50	01.50	-	-
Soybean meal (44% CP)	13.50	14.50	16.50	25.00	28.00
Yellow corn, ground	10.00	-	-	-	-
Wheat straw	01.50	02.00	02.50	-	-
Clover Straw	-	-	-	15.00	20.50
Dl-Methionine	00.35	00.35	00.35	00.35	00.35
Premix*	00.50	00.50	00.50	00.50	00.50
Na Cl	00.35	00.35	00.35	00.35	00.35
Di calcium phosphate	01.90	01.90	01.90	01.90	01.90
CaCO3	00.90	00.90	00.90	00.90	00.90
Zylam**	(-)(+)	(-)(+)	(-)(+)	(-)(+)	(-)(+)
Total (kg)	100	100	100	100	100
*Calculated values****					
Crude protein %	17.24	17.26	17.12	17.39	16.51
ME, kcal/kg diet	2520	2523	2538	2516	2533
Crude fiber %	12.00	13.14	14.25	15.67	14.31
Ether extract %	2.59	02.45	02.33	01.65	01.43
Calcium %	01.10	01.21	01.32	01.43	01.45
Available phosphorus	00.41	00.46	00.52	00.58	00.61
Lysine %	00.81	00.84	00.87	00.95	00.95
Methionine	00.60	00.59	00.59	00.58	00.56
Determined values :					
Crude protein %	17.43	16.98	17.33	17.36	16.75
Crude fiber %	12.74	12.53	13.54	14.01	13.82
Ether extract %	03.11	02.55	02.86	03.01	02.76
DE, *(Mcal/kg)** diet	02.37	02.54	02.51	02.49	02.50
Cost/kg of diet in L.E. ****	02.73	02.38	02.31	02.44	02.45

**The premix (Vit. & Min.) was added at a rate of 3 kg per ton of diet and supplied the following per kg of diet (as mg or I.U. per kg of diet): Vit. A 12000 I.U., Vit. D3 2000 I.U., Vit. E 40 mg, Vit. K3 4 mg, Vit. B1 3 mg, Vit. B2 6 mg, Vit. B6 4 mg, Vit. B12 0.03 mg, Niacin 30 mg, Biotin 0.08 mg, Pantothenic acid 12 mg, Folic acid 1.5 mg, Choline chloride 700 mg, Mn 80 mg, Cu 10 mg, Se 0.2 mg, I 40 mg, Fe 40 mg, Zn 70 mg and Co 0.25mg.*

*** Each Experimental diet devided into 2 patches: the frist Patch not-supplemented with **Zylam (-)** and the other supplemented with 0.1% Zylam (+)*

****According to Feed Composition Tables for animal & poultry feedstuffs used in Egypt (2001) and NRC (1994).*
*****According to market prices of the year 2014.*

Individual body weight was taken weekly to the nearest ± 2.0 g by digital weighing scale (Mettler Toledo, Top Pan Sensitive Balance, J. Liang Int. Ltd. U.K.). The measurements were taken while the animals were held in a standing position.

Individual body weight gain (BWG) for each rabbit was calculated at 2, 4, 6, 8, 10 and 12 weeks of experimental period by subtracting the initial LBW of a certain period from the final LBW of the same period, as follows:- $BWG = W_2 - W_1$

Where: W_1 = LBW at the onset of a certain period.

W_2 = LBW at the end of the same period.

Feed intake (FI) for each replicate under each treatment was weekly calculated, on a group basis, by subtracting the residual feed from the offered one. Average daily feed intake per rabbit was then calculated by using the following equations:

$$\text{FI/rabbit/day} = \frac{\text{FI / replicate/week}}{\text{No. of rabbits consumed feed daily during the week period}}$$

The feed conversion ration (FCR) values (using the weight of mortality to correct FI data), weekly and allover the experimental period were calculated for each replicate under each treatment by using the following formula:

$$\text{FCR} = \frac{\text{FI (g)/replicate during a certain period}}{\text{LBWG (g)/replicate during the same period}}$$

The performance index (PI) ,weekly and for the whole experimental period, was calculated for each replicate under each treatment according **the equation reported by North (1981) as follows:**

$$\textbf{PI} = \frac{LBW\ (kg)}{FCR} \times \mathbf{100}$$

Table (3): Proximate Analysis (DM basis %), Fiber fractions, g/kg DM and energy value of DWM.

