EFFECT OF FEEDING DIFFERENT LEVELS OF YELLOW CORN WITH OR WITHOUT MULTI-ENZYMES OR PREBIOTIC SUPPLEMENTATION ON GROWTH PERFORMANCE AND ECONOMICAL EFFICIENCY IN GROWING RABBIT RATIONS

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SUMMARY

One hundred and eight, 6 weeks of age weaning New Zealand White (NZW) rabbits were used in this study to investigate the impact of feeding three levels of yellow corn diets without or with enzymes or prebiotics or both. Rabbits were distributed in a completely randomized experimental design in a 3×4 factorial arrangements, with the variables being supplementation or not with enzymes (500 g / ton feed) or prebiotics (500 g / ton feed) or both (500 g enzymes +500 g prebiotics) / ton feed. The experimental groups of rabbits were fed their respective experimental rations in pelleted form. Three basal rations were used in this study; the first containing 5% corn (R1), the second one contained 10% corn (R5) and the third one contained 15% corn (R9). The composition and calculated analysis of the basal diets were done according to NRC (1977). The basal ration (R1) was supplemented with enzymes or prebiotics or both for R2, R3 and R4, respectively. While the basal ration (R5) was supplemented with enzymes or prebiotics or both for R6, R7 and R8, respectively, and the basal ration (R9) was supplemented with enzymes or prebiotics or both for R10, R11 and R12, respectively. Apart from the effect of feed rations which were contained 5% or 15% corn, were significantly ($P<0.05$) higher live body weight (LBW) of rabbits 7 weeks of age than feeding on ration was contained 10% corn, but without significant effect on LBW at different ages of the experimental period, from 8 to 15 weeks of age. Regardless of the effect of dietary corn level, addition of enzymes or prebiotics or both had no significant effect ($P>0.05$) on live body weight of rabbits at different ages of the experimental period, from 6 to 15 weeks of age. Apart from the effect of corn levels and dietary supplements had no significant effect ($P< 0.05$) on daily feed intake (DFI) of rabbits during the period from 6 to 15 weeks. The daily feed intake (DFI) of rabbits fed rations contained 5%, 10% and 15% corn were 89.88, 89.03 and 89.62 g / d, respectively. The interaction between dietary corn levels and added supplements on feed conversion ratio (FCR) during the whole experimental period (from 6-15 weeks) showed that, the FCR of the growing rabbits were better ($P<0.05$) with rations R8, R9 and R11 (3.93, 4.07 and 4.04 g/d, respectively). The effect of dietary interaction, showed that addition of enzymes with diet containing 5% corn or diet containing 10% corn without supplements lead to a significant ($p<0.05$) increased in weight of viscera. The economic efficiency (%) showed that feeding growing rabbits on ration contained 10% corn and supplemented with enzymes plus prebiotics (R8) or feeding diet contained 15% corn without supplements (R9), improved of feed efficiency (102.8 and 102.4 %, respectively).

Keywords: *performance, multi-enzymes, prebiotic and economic efficiency.*

INTRODUCTION

Rabbit meat is excellent protein quality, low in total as well as saturated fat, cholesterol and sodium. Therefore, rabbit production is considered as a good source of meat in tropical developing countries where there is an abundance of by- product feedstuffs (Taylor *et al*. 1989). Several studies carried out on poultry and pigs have shown that the nutritive value of feedstuffs, especially of poor quality, can be enhanced by supplemental enzymes (Cowan *et al*.1996). Abo El-Maaty *et al.* (2014) were designed an experiment to study the effect of partial or complete substitution of cucumber vines straw (CVS) for dietary clover hay in presence or absence of multi-enzyme addition on growth performance of New Zealand White (NZW) rabbits. They found that, dietary supplementation with enzyme preparation (Natuzyme, NZ) to the diet containing 30 % CVS restored the normal values of growth performance and economic efficiency attained by the control rabbits.

On the other hand, probiotics such as yeast culture can be used to manipulate rumen fermentation in ruminant (Williams and Newbold, 1990). Rabbits may also benefit from prebiotic feed additives as they are highly dependent on hindgut fermentation to utilize their feed efficiently. However the use of such feed additives in the rabbit has not been extensively studied (Shanmuganathan *et al*. 2004).

