Egypt. Poult. Sci. Vol (28) (IV) (1003-1022)

EFFECT OF USING COMMERCIAL ENZYMES ON PERFORMANCE AND SOME METABOLIC FUNCTIONS OF RABBITS FED GRADE LEVELS OF CRUDE FIBER

BY

Abd El-Latif , S. A. , Kh. A. Mohammed, Kawsar A. Ghaly and Maha A. Abd El-Latif

Dep of Animal prod, Fac of Agric, Minia University.

Received: 06/08/2008 **Accepted**:16/10/2008

ABSTRACT: *A total number of thirty two males and females, 35 to 40 days old growing New Zealand White (NWZ) rabbits were performed to investigate the effect of feeding rabbits on 8 diets with grade levels 10, 13, 16 and 19% of crude fiber (CF) incorporated with or without some enzymes (Caplix commercial product for multienzymes) supplementation at the level of 0.5 ml / 1 litter water (as recommended by producing company) on performance, digestibility, some metabolic functions and the economic efficiency. Rabbits were divided equally into 8 groups containing 4 rabbits each. Each group contained 4 replicates, of one rabbit. The first four treatment groups were distributed to contain 10, 13, 16 and 19% fiber levels without enzymes. While, the other four treatment groups were distributed to contain the same previous fiber levels with enzymes. The experiment was terminated when birds were 17 weeks old (12 weeks of treatments). Body weight, weight gain and feed intake were recorded. Feed conversion (feed / gain) was calculated. At the end of the experiment blood samples were taken to determine some blood serum constituents and rabbits were kept for the digestibility experiment. The economic efficiency values were calculated.*

The data revealed that, rabbits fed dietary containing low (10 and 13%) fiber levels either with or without enzymes improve live body weight and body gain as compared dietary with high (16 and 19%) levels of crude fiber. Adding enzymes supplemention improved body weight gain for rabbits fed dietary 10% CF during the entire period. Adding enzymes reduced feed intake for rabbits fed dietary CF at all levels (10, 13, 16 and 19 %) compared with other same dietary CF without enzymes additions, during all experimental period. Feed conversion efficiency improved for rabbits fed (10 or 13 %) CF either with or without providing enzymes compared with rabbits fed high fiber diets (16 and 19% CF). Rabbits fed 10% CF and *provided with enzymes recorded better (P<0.05) values of dry mater (DM), crude protein (CP) and crude fiber (CF) digestibility. Also, it recorded the best total protein (TP) , total globulin (TG) total lipids (TL) and glucose compared with other dietary levels of fiber. The higher values of (GOT) and (GPT) was recorded for rabbits fed dietary 16% CF and providing with enzymes compared with other dietary enzyme. The greatest total revenue and profit were calculated for rabbits fed diet contain 10% CF and provided with enzymes as compared with other dietary treatments. .*

INTRODUCTION

Many attempts have been undertaken in order to improve the utilization of diet nutrients by adding dietary supplementation of several growth feed additives from different sources (Boulos et al.,1992, Dorgham et al., 1994, El-Gendi et al., 1994, Ibrahim et al., 1998 and Abdel-Azeem, 2002). Enzymes are organic catalysts which used as different feed additive in poultry and monogastric animal diets. Using enzymes are found to improve the performance of intestines, and elevating the nutritive value of the diets of monogastric animals (Tawfeek, 1996 and Bedford and Morgan, 1996). The addition of dietary enzymes preparation could be largely attributed to the degradation of the viscosity of intestinal digesta (Sullivan, 1987, and Easter, 1988) in diets which contain of a high level of non-starsh polysaccharides (NSP). The use of enzymes in animal feeds are becoming more common. Reasons for this include; lower costs of commercial enzyme preparations, improved enzymes for animal feeds, and a better understanding of the composition of the anti-nutritive compounds.

In order to obtain maximal benefits from enzyme inclusion in animal feeds, it is necessary to ensure that the enzymes are chosen on the basis of the feed composition. Simply put, the enzyme must be matched to the substrate. Enzyme cocktails containing

more than one enzyme will often improve the response compared to pure, single enzymes, assuming that cost considerations are not ignored.

New Zealand White rabbits fed diets incorporating kemzyme or optizyme recorded an improvement in body weight and weight gain as compared with the control diet (El- Katacha et al. 1988 , Tawfeek, 1996 , Ibrahim et al., 1999, and Ibrahim, 2000). Moreover, Sarhan (2001) found that adding 500 mg Kemzyme or Optizyme / kg to growing rabbits diet significantly improved live body weight at 9 and 13 weeks of age. Eiben et al., (2002) fed NZW rabbits diets contain four levels of cellulose complex (52.8, 35.20, 11.99 and 0 FPU/kg diet) and they found that the body weight increased at 77 days of age by 0.4 to 1 % compared to the control group. Gutierrez et al., (2002**)** showed that body gain of rabbits was increased by 3.1 % as a result of included Porzyme and NSP digesting enzyme (Xylanase , Pectinase) from 25 to 39 days of age diets.

Makled *et al.,* (2005) fed rabbits on diets incorporating supplementation of 0, 500 and 750 mg Kemzyme /kg feed. They found an improvement (P>0.05) in live body weight at 6 , 8 , 10 and 12 wks of age due to adding 500 mg Optizyme / kg feed to rabbits diet. In contrast, rabbits fed the high level of Optizyme (750 mg/kg feed) recorded significant decrease in live body weight at 8 wks of age. feed intake insignificantly increased during the periods from 6 to 8 and from 8 to 10 weeks of age as affect of adding enzymes . Rabbits (10 months old) fed diet incorporate 500 and 750 mg/kg, increased (P<0.05) the digestibility coefficients of dry matter, organic mater, crude protein, crude fiber and ether extract compared with the control diet but it had no significant effect on digestibility coefficient of nitrogen free extract .