Component	% DM basis
Dry matter (DM)	89.30
Organic matter (OM)	96.31
Crude protein (CP)	05.85
Ether extract (EE)	01.96
Crud fiber(CF)	07.58
Nitrogen free extract (NFE)	80.92
Ash	03.69
Calcium (Ca),	00.91
Total Phosphorus (p),	00.64
Methionine ,	00.92
Lysine ,	00.31
Fiber fractions , g/kg DM:*	
NDF	33.90
ADF	80.12
ADL	93.71
Hemi-cellulose	46.22
Cellulose	13.59
DE (Mcal/kg)**	02.70

**NDF: neutral detergent fiber; ADF: Acid detergent fiber; ADL: Acid detergent lignin.*

***DE(Mcal/kg) = 4.36 – 0.049 x NDF, NDF% = 28.924 +0.657 (CF%) according to Cheeke et al. (1982).*

Chemical analyses

Proximate analysis of the diets, feedstuffs and feces were analyzed according to AOAC (2000) methods. All chemical analyses for feedstuffs and dried feces samples were carried out at Central Laboratory for Feed and Food, Agricultural Research Centre, Ministry of Agriculture. Nitrogen free extract (NFE) on DM basis was calculated by the difference [NFE = 100 - (CP% + EE% + Ash% + CF %)].

Plasma biochemical analysis

Total plasma protein (g/dl) was determined colorimetrically using Buriet method as described by Cannon *et al.* (1974).

Plasma albumin content (g/dl) was determined by colorimetric method using bromocresol green at pH 4.2. The optical density of the standard or the samples was measured at wave length 628 nm according to the method described by Daumas (1971). The concentration of plasma globulin (g/dl) was

estimated by subtracting plasma albumin from plasma total proteins. Albumin/Globulin ratio (A/G ratio) was calculated as follows:

A/G ratio = {Plasma albumin (g/dl) / Plasma globulins (g/dl)} x 100.

Plasma total cholesterol (CHO) concentration (mg/dl) was determined according to the method of Watson (1960). Plasma triglycerides (Tri) concentration (mg/dl) was determined according to Trinder (1969).

In order to evaluate the liver function under the effects of the physiological and nutritional factors, the plasma enzymes concentrations (u/l) of both alanine amino transferase (ALT) and aspartate aminotransferase (AST) were assayed according to Reitman and Frankel (1957).

Statistical analysis

The statistical analysis for the feeding trials were performed by using the general linear model (GLM) procedures according to SAS (2006) and significant mean differences between treatment means were distinguished by Duncan's Multiple Range Test (Duncan, 1955). All statements of significance were based on $P \leq 0.05$. The statistical model used in this experiment was as following:

$Y_{ijkl} = \mu + t_i + s_j + z_k + (t*s)_{ij} + (t*z)_{ik} + (s*z)_{jk} + (t*s*z)_{ijk} + e_{ijkl}$.

Where,

Y_{ijkl} is the dependent variable of the n^{th} record in the i^{th} Date waste meal, j^{th} sex, k^{th} Enzym;

μ is the overall mean,

t_i is the effect of the i^{th} Date waste meal, I (level) = 1 (10%), 2 (20%), 3 (30%) and 4 (40%);

s_j is the effect of the j^{th} sex, j = 1 (male) to 2 (female);

z_k is the effect of the k^{th} enzyme, k = 1 (with enzym) to 2 (without enzym);

$(t*s)_{ij}$ is the effect of interaction between the i^{th} Date waste meal level and the j^{th} sex;

$(t*z)_{ik}$ is the effect of interaction between the i^{th} Date waste meal level and the k^{th} enzyme;

$(s*z)_{jk}$ is the effect of interaction between the j^{th} sex and the k^{th} enzyme

$(t*s*z)_{ijk}$ is the effect of interaction between the i^{th} Date waste meal level, the j^{th} sex and the k^{th} enzyme;

e_{ijkl} is the effect of experimental random error, associated with each observation assumed to be normally and independently distributed with 0 mean and variance $\sigma_e^2 I$.