The important carbohydrates in rabbit feed are starch (digestible) and fiber (indigestible). Starch provides energy that is readily available and easily digestible. Although grains are good sources of starch, rabbit diets high in grain can cause a starch overload in the hindgut leading to enteritis. Fiber is important for overall gut health and mobility and appetite stimulation. The bacterial population in the hindgut allows rabbits to diets fiber to some extent. Rabbits have a high feed intake (65- 80g/kg body weight) and a rapid feed transit time (about 19 hours) and this are able to consume lower quality forages and still meet their nutritional needs (De Blac and Wiseman, 2003). The benefits of adding enzymes to diets of non-ruminant animals particularly poultry, has become more important (Campell and Bedford, 1992). These enzymes potentially hydrolyze non soluble protein (NSP), reduce the viscosity of gut contents, and result in improvements in nutrient absorption. Dietary fiber plays an important role in the diet of rabbit because of its influence on caecal microbial activity (Gidenne *et al*. 2010a).

The optimal dietary fiber level for growing rabbits is variable and may depend largely upon other factors such as type of fiber, age and breed of rabbits, and /or digestible energy content of the diet (Gidenne *et al*. 2010). Most organisms used in probiotics are strains of gram positive bacteria of the genera [*bacillus (B. subtilis*), enterococcus (*E. faecium*), lactobacillus (*l. acidophilus*), Bifid bacteria (B. lactic), streptococcus (*S.infanarius*) and some yeasts or fungi such as *Saccharomyces cerevisae*]. The use of oligosaccharides to affect increase in gut bacteria seen as beneficial has been for many years; however the term "prebiotic" was only first coined in mid-1990 (Gibson and Roberfroid, 1995). This clearly built upon the success of probiotics for micro flora management approaches.

The present study was performed to investigate the influence of feeding diets without or with enzymes or prebiotics or both on the performance, carcass traits and economic efficiency of growing New Zealand white rabbits.

MATERIALS AND METHODS

The experimental work of the present study was carried out at the Poultry Research Unit, Agricultural Research and Experimental Center, Faculty of Agriculture, Mansoura University.

Experimental animals and management

One hundred and eight, 6 weeks old weaning New Zealand White (NZW) rabbits were used in this study. Rabbits were randomly distributed into 12 equal experimental groups; each contained three equal replications. Each replicate group (3 rabbits) was housed in a separate cage with the following dimensions 50×50×45 cm for length, width and height, respectively. Rabbits were fed their respective experimental diets from 6 to 15 weeks of age. Feed and water were offered *ad libitum* throughout the experimental period. The values of live body weight and feed intake were recorded on a replicate group basis and thus daily weight gain and feed conversion were also calculated.

Feed supplements

In the present study, the multi-enzyme extra and prefect were performance in aquaculture and agriculture (KIOTECHAGIL). The specific wall stabilized enzymes combination of German origin (xylanase, betaglucanase, alpha amylase, protease and phytase), which 500 g were added to ton feed of the basal diet. Prefect is a buffered blend of specific acids on a unique mineral carrier system combined with a fructo-oligosaccharide (FOS) to promote a healthy gut microflora, which 500 g were added to ton feed of the basal diet.

Experimental rations and design

An experiment (3×4) was conducted with factorial arrangement of treatments, being three levels of yellow corn without or with enzymes or prebiotics or both. Thus, twelve experimental rations were formulated and used. The experimental groups of rabbits were fed their respective experimental rations in pelleted form. Three basal rations were used in this study; the first containing 5% corn (R1), the second one contained 10% corn (R5) and the third one contained 15% corn (R9). The composition and calculated analysis of the basal diets are presented in Table 1, according to NRC (1977).

The basal ration (R1) was supplemented with enzymes or prebiotics or both for R2, R3 and R4, respectively. While the basal ration (R5) was supplemented with enzymes or prebiotics or both for R6, R7 and R8, respectively, and the basal ration (R9) was supplemented with enzymes or prebiotics or both for R10, R11 and R12, respectively.

Growth performance parameters

Live body weights of the experimental rabbits were individually recorded at the start of the experiment and at a weekly basis thereafter and were estimated to the nearest five grams in the early morning before receiving any feed or water. Body weight gain and feed conversion ratio were also calculated on a replicate group basis. Mortality of rabbits was also monitored and recorded daily.

Table (1): Ingredients and chemical composition of the basal diets.