Ronaled (2007), found that supplementation rabbits diet with multi-enzymes (Protozin) causes increases the hemoglobin and leukocyte level in the blood of the experimental animals**.**

The present study performed to evaluate the effect of feeding NZW rabbits 8 diets with different levels 10, 13, 16 and 19% of CF incorporated with or without some enzymes supplementation (0.5 ml / 1 litter water) on growth performance, digestibility, metabolic functions and the economic efficiency.

MATERIAL AND METHODS

Rabbits:

A total number of thirty two males and females aged, 35 to 40 days old growing NZW rabbits were randomly distributed into (8 treatments x 4 replicates x 1 rabbit = 32). All rabbits were housed in open house. The individual rabbit was allocated in a cage with slatted floor of iron (45 × 45 × 38 cm) for length, width and high, respectively. Feed and water given to the rabbits *ad-libitum* during the experimental periods (5 to 17 weeks of age).

Diets:

Rabbits were fed 8 diets with different levels of fiber (10, 13, 16 and 19%) supplemented without or without enzymes in drinking water (0.5ml Caplix /1 litter water). All experimental diets are formulated to contain adequate levels of nutrients for growing New Zealand White rabbits as recommended by the National Research Council, (**NRC, 1994)**.

The composition and analysis of dietary treatments for all rabbits are shown in Table (1). The compositions of Caplix enzymes as reported on the packet of enzyme are reported in Table (2).

Table 1: The composition and analysis of dietary treatments

Ingredients	Crude fiber levels (%)			
	10	13	16	19
Yellow corn	34.6	26.5	13	2.1
Soybean meal	22	21	19.75	17.6
Wheat bran	7.5	5.0	0.25	0.25
Barley	6.0	4.7	1.7	0.25
Clover hay	28	43	58	70
Vegetable oil	0.1	2.5	5.5	8.0
Limestone	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5
Premix **	0.3	0.3	0.3	0.3
Total	100	100	100	100
Chemical and proximate analysis				
Crude protein*	17.80	18.10	17.90	18.00
Crude Fiber *	9.6	12.9	16.15	19.07
ME (K.Cal/Kg)	2448	2485	2422	2387
Calcium	0.797	0.665	0.864	1.420
Av. phosphorus	0.438	0.186	0.275	0.184
Lysine	0.958	0.979	0.959	0.935
Methionine	0.282	0.208	0.269	0.258
Cystine	0.288	0.274	0.251	0.240

*Proximate analyses

** Premix : Each 2.5 kg of vitamins and minerals mixture contain : 12000.000 IU vitamin A acetate ; 2000.000 IU vitamin D3 ; 10.000 mg vitamin E acetate ; 2000 mg vitamin K3 ; 100 mg vitamin B1 ; 4000 mg vitamin B2; 1500 mg vitamin B6 ; 10 mg vitamin B12 ; 10.000 mg Pantothenic acid ; 20.000 mg Nicotinic acid ; 1000 mg folic acid ; 50 mg Biotin ; 500.000 mg Chorine ; 10.000 mg Copper ; 1000 mg Iodine ; 300.00 mg Iron ; 55.000 mg Manganese ; 55.000 mg Zinc , and 100 mg Selenium .

Table (2) : The composition of (Caplix) enzymes*

Component	**I U**
Cellulase	100000000
Amylase	250000
Arabinase	7000
Pectinase	30000
Protease	400000
Lipase	6500
Xylanase	1500000
Beta glucanase	10000
Alpha galactosidase	10000

* caplix is a commercial enzymes produced by (WOCKHARDT LIMITED) wockhardt towrs, bandra-kurla complex, bandra (E), Mumbai-400 051

Measurements and determinations:

Live boy weight, body weight gain and feed intake were recorded for rabbits biweekly and feed conversion values (feed, g/gain, g) were calculated. At the end of experiment (17 weeks of age), blood samples from randomly 3 rabbits of each treatment, were collected in unheparinized tubes and centrifuged at 3000rpm /15minutes. The surm was obtained and immediately stored at -20^{o} C till analysis. Total protein, albumin, total lipids and glucose were determined according to Gornal et al., (1949), Doumas (1971), Trinder, (1969) and Zollner and Kirsch 1962). The total globulin values were calculated by subtracting the values of total albumin from the values of total protein for each sample.

At the end of the experiment, three rabbits from each treatment were housed individually and used in the digestibility experiment. The collection period lasted for 5 days. Feed intake was measured and feces output was collected daily. Hair and scattered feed were separated or taken out of the feces. The collected feces of each

treatment was pooled together, and then dried at 60º C till constant weight. The dried feces for the successive five days were left few hours to get equilibrium with it in the atmosphere then, ground, well mixed and stored in screw-top glass jars for analysis.

The chemical analysis of diets and feces for DM, EE, CP, CF, NFE and ash were conducted according to AOAC (1999).

ANOVA and LSD procedures were performed as outlined be Snedecor and Cochran, (1980).

RESULTS AND DISCUSSION

Growth performance:

The effects of enzymes on live body weight, body weight gain, feed intake and feed conversion (feed/gain) are shown in Table (3). The data revealed that using enzymes for rabbits fed diet contain 10% C. F. improved ($P<0.05$) live body weight, and body gain compared with other high dietary fiber levels (16 and 19% C.F.) with the same level of enzyme . The highest ($P<0.05$) values of live body weight was found for rabbits fed dietary 13% C.F followed by those fed dietary 10% C.F. with enzyme addition during the period from 0 to 8 weeks of treatment. While, rabbits fed high level of CF (19%) with enzyme recorded the lowest ($P<0.05$) value of body weight gain compared with other rabbits fed enzymatic treatments. Feed intake was reduced (($P<0.05$) for rabbits fed dietary crude fiber at all levels with enzymes compared with other same dietary crude fiber without enzymes additions. During the period from 0 to 12 weeks of treatments, rabbits fed 10% crude fiber with Caplix multi-enzymes recorded the highest value of feed conversion compared with other fiber levels. As this may be due to increasing body weight gain and decreasing feed intake for rabbits provided enzymes. The lowest ($P<0.05$) feed conversion was noticed for rabbits fed 19% CF without enzyme compared with all dietary treatments.