RESULTS AND DISCUSSION

Chemical analysis of date waste meal (DWM)

Chemical analysis (on DM basis %) of date waste meal (DWM) are presented in Table (3). Analyzed data showed that, it had a considerable amount of crude protein (5.85%) with low level of ether extract (1.96%). Also, it contained high level of crude fiber (7.58%) which consists mainly of NDF (33.90g/kg); ADF (80.12g/kg); ADL (93.71g/kg); Cellulose (82.46g/kg); and hemi-cellulose (5.42 g/kg)) and nitrogen free extract (80.94%). This means that DWM might be considered as a promising source of energy and dietary fiber in poultry and rabbits diets. Similar results were reported earlier by (Al-Homidan, 2003 and Al-Harthi *et al*., 2009) and recently by El-Sheikh *et al.* (2013) and (2015) who reported that date are considered as a good energy source for poultry. However, the remarkable high contents of crude fiber (7.58 %) and its fractions 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).

It was observed that chemical composition varies between cultivars of the same species and genotype. Furthermore, the agronomic cultivation conditions such as factors of environment prior to harvest and storage conditions after harvest can influence on chemical composition of DWM according to El-Sheikh *et al*. (2013 and 2015), who reported that chemical composition of DWM might vary according to the date type, maturity stage of the fruit and conditions relating to the circumstances of the experiment.

Chemical composition of tested diets

Chemical analyses of experimental diets (as fed) are shown in Table (4).

Table (4). Chemical composition (Proximate analysis) of experimental rations (as fed).

Item	DM %	Moisture %	OM %	CP %	CF %	EE %	NFE %	Ash %	DE *(Mcal/kg)**
Ration1	92.23	7.77	79.37	17.43	12.74	3.11	46.09	12.86	2.37
Ration2	89.85	10.15	78.10	16.98	12.53	2.55	46.04	11.75	2.54
Ration3	90.86	9.14	76.83	17.33	13.54	2.86	43.10	14.03	2.51
Ration4	91.97	8.03	77.84	17.36	14.01	3.01	43.46	14.13	2.49
Ration5	92.86	7.14	78.93	16.75	13.82	2.76	45.60	13.93	2.50

**DE (Mcal/kg) = 4.36 – 0.049 x NDF, NDF% = 28.924 +0.657 (CF %) according to (Cheeke et al., 1982).*

Nutrient digestion coefficients and feeding value of experimental diets

Results illustrated in Table (5) revealed that the digestion coefficients of dietary DM were significantly ($p<0.05$) higher among groups fed 0.0 (control); 10 and 20% DWM diets than those contain 30 or 40% dietary DWM and also, showed the adverse effect on digestion coefficient of nutrients by increasing DWM levels, which may be attributed to the high crude fiber content in DWM, which in consequence may reduce digestibility and availability of nutrients. The same trend was observed with CP and CF digestion coefficients and TDN. Data indicated that group fed 20% dietary DWM with zylam (T_2Z) significantly ($p<0.05$) recorded the best digestibility values (74.66, 74.91, 87.64, 52.8, 83.18, 79.46 and 66.88 % for DM, OM, CP, CF, EE, NFE and TDN, respectively) comparing with control and other experimental diets, while the level of 40% DWM with zylam (T_4Z) group was the worst one. With the same trend, results detected that dietary enzyme supplementation significantly ($p<0.05$) improved digestibility coefficients values for dietary nutrients. Rabbits fed 1g enzym (Zylam) showed higher ($P<0.05$) digestion coefficients of DM, OM, CP, CF, EE and NFE. The same trend was observed with TDN. These findings are in agreement with those obtained by El-Sheikh *et al* (2015) who noted that all digestion coefficients and nutritive values improved by using enzyme treatments. Also, These findings are agree with those reported by (Najib *et al.,* 1995) who found that hens fed the control group recorded significantly the best digestion coefficient of OM, CP, EE and NFE compared to 10, 20, 30 and 40% ADM. Taha *et al.* (2013) found that protein digestibility was significantly decreased when date waste was fed at 20% compared to the other levels of date waste.