Feed ingredient	Basal diets		
	(1) R1	(2) R5	(3) R9
	5% yellow corn	10% yellow corn	15% yellow corn
Barley	12	10	9
Yellow corn	5	10	15
Wheat bran	35	30	25
Soybean meal	7.5	8.5	9.5
Alfalfa hay	35.7	36.7	36.7
Molasses	2.0	2.0	2.0
Limestone	1.0	1.0	1.0
Dicalcium phosphate	1.2	1.2	1.2
Sodium chloride	0.3	0.3	0.3
Vit. & Min. premix	0.3	0.3	0.3
Total	100	100	100
Calculated analysis on DM basis (NRC, 1977)			
Digestible energy (Kcal/kg)	2597	2600	2615
Crude protein (%)	16.02	16.08	16.09
Crude fiber (%)	14.37	14.22	13.84
Ether extract (%)	2.84	2.83	2.81
Calcium (%)	1.24	1.25	1.24
Total phosphorus (%)	0.77	0.74	0.70
Lysine (%)	0.70	0.71	0.72
Methionine (%)	0.19	0.20	0.20
Methionine+cysteine (%)	0.50	0.50	0.51

**Premix: Each 2 kg of the premix contained Vit A, 10.000000 IU; Vit D_3, 2000000 IU, Vit E, 10000 mg; Zinc, 3000 mg, Manganese, 2000 mg; Iron, 4000 mg; Copper, 1000 mg; Iodine, 100 mg; Selenium, 10 mg; Cobalt, 10 mg; Sodium, 23000 mg; and Magnesium, 2000 mg; ($CaCo_3$ was added to 2.0 kg) .*

Carcass evaluation

At the end of the experimental period, three rabbits from each experimental treatment were randomly chosen and slaughtered to study carcass characteristics. Rabbits were fasted for approximately 18 hours before slaughtering, individually weighed and slaughtered according to the rules of Islamic religion. Slaughter data were immediately recorded for the individual rabbits. Skinning was carried out by removing the skin including tail and legs. Carcasses were eviscerated and the different organs (e.g. liver, heart, kidneys, viscera and lungs) were removed and immediately weighed to the nearest gram. Absolute weights of dressed carcass and organs and dressing-out percentage were estimated.

Economic efficiency

The local price of daily body weight gain and daily feed cost were calculated depending on the prevailing prices being: Price of kg body weight = 35.00 LE; Kg enzymes= 150 LE; Kg prebiotics= 220 LE; Kg feed (R1)= 4.2 LE; Kg feed (R2)= 4.28 LE; Kg (R3)= 4.31 LE; Kg (R4)= 4.39 LE; Kg (R5)= 4.21 LE; Kg (R6)= 4.29 LE; Kg feed (R7)= 4.32 LE; Kg feed (R8)= 4.4 LE; Kg feed (R9)= 4.24 LE; Kg feed (R10)= 4.32 LE; Kg feed (R11)= 4.35 LE and Kg feed (R12)= 4.43 LE.

- Total feed cost = Average feed intake (kg) × price per (kg) feed.
- Weight gain price = Average weight gain (kg) × price per kg live body weight.
- Net revenue or profit (LE) = Price of weight gain – price of feed cost.
- Economic efficiency = Profit (LE) × 100 / total feed cost.

Statistical analysis

Statistical analysis of data was carried out using the General Linear Model Program of **SAS (2000).** Differences among means of treatments were identified by Duncan's Multiple Range Test **(Duncan, 1955)**. The obtained data for productive traits of different groups of rabbits were subjected to factorial analysis of variance according to the following mathematical model: $Y_{ijk} = \mu + T_i + L_j + TL_{ij} + e_{ijk}$

Where; Y_{ijk} = observation of the tested factor, μ = overall mean, T_i = the effect of corn level, L_j = the effect of supplements, TL_{ij} = the interaction between corn level and supplements and e_{ijk} = experimental random error.

RESULTS AND DISCUSSION

Live body weights and weight gain of growing rabbits

The effects of feeding diets containing three levels of yellow corn without or supplemented with enzymes or prebiotics or both on live body weight and weight gain of growing rabbits are presented in Tables (2 and 3). No deaths of rabbits occurred during the duration of this study.

Apart from the effect of feed rations contained 5% or 15% corn, were significantly ($P<0.05$) higher live body weight (LBW) of rabbits 7 weeks of age than those fed ration contained 10% corn (Table 2), but without significant effect on LBW at different ages of the experimental period, from 8 to 15 weeks of age. Regardless of the effect of dietary corn level, addition of enzymes or prebiotics or both had no significant effect ($P>0.05$) on live body weight of rabbits at different ages of the experimental period, from 6 to 15 weeks of age. The interaction between corn levels and supplements did not significantly affect live body weight of growing rabbits throughout the whole experimental period from 6 to 15 weeks of age.