The improvement in live body weight and body gain rabbits fed enzyme supplementation may be due to the enhancing effect of Caplix enzymes in microflora growth in gut and cecum as well as increase in volatile fatty acids production and

organic matter digestibility**.** In addition, adding a multiple enzymes product (Optizyme) which contain protease amylogulcosidase Xylanases , β - glucannase , cellulase and

hemicellulase monogastric animal diets suffer from under utilization of nutrients due to absence of enzymes necessary for hydrolyzing non-starch polysaccharides in the foregut, reduces the viscosity of intestinal content and improves nutrients absorption **(Sullivan , 1987**). Moreover, **Makled et al., (2005)** reported that the increase of total protein content in blood plasma as affect of adding Optizyme supplemented may be associated with the noticed improvement in crude protein digestibility this may explain the improvement in growth performance as a result of optizyme supplemented groups. Sarhan (2001) found that under Egyptian conditions, feeding rabbits diet supplemented with 0.5 g/kg of either kemzyme or Optizyme (multi enzyme mixtures). significantly improved daily weight gain from 5 to 9 and from 5 to 13 weeks of age.

The reduction in feed intake as affected by provided rabbits fed crude fiber levels with enzymes in drinking water, may be due to the effect of glucanases with galactanase and pectinase activities in improving the digestibility of the NSPs and increase metabolisable energy content of the diet (Kocher et al., 2002) which may affect in reducing feed intake. Makled et al., (2005) found that average daily feed intake of rabbits during the growth period from 6 to 12 weeks of experimental period was increased due to adding optizyme at a levels of 500 or 750 mg / kg feed.

The enhancement in feed conversion efficiency as a result of adding enzymes may be due to the effect of enzymes in improving the digestibility of nutrients (El-mandy et al., 2002). The present results of feed conversion efficiency are agree with the fending of Valente et al., (1999) mentioned an advantage only in FCR with supplementation at 0.05 % Cellulase and protease activity enzyme complex (VEGPRO) in the diet of rabbits weaned at 40 days of age . Sarhan (2001) found that feed conversion ratio significantly improved during the periods from 8 to 10 and from 10 to 12 weeks of age due to Optizyme supplementation .

Table (3) : Effect of dietary treatments on live body weight (gm), body gain, feed intake and feed conversion of growing New Zealand White rabbits

Items	Age/ weeks	Treatments							
		Fiber levels (without enzymes)				Fiber levels (with enzymes)			
		10%	**13%**	**16%**	**19%**	**10%**	**13%**	**16%**	**19%**
	0	1203^{a} ±99.41	1198^{a} ±33.85	1194^{a} ±90.33	1195^{a} ±136.00	1193^{a} ±120.40	1191^{a} ±78.88	1196^{a} ±128.60	1193^{a} ±130.0
	4	1732^{ab} ±37.85	1877^{a} ±43.42	1496^{abc} ±97.48	1373^{c} ±224.6	1866^{a} ±184.9	1612^{abc} ±91.080	1554^{abc} ±142.40	1405^{bc} ±181.40
	8	2358^{ab} ±96.020	2528^{a} ±73.83	1988^{cd} ±63.05	1832^{cd} ±157.40	2413^{ab} ±144.4	2116^{bc} ±21.37	1920^{cd} ±115.2	1775^{d} ±141.00
	12	2688^{a} ±124.8	2805^{a} ±62.92	2225^{bc} ±75.00	2218^{bc} ±176.20	2816^{a} ±199.10	2488^{ab} ±23.94	2202^{bc} ±98.48	2138^{c} ±108.75
Body gain, gm	**0 to 4**	1155^{a} ±57.56	679.0^{a} ±65.88	302.5^{d} ±85.88	279.0^{d} ±24.83	673.3^{ab} ±78.09	421.3^{bcd} ±65.79	358.8^{cd} ±36.04	282.3^{d} ±73.94
	0 to 8	1155^{a} ±54.43	1330^{a} ±95.18	794.3^{bc} ±102.3	738.3^{bc} ±87.7	1220^{a} ±53.32	937.3^{b} ±60.18	724.8^{c} ±56.72	653.03^{c} ±57.63
	0 to 12	1485^{ab} ±135.3	1607^{a} ±91.49	1031^{d} ±71.92	1123^{cd} ±64.73	1623^{a} ±89.19	1297^{bc} ±73.12	1006^{d} ±43.05	1015^{d} ±82.70
Feed intake, gm	**0 to 4**	2620^{ab} ±171.7	3120^{a} ±239.7	2280^{abc} ±554.5	2242^{bc} ±194.1	2240^{bc} ±291.3	1740^{c} ±143.2	1513^{c} ±56.62	1733^{c}± 373.5
	0 to 8	5858^{abc} ±183.3	6538^{ab} ±212.5	5828^{abc} ±626.2	6798^{a} ±699.4	5400^{cd} ±447	4987^{c} ±263.5	4790^{c} ±155.6	4933^{c} ±606.5
	0 to 12	9325^{bc} ±166.6	9998^{b} ±206.5	9255^{bc} ±518.5	11778^{a} ±522.2	7512^{d} ±210.2	8290^{cd} ±340.3	7680^{d} ±285.0	8103^{cd} ±752.1
Feed conversion, (g, feed / gm, gain)	**0 to 4**	4.950^{bc} ±0.665	4.590^{c} ±0.327	7.530^{a} ±0.899	8.03^{a} ±0.060	3.900^{c} ±0.207	4.130^{c} ±0.537	4.210^{c} ±0.431	6.130^{ab} ±1.315
	0 to 8	5.070^{c} ±0.285	4.915^{c} ±0.375	7.340^{b} ±0.416	9.210^{a} ±0.244	4.420^{c} ±0.260	5.320^{c} ±0.366	6.601^{b} ±0.410	7.560^{b} ±0.546
	0 to 12	6.270^{cd} ±0.626	6.222^{d} ±0.354	8.970^{b} ±0.611	10.48^{a} ±0.155	4.617^{d} ±0.167	6.390^{cd} ±0.325	7.630^{bc} ±0.323	7.980^{b} ±0.775