Nitrogen balance

Data of nitrogen intake (NI), fecal nitrogen (FN), urinary nitrogen (UN), nitrogen retention (NR) and biological value (BV) are presented Table (6). Results showed that group fed 20% DWM with zylam (T_2Z) recorded significantly ($p<0.05$) higher values of NI, NR and BV values being 3.05g, 2.70g and 88.35%, respectively) where the group fed 30% dietary DWM without zylam (T_3C) significantly ($p<0.05$) recorded the worst BV (49.6%) (Table 6). These results indicated that increasing the availability of nutrients causing an improvement in digestion coefficients and nutritive values. Some additives and treatments may counteract some of these problems, for example enzyme mixture could support the endogenous enzymes of the poultry (amylase and protease), break down of components in cell wall, which can't be broken down into absorbable nutrients by endogenous enzymes, lowering the gastrointestinal viscosity in digestive tract, reducing nutrient entrapment and releasing other nutrients like minerals (El-Sheikh *et al*., 2015).

Growth performance

Live Body weight (FBW) and body weight gain (BWG)

Data in Table (7) showed that, date waste meal (DWM) inclusion at 10% indicated a significant ($p<0.05$) increase in final live body weight (FLBW) compared with 30% and 40%, while it presented insignificant ($p>0.05$) increase compared to control group and 20%.

Tables 5-6

Table (7). Means ± SE of final live body weight (FLBW), total gain (TG), total feed intake (TFI), feed conversion (FCR) and performance index (PI) of growing rabbit as affected by different levels of dietary date waste meal (DWM) with or without enzyme.

Item	FLBW	TG	TFI	FCR	PI
DWM Level effect					
Control	2.66^{a}±0.11	1.07±0.13	7.32^{ab}±0.11	7.48^{b}±1.06	39.45^{ab}±5.13
10%	2.85^{a}±0.11	1.23±0.13	7.48^{a}±0.11	6.76^{b}±1.06	47.59^{a}±5.13
20%	2.55^{ab}±0.11	0.99±0.13	7.48^{a}±0.11	8.40^{ab}±1.06	34.47^{ab}±5.13
30%	2.23^{bc}±0.11	0.84±0.13	7.51^{a}±0.11	10.72^{a}±1.12	25.40^{b}±5.45
40%	2.07^{c}±0.11	0.92 ±0.13	7.06^{b}±0.11	8.11^{ab}±1.19	29.53^{b}±5.74
Sg.	*	NS	*	*	*
Sex Effect					
M	2.49±0.07	1.01±0.08	7.30±0.07	8.17±0.69	36.46±3.33
F	2.46±0.07	1.01±0.08	7.44±0.07	8.42±0.70	34.11±3.41
Sg.	NS	NS	NS	NS	NS
Enzyme Effect:					
With:	2.55±0.07	1.09±0.08	7.40±0.07	8.39±0.67	38.82±3.25
Without:	2.40±0.07	0.93±0.08	7.33±0.07	8.19±0.72	31.75±3.48
Sg.	NS	NS	NS	NS	NS

a, b,..etc.: Means in the same column with different letters, differ significantly (P<0.05). NS= not significant.

These results are in agreement with Ali *et al.* (1999) who found that powdered date pits addition at a concentration of 14% significantly increased the body weight of rats. On the other hand, El-Sheikh *et al.* (2013) found that final body weight; body weight change and feed consumption were not affected significantly by Azzawi date meal (ADM) as a non-conventional feedstuff in local laying hen diets at 10, 20, 30, and 40% inclusion of the diet.