As regards the effects of dietary treatments, rabbits fed the diets containing 5% or 15% corn exhibited significantly higher ($P<0.05$) body weight gain during the 7^{th} (6-7 wk) and 10^{th} (9-10 wk) weeks than feeding on ration was contained 10% corn (Table 3). Apart from the effect of addition of enzymes together with prebiotics had significant effect ($P<0.05$) on body weight gain (BWG) of rabbits at 9^{th} (8-9 wk) and 12^{th} (11-12 wk) weeks than feeding on the control ration. At period from 9-10 weeks of age in which the control or adding prebiotics were significantly higher ($P<0.05$) body weight gain compared with those adding enzymes or enzymes with prebiotics. Dietary treatments by added supplements and corn levels interaction did not significantly affect live body weight of growing rabbits throughout the whole experimental period.

Xiccato *et al*. (1998) reported that when high starch diets were fed to rabbits older than 35 d of age under more balanced nutritional conditions and respecting minimum fiber level, no significance recorded on health status. Similarly, Nizza and Moniello (2000) did not report any effect of the starch source on growth performance and meat properties.

Several works have already investigated the efficacy of digestive enzymes in 35 to 49 day old of rabbits (Remois *et al*. 1996). The results of these studies have shown little or no effects of enzyme supplementation on fattening rabbit performance. However, in younger animals from 25 to 39 days of age, addition enzymes has improved daily gain by + 3.1 %. Danicke *et al*. (1999) suggested that addition of b-xylanases could modulate gut microflora, enhancing growth performance and health status of the animals, especially in the post – weaning period. Falcao-e-Cunha *et al*. (2007) did not detect any significant effect of enzymes on rabbit's performance. Garcia *et al*. (2005) found some positive results with proteases and proteases + xylanases.

The effects of feeding diets containing three levels of yellow corn without or supplemented with enzymes or prebiotics or both on daily feed intake (DFI) and feed conversion ratio (FCR) of growing rabbits are presented in Tables 4 and 5, respectively. Apart from the effect of corn levels and dietary supplements had no significant effect ($P< 0.05$) on DFI of rabbits during the periods of 9-10, 10-11, 11-12, 12-13, 13-14, 14-15 weeks of age (Table 4). The DFI of rabbits fed rations contained 5%, 10% and

15% corn were 89.88, 89.03 and 89.62 g / d, respectively. The DFI without supplement 0.0 % enzyme (B1) or with 0.05 % enzyme (B2) or with 0.05 % prebiotic (B3) or with 0.05 % enzyme + 0.05% prebiotic (B4) were 88.67, 89.04, 90.14 and 90.19 g / d, respectively, (Table 4).

Table (2): Effect of fed diets containing three levels of corn supplemented with enzyme or prebiotic or both on live body weight of growing rabbits from 6 to 15 weeks of age.