Means within rows with no common superscripts are significantly different (P<0.05).

Table(4): Effect of dietary treatments on digestibility of nutrients of growing New Zealand White rabbits

Items	Treatments							
	Fiber levels (without enzymes)				Fiber levels (with enzymes)			
	10%	13%	16%	19%	10%	13%	16%	19%
DM	69.21[ab] ±1.15	68.42[abc] ±0.796	64.54[bcd] ±0.177	53.81[e] ±1.276	71.88[a] ±0.436	69.74[ab] ±1.187	64.07[cd] ±4.041	61.83[d] ±0.544
OM	68.98[a] ±1.228	67.67[a] ±0.818	62.52[b] ±0.123	49.09[c] ±1.394	70.95[a] ±0.449	69.49[a] ±1.194	62.21[b] ±4.259	57.90[b] ±0.597
CP	62.29[a] ±0.802	58.15[ab] ±1.064	52.11[b] ±5.952	41.50[c] ±1.608	63.08[a] ±1.396	62.60[a] ±0.755	53.13[b] ±0.154	56.76[ab] ±0.619
CF	18.52[d] ±1.115	27.44[cd] ±1.83	26.62[cd] ±0.234	7.960[e] ±0.265	40.18[ab] ±0.153	49.00[a] ±1.251	39.60[ab] ±9.109	31.22[bc] ±0.982
EE	76.17[d] ±0.891	87.46[a] ±0.176	86.42[ab] ±0.040	82.99[c] ±1.030	77.14[d] ±0.764	85.15[bc] ±0.651	87.11[ab] ±1.462	87.73[a] ±0.326
NFE	78.97[a] ±0.783	78.78[a] ±0.532	74.21[bc] ±0.0819	62.50[d] ±1.250	77.58[ab] ±0.770	76.98[ab] ±0.920	71.70[c] ±3.184	63.78[d] ±0.513

Means within rows with no common superscripts are significantly different (P<0.05).

Table (5) :Effect of dietary treatments on some metabolic functions of growing New Zealand Wight rabbits

Treatments								
Item	Fiber levels (without enzyme)				Fiber levels (with enzyme)			
	10%	13%	16%	19%	10%	13%	16%	19%
Total protein (g/dl)	5.173[bc] ±0.573	5.39[abc] ±0.1002	4.253[bc] ±0.160	4.137[c] ±0.489	6.607[a] ±0.751	5.18[bc] ±0.949	5.074[bc] ±0.188	5.590[ab] ±0.603
Total albumin (g/dl)	3.037[ab] ±0.320	2.947[ab] ±0.202	2.510[b] ±0.142	3.023[ab] ±0.241	2.803[ab] ±0.283	3.313[a] ±0.145	2.820[ab] ±0.142	3.020[ab] ±0.203
Total globulin (g/dl)	2.137[bc] ±0.265	2.443[bc] ±0.136	1.743[bc] ±0.155	1.113[c] ±0.298	3.803[a] ±0.806	1.867[bc] ±0.319	2.227[bc] ±0.928	2.570[ab] ±0.429
Glucose (mg/dl)	141.0[bcd] ±0.577	137.7[cd] ±1.453	137.0[cd] ±3.786	135.3[d] ±2.333	148.0[a] ±2.646	146.3[ab] ±0.881	142.3[abc] ±1.202	137.3[cd] ±1.202

Means within rows with no common superscripts are significantly different (P<0.05).

Table (6) : Effect of dietary treatments on liver enzymes; Glutamic-Oxaloacetic-Transaminase (GOT), Glutamic-Pyruvic Transaminase (GPT); and total lipids of growing New Zealand White rabbits

Treatments								
Item	Fiber levels (without enzyme)				Fiber levels (with enzyme)			
	10%	13%	16%	19%	10%	13%	16%	19%
GOT (IU/I)	35.75[c] ±2.129	43.41[b] ±1.521	46.57[b] ±1.399	29.55 d ±0.550	35.77[c] 0.333	53.67[a] ±2.605	±55.80[a] ±2.289	33.58[cd] ±1.829
GPT (IU/I)	20.08[bc] ±4.072	22.86[abc] ±1.777	23.72[ab] ±0.915	20.40[b] ±1.822	15.34[c] ±3.744	24.99[ab] ±3.380	29.99[a] ±0.680	23.33[ab] ±1.011
Total lipids (g/dl)	9.063[ab] ±1.163	6.903[ab] ±1.755	6.133[c] ±0.886	5.770[c] ±0.588	10.60[a] ±0.612	8.277[ab] ±0.922	6.637[b] ±0.343	6.957[ab] ±2.49

Means within rows with no common superscripts are significantly different (P<0.05).