The findings in Table (7) shows that date waste meal inclusion at 10% reflected an increase in total gain compared with control group and the other levels of DWM with no significant differences (p>0.05). This result confirms those obtained by Hussein *et al.* (1998) who found that the use of dates and date pits in broiler starter and finisher diets improved the body weight, total body weight gain, and feed utilization efficiency in chicks. Regarding total weight gain, there was no significant difference between male and female. Also, all levels of DWM with adding enzyme showed insignificant (p>0.05) increase in total weight gain compared with groups without enzyme supplementation. These results are not consistant with those obtained by Choct *et al. (*1996) who reported that the various effects of enzyme supplementation in the digestive process are usually reflected by a considerable improvement of growth and feed conversion rates of poultry. Al-Homidan (2003) reported that adding date to broiler diets tend to increase weight gain. Also, Al-Harthi (2006) found that date waste meal can be used up to 21% in the diets of broilers. Another study by Al-Mafragy (1999) also proved that *Al-Zahdi* date addition leads to high increase in weight gain. They found that date waste can be fed to broilers up to 20% in the growing-finishing period during 21–40 days of age without negative effects on growth performance.

The enhancement in BWG due to enzymes mixture supplementation was reported by Tawfeek (1996) on growing rabbits and Gracia *et al* (2005) on broilers and recently by El-Sheikh *et al* (2015) on ducks. The positive effect of enzyme supplementation could be explained on the basis that enzymes mixture has specific enzymes such as xylanase, cellulase and B-glucanase. These multi-enzymes could exert a partial hydrolysis of some anti-nutritional factors in DWM (pentosans and cellulose) and hence, increase the availability of nutrients causing an improvement in live body weight (Lazaro *et al.*, 2004).

Total feed intake (TFI), feed conversion ratio (FCR) and performance index (PI)

Data illustrated in Table (7) showed that DWM inclusion at 10%, 20% and 30% reflected an insignificant increase (p>0.05) in total feed intake compared with control group. DWM inclusion at 40% reflected a significant decrease (p<0.05) in total feed intake compared with 10%, 20% and 30% while, it reflected an insignificant decrease (p>0.05) compared with control group. These results are in agreement with those detected by Al-Bowait and Al-Sultan (2007) and Al-Shami and Mohammed (2009) who showed that date pits inclusion in broiler diets increased feed intake when compared with control group.

There was no significant (p<0.05) difference in total feed intake as affected by male and female during the experimental period. Also, groups fed diets with enzyme supplementation showed insignificant

(P<0.05) increase in total feed intake during the experimental period compared with those fed diets without enzyme supplementation.

The results of Table (7) cleared that, DWM inclusion at 10% achieved insignificant difference among feed conversion compared with control group, 20% and 40% (6.76 *vs* 7.48, 8.40 and 8.11). A significant difference (p<0.05) was detected with rabbits group fed dietary 30% compared to control group (10.72 *vs* 7.48). These results are in agreement with those obtained by Al-Bowait and Al-Sultan (2007) and Al-Shami and Mohammed (2009) who found that date pits inclusion in broiler diet increased feed intake when compared with control group.

Also, results in Table (7) showed insignificant difference among feed conversion (FC) between males and females during experimental period. It was observed that enzyme supplementation achieved insignificant (p<0.05) improvements in total FCR compared with those without enzyme supplementation (Table 7).

Data of performance index values presented in Table (7) showed that DWM inclusion at 10% were reflected an increase (p<0.05) in performance index compared with control and other experimental groups (20, 30% and 40%), but with insignificant difference (p<0.05) between 10%, control group and 20% .While, there was a significant difference (p<0.05) between 10% versus 30% and 40% of date waste meal (DWM).

The same table showed that control group reflected an insignificant increase (p<0.05) in PI compared with 20%, 30% and 40% of date waste meal (DWM). These results are consistent with AL-Shami and Mohammed (2009) who stated that rejected date addition (15, 30 or 45%) deteriorated PI when compared with the control.

Also, there was no significant difference (p<0.05) in PI between male and female (Table 7). The same table showed that with adding enzyme reflected a non significant increase in PI (p<0.05) compared with that without adding enzyme**.**

Blood plasma parameters

Data in Table (8) showed that total protein (TP) and Globulin (G) concentrations of plasma increased, while Albumin and Albumin/Globulin ratio (A/G) decreased (P < 0.05) in rabbits fed 30 and 40% level of DWM inclusion in their diets in relative to rabbits fed the other levels (10 and 20%) and control group. This result is in agreement with Mohammed (2013) who stated that, there were significant (P < 0.05) effects of date palm in the diet on serum total protein, albumin and globulin that may be due to the improvement in nutrient utilization especially protein and sugars of dates which are easily digested and absorbed. The values of the present study were in the range of normal values defined for these parameters by previous studies (Özkan *et al.*, 2012) in rabbits.

The results of Table (8) showed no significant differences of including different levels of DWM in the diets on cholesterol, triglycerides, ALT and AST. These results are in agreement with Abdel-Fattah *et al.* (2012) who found that inclusion of crushed date palm (CDP) in concentrate feed mixture (CFM) at 50% (weight/weight) did not affect the activities of plasma ALT and AST and subsequently on liver function of growing Barki lambs.

The average values of blood plasma parameters concentrations for rabbits fed diets with adding zylam were nearly similar with the average values of rabbits fed diets without adding zylam (Table 8).

Regarding the effect of sex, the results obtained (Table 8) indicated that there was no significant difference between male and female for all blood plasma parameters. This result is in agreement with Abdel-Azeem *et al.* (2007) who found that sex had no significant effects on plasma total protein (TP), albumin (A), globulin concentration (G), albumin/globulin ratio (A/G) and triglycerides.

These results of blood plasma parameters indicated that inclusion different levels of DWN in the rations of rabbits were not negatively affected liver activity or rabbit's health**.**

Mortality rate

There were no death losses during the whole experimental period niether for the rabbit fed on control rations as the major source of fiber nor did the groups received different levels of dietary DWM. This may be an indication that growing rabbits can utilize different dietary levels of DWM.

Economical efficiency

The economical importance of poultry feeding becomes apparent, because it is well-established that feed, as a main input in poultry industry, represent about 60% to 75% of the total cost (Oladeebo and

Tables 8-9

Ambe-Lamidi, 2007). Data of economical efficiency (EE) and relative economical efficiency (REE) estimated for the different treatments during experiment are shown in Table (9). According to the input-output, economical efficiency and relative economical efficiency ranged between 0.07 to 0.76 and 31.82 to 345.46%, respectively for the control and the experimental treatments. The best value for EE and REE had been recorded by rabbits group fed diet contained 10% DWM and supplemented with 1g zylam (T1Z) ((0.76 and 345.46%) compared to the control without enzyme supplementation or control (CC) (0.22 and 100%). Also, data cleared that groups fed 40% DWM with enzyme supplementation recorded better values for EE and REE (0.37 and 168.18% vs. 0.15 and 68.18%) than those fed the same dietary levels without enzyme supplementation. This could be due to the good role of zylam toward the high fiber fractions content of DWM. With respect to relative economical efficiency, the best value (345.46%) had been recorded by rabbits group fed diet contained 10% DWM with enzyme supplementation.

These improvements of the EE and REE values may be due to low price of DWM and the highest weight gain of growing rabbits. These results are agree with those obtained by El-Sheikh *et al* (2013) who found that hens fed 40% DWM recorded the best economical efficiency and relative economical efficiency. Also, El-Sheikh *et al*. (2015) revealed that improvement of the EE and REE values may be due to low price of DWM and the highest weight gain of duckling. On the other hand, Masoudi *et al*. (2011) reported that use of date pits reduces the cost of diets but had no significant effect on meat cost. Thus, date pits may be used in poultry rations in replacement of maize, but there are no profits unless when access to corn is limited. It could be concluded that the tested diets can be used for growing rabbits without adverse effect, except diets T3Z (30% DWN + enzyme) and T4C (40% DWM without enzyme) which recorded 31.82% and 68.18% REE, respectively.