Table (7): Effect of dietary treatments on economic efficiency of the experimental diets (L.E in 2007) of growing New Zealand white rabbit

Treatments								
Items	Fiber levels (without enzymes)				Fiber levels (with enzymes)			
	10%	13%	16%	19%	10%	13%	16%	19%
Price of 1 kg diet	1.01	0.88	0.715	0.579	1.01	0.88	0.715	0.579
Total F.I (0-12)	9.325	9.998	9.255	11.778	7.511	8.289	7.680	8.102
Total cost of FI (0-12)	9.418	8.87	6.617	6.819	7.58	7.294	5.491	4.691
TotalW.I (0-12)	18.65	19.996	18.510	23.556	15.02	16.57	15.36	16.20
Total cost of W. I *	0	0	0	0	0.9	0.99	0.92	0.97
Purchase price	15	15	15	15	15	15	15	15
Total cost	24.42	23.87	21.61	21.83	23.48	23.29	21.42	20.66
L.B.W (0-12)	2.67	2.80	2.23	2.22	2.82	2.49	2.20	2.19
Price of 1 kg L.B.W	17	17	17	17	17	17	17	17
Revenue	45.73	47.60	37.91	37.74	47.94	42.33	37.43	36.38
Profit	21.31	24.24	16.24	15.91	24.50	19.04	15.98	15.72

FI = feed intake WI = water intake L.B.W. = live body weight

***** The level of enzymes supplementation was 0.5ml enzymes /1 litter water and we are considered that rabbits consumed water twice as feed intake. Also, Price of 1 ml Caplix enzymes =0.12 L.E

From this study it could be concluded that providing enzymes(Caplix) at the level of 0.5 ml / 1 litter in drinking water could be enhanced the performance, digestibility, metabolic functions and economic efficiency for rabbits fed dietary 10 % crude fiber followed by 13% CF. Adding enzymes to NZW rabbits diet incorporating high fiber diets i.e. 16 or 19% CF had no benefit on rabbit performance.

Digestibility coefficients:

The effect of dietary treatments on digestibility coefficiency of nutrients are presented in table (4). The data revealed that rabbits fed on dietary crude fiber (10%) and provided with enzymes recorded better (P<0.05) values of DM, OM, and CP, digestibility compared with other dietary crude fiber. While rabbits fed 19% CF with Caplix enzymes addition recorded the best (P<0.05) value of EE digestibility compared with other dietary fiber and rabbits fed dietary 13% CF recorded the better

(P<0.05) of CF digestibility. Rabbits fed dietary fibers without enzymes additions recorded the highest (P<0.05) values of DM, OM, CP and NFE digestibility when rabbits fed diet contain 10% CF, while rabbits fed 13% CF recorded the best (P<0.05) value of CF and EE digestibility as compared with other dietary fiber levels without enzymes addition.

In general, it could be noticed that adding enzymes (Caplix) improved (P<0.05) digestibility of all nutrients specific crude fiber in the presence of high levels of CF in rabbit diets (16 and 19%). Moreover, the lowest (P<0.05) digestibility of CF was recorded for rabbits fed the high level of CF (19%) without enzymes addition.

The enhancement in digestibility nutrients of rabbits fed enzymes supplementation, may be due to the enhancing effect of enzymes on microflora growth in gut and cecum as well as increase in volatile fatty acids production and organic matter digestibility. Also, the enzymes may improve the release of cell bound nutrients, improve the activity of gut ecology and nutritive values expressed as DCP , TPN and DE **(Makled et al., 2005)**. In addition, the improvement in digestibility coefficients of most nutrients especially CP and CF fiber may be due to the presence of Xylanase, protease, cellulase and amylase in (Caplix) enzymes (Table 4) which may improve the digestion .Parallel to our reported results Makled et al., (2005) found that some improvement in digestibility coefficients of most nutrients especially CP and CF with Optizyme supplementation such as xylanase, protease, cellulase, hemocellulase and amylase. They also concluded that Optizyme supplementation may improve the release of cell bound nutrients, compensate for the decrease in the endogenous enzymes and improve the activity of gut ecology. In addition, the Inclusion of 750 mg Optizyme / kg diet slightly improved digestibility coefficients of most nutrients and nutritive values than 500 mg optizyme / kg feed.

The reducing in digestibility of nutrient of rabbits which fed high levels of CF (19%) without enzymes may be due to the most noticeable effect of NSPs in the diets of monogastric animals is an increase in viscosity of digesta and the excretion of sticky dropping . This is considered to be the main influence of NSPs on productivity (**Salih et al., 1990 , Classen and Bedford , 1991 , Smits and Annison , 1996).**

Metabolites changes:

The effect of dietary treatments on some metabolic functions of growing rabbits i.e. total protein, albumin, globulin, glucose and liver functions parameter such as GOT , GPT and total lipids are presented in Tables 5 and 6.

Total protein, albumin, globulin and glucose:

The effect of dietary treatments on total protein, total albumin, total globulin and glucose are presented in Table (5). The data revealed that rabbits fed low level of CF (10%) and provided with enzymes recorded the highest (P<0.05) value of TP, TG

and TA (P>0.05) compared with other levels of dietary CF which provided with (Caplix) enzymes. Whereas, rabbits fed dietary 13% CF with enzyme addition were recorded the highest (P<0.05) value of TA (g/dl) compared with other levels of dietary CF which provided with (Caplix) enzymes. Rabbits fed dietary contain (13% CF) without enzymes addition was recorded the better (P>0.05) value of TG compared with other dietary levels of CF.

Serum glucose (mg/dl) for rabbits fed dietary 10% CF and provided with enzymes was recorded the highest value (P<0.05) compared with other crude fiber. While, no significant difference was observed between dietary 13, 16, and 19% CF with enzyme in blood serum glucose.

The enhancement in serum total protein (TP), total albumin(TA), total globulin (TG) and glucose as affected by providing rabbits with enzymes in drinking water may be due to the critical role of enzyme in improving the digestibility of CF and OM for these rabbits (Table 4). Moreover, **Makled et al., (2005)** indicated that increasing Optizyme level to 750 mg/kg feed in rabbits diet insignificantly improved the concentration of total protein and significantly increased only when rabbit does were fed on diet containing 500 mg Optizyme /kg feed, this enhancement in total protein was also associated with the noticed improvement in CP digestibility. **Ronaled (2007),** found that supplementation rabbits diet with multi-enzymes (Protozin) causes the following changes in the blood parameters of rabbits increases the hemoglobin and leukocyte level in the blood of the experimental animals**.**

On the other hand**, Veslin et al. (2003)** found no significant change in the level of the TP, albumin and globulin in the blood of rabbits supplemented with Protozin enzyme (19 mg/kg diet) in the concentrate mixture. **Selim et al., (2004)** found that NZW rabbits × Californian rabbits fed diet with commercial enzymes mixture (Kemzyme; 1kg/ ton) did not significantly affect (%) plasma glucose. Also, **El-Tantawy et al,. (2001)** found that rabbits total lipids were insignificantly affected with Kemzyme supplementation in rabbits fed diets supplemented with kemzyme.

Liver enzymes and Total lipids

The effect of dietary treatments on some liver enzymes i.e. Glutamic-Oxaloacetic Transaminase (GOT), Glutamic- Pyruvic Transaminase (GPT) and total lipids of New Zealand White rabbits shown in Table (6). The data revealed that the better value of (GOT) and (GPT) was recorded for rabbits fed dietary 16% CF with providing (Caplix) enzymes followed by 13% CF compared with other dietary fiber treatments. While the highest value ($P<0.05$) in (GOT) and (GPT) for rabbits fed different levels of dietary fiber without enzyme addition was recorded for rabbits fed diet contain 16% CF followed by 13% CF. Moreover, the highest value in total lipids ($P<0.05$) shown in rabbits fed on diet which contain (10% CF) with enzyme providing compared with other different dietary levels of fiber. Whereas, the greatest ($P<0.05$) total lipids value was recorded for rabbits fed diet contain (10% CF) in the treatments without enzyme addition.

In general, the addition of enzymes improve ($P<0.05$) the liver functions (GOT), (GPT) and total lipids. These results agree with Selim et al., (2004) they found that New Zealand White rabbits × Californian rabbits fed diet with commercial

enzymes mixture (Kemzyme; 1kg/ ton) significantly affect plasma total lipids. Also, El-Tantawy et al., (2001). found that total lipids was insignificantly affected with Kemzyme supplementation. Yassein et al., (2004) showed that plasma total lipids concentrations were not differ significantly by feeding barley based-diets with or without enzymes (Optizyme-P5) 1 kg/ ton fed addition in turkey.

Ghally and Abd EL-Latif (2007), revealed that plasma total lipids, GOT and GPT improved ($P<0.05$) by adding yeast culture to the control diet of Japanese quail up to 2%. the enhancement in blood parameters as affected of adding yeast to monogastric animal diets may be due to that yeast, have the ability to stimulate digestion and aid in maintaining microbial equilibrium in the gut. In addition, Live yeast, such as *saccharomyces cerevisia,* contains numerous enzymes that could be released into the intestine and aid existing enzymes in the digestive tract in the digestion of feed (Kornegay et al., 1995). Moreover, yeast supplementation can inhibit pathogenic bacteria and increase the number of anaerobic and cellulytic bacteria as reported by (Abd El-Azeem ,2002).

Economic efficiency

The effect of dietary treatments in the value of economic efficiency are presented in Table (7). The data revealed that adding enzymes reduced feed intake, accordingly water intake reduced because we are considered that rabbits consumed water twice as feed intake. The depression in feed intake as a result of providing rabbits with enzymes reduced the total cost of feed intake of these rabbits compared with rabbits had no enzymes providing in drinking water. The lowest price of total feed intake was calculated for rabbits fed 19% CF and provided with enzymes compared with either rabbits fed enzymes or other dietary treatments. Whoever, the lowest price of total feed intake for rabbits fed dietary crude fiber without enzymes was calculated for rabbits fed 16% CF compared with other rabbits without enzymes supplemention. The total price of live body weight for rabbits offered enzymes had no improved because enzymes did not improved the live body weight compared with other treatments.

The greatest total revenue and profit were calculated for rabbits fed diet contain 10% crude fiber and provided with enzymes addition compared with other dietary treatments. While, rabbits fed dietary crude fiber without enzymes recorded the highest revenue when rabbits fed 13% CF without enzyme addition. In general, it could be noticed that all dietary treatments achieved profit hence the greatest profit calculated for rabbits fed 10% CF and provided with enzymes among the enzymatic treatments. While, the highest profit was noticed for rabbits fed level of 13% CF without enzymes compared with all dietary treatments.

Sarhan (2001) Found that economic efficiency significantly improved during the period from 3 to 10 and from 10 to 12 weeks of age due to optizyme supplementation in rabbits diet . Makled et al (2005) indicated that economic efficiency of rabbits were significantly improved during the period from 8-10 and from 10-12 wks of age by adding 500 or 750 optizyme / kg feed in supplemented groups compared as with the unsupplemented one. This is in agreement with finding by Abd El-Latif (1987) who reported that dietary 14 CF (including 20% of broiler litter) reduced the dietary cost by 18.3% in growing rabbits compared as with other dietary fiber levels (18 and 22%CF) .