CONCLUSION

In general, based on the obtained results reported in this study, DWM can be incorporated in rabbit diets up to 20% with adding zylam (0.1%) to achieve improvement in live body weight. These results are indicators to the possibility of using date palm wastes without adverse effect on growth performance, digestibility coefficients, blood serum parameters and economical efficiency in rabbits feeding at the desert areas and the new-reclaimed lands.

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تأثير إضافة مستويات مختلفة من مخلف البلح على آداء الأرانب النامية

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أجريت تلك الدراسة فى الفترة من شهر إبريل حتى شهر يونيو 2014م بمحطة كنج مريوط – مركز بحوث الصحراء – وزارة الزراعة بالتعاون مع قسم التنمية المتواصلة للبيئة وادارة مشروعاتها – معهد الدراسات والبحوث البيئية – جامعة مدينة السادات – مصر. كان الهدف من هذه الدراسة هو بحث تأثير إضافة مستويات مختلفة من مخلف البلح بنسب صفر ، 10% ، 20% ، 30% ، 40% من العليقة ، مع إضافة أو بدون إضافة إنزيم الزيلام على اداء الأرانب النيوزيلندى البيضاء النامية . أستخدم فى هذه الدراسة عدد 60 أرنب نيوزيلاندى (30 ذكر و30 أنثى) عمر 8 أسابيع بمتوسط وزن 1.53 كجم لكل من الجنسين. تم توزيع كل من الجنسين إلى 5 مجموعات متساوية (6 أرانب فى كل مجموعة) وفقا لمستوى الإحلال من مخلف البلح (صفر (كنترول) ، 10% (المعاملة الأولى) ، 20% (المعاملة الثانية) ، 30% (المعاملة الثالثة) ، 40% (المعاملة الرابعة). قسمت كل مجموعة إلى مكررين (3 أرانب فى كل مجموعة) وفقا لإضافة الإنزيم (إضافة وبدون إضافة). أوضحت النتائج أن قيم معامل الهضم كانت أفضل معنويا (عند مستوى 5%) فى مجموعة المعاملة الثانية بالإنزيم لكل من المادة الجافة والمادة العضوية والبروتين الخام والألياف الخام والدهن الخام والكربوهيدرات الذائبة (74.66% ،74.91% ، 87.64% ، 52.8% ، 83.18% ، 79.46% على التوالى) بالمقارنة بمجموعة الكنترول والمجموعات الأخرى فى حين كانت مجموعة المعاملة الرابعة بالأنزيم الأسوأ. انخفض معنويا (عند مستوى 5%) معامل الهضم لكل من المادة الجافة والمادة العضوية والبروتين الخام والدهن الخام والكربوهيدرات الذائبة بزيادة مستويات مخلف البلح. المجموعة المغذاه على 20% من مخلف البلح مع إضافة الإنزيم سجلت تحسنا – معنويا أحسن مركبات مهضومة وأحسن قيمة غذائية (قيمة المركبات الكلية المهضومة 66.88% ، ميزان النتروجين 2.7%) بالمقارنة بمجموعة الكنترول والمجموعات الأخرى للتجربة. إضافة مخلف البلح بنسبة 10% سجل زيادة معنوية (عند مستوى معنوية 5%) فى الوزن النهائى للجسم بالمقارنة بمجموعة الـ 30% ، 40%. لم تسجل فروق معنوية بين المجموعات المعاملة ومجموعة الكنترول بالنسبة للكفاءة التحويلية . لوحظ عدم وجود فروق معنوية بين المستويات المختلفة من مخلف البلح فى تأثيرها على كل من الكوليسترول والدهون الثلاثية وإنزيمات الكبد وإضافتها لم يؤثر سلبيا على نشاط الكبد أو الصحة العامة للأرانب . نستخلص من هذه الدراسة أن العلائق المحتوية على مخلف البلح حتى 20% والمضاف لها 1 جم من إنزيم الزيلام يمكن أن تستخدم بأمان فى علائق الأرانب خلال فترة النمو.