REFERENCES

A.O.A.C. (**1990)**. *Association of official analytical Chemistry. Official methods of analysis 15th ED published by AOAC Washington, D*

Abd El-Azeem, F. (2002). *Digeston, neomycin and yeast supplementation in broiler diets under Egyptian summer conditions. Egypt. Poult Sci. 22 (I): 235-257*

Abd- El-Latif, S. A. (1987). *growth rate, digestibility coefficients and carcass quality of rabbits fed different crude protein and crude fiber levels in their diets. M.Sc. thesis, Fac. Agric, Minia., Egypt.*

**Bedford , M . R. and Morgen A. J. (1996*)*. *The use of enzymes in poultry diet World's Poult. Sci. J . 52 : 61 – 68.*

**Boulos, N. Z., S. M. Shalash., M. N. El Sheikh, H. M. Abdella, and N. A. Hattaba (1992*)*. *Effect of biogenic enhancer Ascogenr on laying hen performance. Egypt Poult. Sci 12:679-695.*

Classen , H. L. and M. R. Bdeford (1991) *, The use of enzyme to improve the nutritive value of poultry feeds . In : Recent Advances in Animal Nutrition , W. Haresing and D. J. A. Cole , Eds , Butterworth , London , England , PP. 95 – 115*

Dorgham, S. M., H. M. Sabri and M. A. El-Sheikh (1994). *Influence of fermato, virginamycin, egg-plus as gross promoters and their synergetic effects on laying performance The Second Conf. on Poult. Kafr El-Sheikh, Egypt.*

Doumas, B.T. ; Watson, W.A. and Biggs, H.G. (1971). *Determination of serum albumin. J. Chem. Acta., 31:87-89.*

Easter, R.A. (1988). *Biochemical aids in gastro-intestinal development and functions in : biotechnology in feed industry. Edited by T.P. Lyons. Proceeding of all tech. animal symposium. Alltech. Technical publications, Kentucky, USA.*

Eiben C. S. , Mezes M. , Szijarton N. , Kustos K. , Godor-Surmann K. and Erdelyi M. (2002). *Dose-dependent effect of cellulase supplementation on performance of early- weaned rabbit. Department of Agricultural* *chemical Technology, Budapest University of Technology and Economics, H-1521 Budapest, P. O. Box 91, Hungary.*

El- Gendi, G. M., F. A. Ismail and F. A. El-Aggoury (1994). *Effect of cocci- Nel and lomoton dietary supplementation as herbal growth promoters on productive performance in broilers Annls of Agric. Sci. Moshtohor, 32(3):1551-1528.*

El- Gendi, G. M., F. A. Ismail and F. A. El-Aggoury (1994). *Effect of cocci- Nel and lomoton dietary supplementation as herbal growth promoters on productive performance in broilers Annls of Agric. Sci. Moshtohor, 32(3):1551-1528.*

El Katacha, M. L., Ismail Y. and Mohamed O. E. (1988). *Performance of growing rabbits fed diets containing corn or bardey grain with or without addition of kemzyme . Alexandaria J. Vet. Sci. 4 : 185 -190*

El-Mandy, M.R. , Salem, F. A. and EL-Homeland, Y.M. (2002) . *Effect of kemzyme in rabbit ration differing in their protein levels on digestion , blood constituentas and carcass Traits , 3 rd conf. on rabbit prod., in Hot climates , Hunghada (Egypt) , 495 - 505 .*

El-Tantawy, S. , Samia Z. Meshreky, Fadia M. Nosseir and F. Hanna (2001). *Effect of some feed additive on: productive performance carcass traits and some blood constituents of growing Bouscat rabbits. Egyptian J. Nutrition and feed. 4, (special issue) : 931-943*

Ghaly, K. A. and S. A. Abd El-Latif (2007). *Effect of dietary yeast on some productive and physiological aspects of growing Japanese quails. African Crop Science Conference Proceedings Vol. 8. 2147-2151*

Gornal A. C, Bardawill C.J. and David, M.M. (1949): *J. Biol. Chem. 177:751.*

Gutierrez, I., Espinosa , A. Garcia, J. Carabano , R. and Dgblas, J. C. (2002) *Effects of strach and protein sources , heat processing , and exogenous enzymes in starter diets for early weaned rabbits Anim. Feed sci , and technol., 98 , 175 – 186*

Ibrahim, H. (2000). *Effect of feeding system and supplemental diet with enzyme preparation on performance of growing rabbits. J. productive Development . 5 : 179 - 185 .*

Ibrahim , M. R. M , Elnogmy K . V. and Faraghly S. M (1999) . *Effect of replacement barely by dried barley radical with or without kemzyme on* *performance of growing males rabbits Egyptian J. of rabbits sci. 9 ; 16 - 68 .*

Ibrahim, M. R. M., S. A. Abd El-Latif and A. T. El.Yamany (1998). *Effect of adding of some natural growth promoters to broiler chicks diets on growth performance, digestibility, and some metabolic functions. J. Agric. Sci. Mansoura Univ., 23(3):1029-1037.*

Kocher , A. Choct M.,. Proter M. D, and Borzt , J. (2002). *Effect of feed enzymes on nutritive value of soybean meal fed to broilers . Br. Poult . Sci. 43 : 54 – 63 .*

Kornegay, E. T., Rhein-Welker, D. , Lindemann, M. D. and Wood, C. M. (1995). *Performance and nutrient digestibility in weanling pigs as influenced by yeast culture additions to starter diets containing dried whey or one of two fiber sources. J. Anim. Sci. 73: 1381-1389*

Makled , M. N., Metwally , M. A., Soliman , I. A. and younis , H. A. (2005). *Impact of different levels of dietary multienzymes supplement on california rabbit performance 3rd . International poultry conference 4 - 7 Apr . 2005 Hunghada - Egypt .*

NRC (1994). *National Research Council (1994). Nutrient requirements of Poultry 9th Edition, National Academy Press, Washington, D.C.*

Ronald, R. marquardt (2007*). Enzyme enhancement of the nutritional value of cears: role of viscous, water souuble, non-starch polysaccharides in chick performance. Department of animal science, university of Manitoba, winnipeq, MB, Canada.*

Salih , M. E. , Classen , H. L. and Compbell , **G.L.** (**1990**). *Response of chickens fed on hull less barely to dietry β- glucanase at different ages J. Anim Sci. Technol. (33) : 139 - 149 .*

Sarhan, A. (2001*). Effect of protein level and supplementation on enzyme preparation in diets of growing rabbits. Egyptian J. Nut and Feeds. 4 : 832 - 843.*

Selim A. D., Soliman A. Z. and Abdel-Khalek A. (2004*).* *Effect of drinking water temperature and some dietary feed additives on performance of heat stressed rabbits. Proceding of the 8 th Congress of the world Rabbit Science Association, Puebla City, Mexico, September, 2004 P: 984-990.*

Smits . C. H. M. and Annison, G. (1996). *Non-Starch polysaccharides in broiler nutrition : towards a physiologically valid approach to their determination . World's Poult. Sci. J, (52) : 203 – 221 .*

Snedecor, G. W. and Cochran, W. G. (1980) *statistical methods. 7th ed. The Iowa state university press, Ames, Iowa.*

Sullivan, L.M.(1987). *Evaluation of sorghum varieties in poultry diets. Feed Facts. Published by grain sorghum producers. Association, vol. 4, no. 2.*

Tawfeek , M. I .(1996). *Effect of feeding system and supplemented diet with kemzyme on growth, blood constitvents, carcass traits and reproductive performance in rabbits under intensive production conditions. Egyptian J. rabbit Sci. 6 : 21 .*

Trinder, P. (1969): *Ann, Clin. Biochem, (6), 24.*

Valente, S.S. Ferreira, W. M. Santiago, G. S. Dias and J. C.C. A.Cavalcate, S.C. (1999). *Effect of enzymatic supplementation on growth performance of rabbits, World rabbits sci. Vol. (7) (1) PP.41 .*

Veselin Radev , Kina sivkova and Encho Enev (2003) . *Changes in Hematological parameters of rabbits given multi-enzyme Protozin in the diet Trakia Journal of sciences , Vol. 1 , No. 1 , PP. 67 – 71*

Yassein S.A.; A.T., El-yamny and G.M., El-mallah. (2004). *Barley as replacement for yellow corn with or without enzyme or DL-methionine in practical diets of growing turkeys. Egypt. Poult. Sci. vol. 24 (IV) : 929-944.*

Zollner, N. and Kirsch, K. (1962): *Z. ges. Exp. Med. 135:545*

الملخص العربي

تأثير استخدام الإنزيمات التجارية على النمو وبعض الوظائف التمثيلية للأرانب المغذاة على مستويات متدرجة من الألياف الخام

شاكر عبد التواب عبد اللطيف- خيرى عبد الحميد محمد-كوثر محمد غالى- مها احمد عبد اللطيف

قسم الإنتاج الحيوانى - كلية الزراعة- جامعة المنيا

استخدم فى هذه التجربة 30 ارنب نيوزيلاندى (ذكور واناث) بهدف دراسة تأثير تغذيتها على مستويات متدرجة من الالياف الخام 10 و 13 و 16و 19 % مع اضافة وعدم اضافة الانريمات (الكابلكس التجارية) اليها بماء الشرب بمستوى 0.5 مل / لتر وذلك على النمو ومعدلات الهضم وبعض الوظائف التمثيلية والكفاءة الاقتصادية. تم توزيع الارانب فى 8 مجموعات حسب مستوى الالياف وحسب اضافة او عدم اضافة الانريم لكل مستوى من مستويات الالياف المستخدمة. وانتهت التجربة عند عمر 17 اسبوع (12 اسبوع من العاملات التجريبية). وتم تسجيل النمو والمأكول من الغذاء وحساب معدلات تحويل الغذاء. وفى نهاية التجربة اخذت عينة دم من 3 حيوانات لكل معاملة وكذلك اجرية تجربة هضم على نفس العدد من الارانب.

وكان من نتائج التجربة ما يلى:- وجد ان الارانب التى غذيت على علائق منخضة فى الالياف (10 و 13 %) سواء فى وجود او عدم وجود الانزيم حققت اعلى معدل نمو وزيادة فى الوزن مقارنة بالمستويات الاعلى من الالياف (16 و 19 %). وكان افضل تحسن فى النمو للارانب النى غذيت على 10% الياف مع اضافة الانزيم اليها. كما اتضح ان اضافة الانريمات الى العلائق خفض المأكول من الغذاء مقارنة بالاخرى التى لم يضاف اليها الانريم. واظهرت الارانب التى غذيت على علائق 10 و 13% الياف خام فى وجود او عدم وجود الانزيم افضل كفاءة تحويلية للغذاء مقارنة بالعلائق الاخرى. وكان افضل تحسن فى معدلات هضم المادة الجافة والبروتين الخام و الالياف الخام والبروتين الكلى والجلبيولين الكلى واللبيدلت الكلية والجلكوز والكفاءة الاقتصادية للارانب النى غذيت على 10% الياف مع اضافة الانزيم اليها مقارنة بالعلائق الاخرى. . واوضحت النتائج ان الارانب المغذاة على علائق 16% الياف مع وجود الانزيمات حققت احسن قيم لانزيمات الكبد (GOT و GPT).