Dietary treatment	Live body weight (g)									
	Week									
	6	7	8	9	10	11	12	13	14	15
Corn levels % (A):										
5 % (A1)	679.7	809.3	927.1	1099.	1296.	1451.	1609.	1776.	1891.	2044.
10% (A2)	679.9	786.9	928.0	1097.	1275.	1444.	1595.	1757.	1889.	2057.
15% (A3)	684.0	807.6	932.6	1111.	1295.	1458.	1625.	1773.	1906.	2064.
SEM	3.35	5.84	9.05	9.66	12.92	13.55	14.92	19.00	22.16	27.25
Significance	NS	*	NS	NS	NS	NS	NS	NS	NS	NS
Supplements (B):										
0.0% (B1)	682.2	805.7	929.3	1088.	1284.	1442.	1593.	1743.	1870.	2035.
0.05% E (B2)	677.2	791.9	923.7	1094.	1278.	1444.	1596.	1748.	1882.	2046.
0.05% P (B3)	681.7	802.3	930.7	1104.	1298.	1465.	1624.	1792.	1910.	2069.
0 .05% E+0.05%	683.9	805.2	933.3	1123.	1295.	1454.	1626.	1790.	1920.	2070.
SEM	3.86	6.74	10.45	11.16	14.93	15.64	17.22	21.94	25.58	31.95
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
AB Interaction:										
A1B1 = R1	671.6	790.5	892.8	1055.	1267.	1411.	1546.	1702.	1814.	1982.
A1B2 = R2	685.0	724.5	951.1	1130.	1323.	1479.	1929.	1795.	1923.	2094.
A1B3 = R3	685.0	814.4	942.8	1103.	1291.	1452.	1623.	1804.	1909.	2057.
A1B4= R4	677.2	807.8	921.7	1107.	1303.	1463.	1637.	1802.	1918.	2042.
A2B1 = R5	687.2	800.0	942.8	1097.	1285.	1447.	1592.	1746.	1875.	2040.
A2B2= R6	675.0	762.4	909.5	1076.	1260.	1442.	1586.	1732.	1871.	2032.
A2B3 = R7	678.3	789.7	929.2	1102.	1292.	1463.	1606.	1776.	1895.	2051.
A2B4= R8	678.9	795.6	930.6	1111.	1265.	1425.	1597.	1772.	1917.	2105.
A3B1 = R9	687.2	826.7	952.2	1113.	1302.	1466.	1641.	1782.	1921.	2082.
A3B2= R10	671.7	788.9	910.6	1076.	1252.	1411.	1572.	1718.	1852.	2013.
A3B3= R11	681.7	802.8	920.0	1106.	1310.	1481.	1642.	1796.	1928.	2100.
A3B4= R12	695.6	812.2	947.8	1150.	1318.	1474.	1644.	1795.	1925.	2063.
SEM	6.69	11.67	18.11	19.32	25.85	27.09	29.83	38.00	44.31	54.5
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*a-b: For each of the main effects, means within the same column with different superscripts differ significantly (P<0.05). SEM=Standard error of means; NS: not significant; *: significant.*

With regard to the effect of dietary treatments on FCR, dietary corn levels had a significant effect (P<0.05) on FCR of growing rabbits during the periods of 6 -7, 7-8, 9-10, 11-12, 12-13, 13-14 and from 14-15 weeks of age, but without significant effect during the whole experimental period (from 6-15 weeks) (Table 5).

Irrespective of the effect of dietary corn levels, FCR of rabbits fed control ration was significantly better (P<0.05) from 9-10 and from 14-15 weeks, while ration which supplemented with 0.05% enzume was the better at 13-14 weeks than the other supplements. The interaction between dietary corn levels and added supplements on FCR during the whole experimental period (from 6-15 weeks) showed that, the

FCR of the growing rabbits were better (P<0.05) with rations R8, R9 and R11 (3.93, 4.07 and 4.04 g/d, respectively) as shown in Table (5).

Table (3): Effect of fed diets containing three levels of corn supplemented with enzyme or prebiotic or both on daily weight gain of growing rabbits from 6 to 15 weeks of age.

Dietary treatment	Daily weight gain (g)									
	Week									
	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	6-15
Corn levels % (A):										
5% (A1)	18.52^{a}	16.83^{b}	24.58	28.19^{a}	22.18	22.46	23.86	16.51	21.76	21.66
10% (A2)	15.28^{b}	20.15^{a}	24.14	25.53^{b}	24.17	21.60	23.01	18.94	23.98	21.87
15% (A3)	17.66^{a}	17.84^{a}	25.59	26.27^{a}	23.27	23.86	21.11	19.08	22.57	21.91
SEM	0.69	0.82	0.99	0.78	0.75	0.72	0.95	0.85	0.99	0.43
Significance	**	*	NS	*	NS	NS	NS	NS	NS	NS
Supplements % (B):										
0.0 % (B1)	17.68	17.63	22.79^{b}	28.02^{a}	22.46	21.64^{b}	21.44	18.08	23.56	21.47
0.05% E (B2)	16.39	18.81	24.42^{a}	26.31^{a}	23.66	21.71^{b}	21.80	19.10	23.43	21.74
0.05% P (B3)	17.22	18.33	24.78^{a}	27.69^{a}	23.99	22.62^{a}	24.00	16.93	21.44	22.01
0.05%E+0.05%	17.32	18.31	27.10^{a}	24.62^{b}	22.72	24.60^{a}	23.39	18.59	22.67	22.02
SEM	0.80	0.95	1.14	0.90	0.86	0.83	1.09	0.98	1.13	0.49
Significance	NS	NS	*	*	NS	*	NS	NS	NS	NS
AB Interaction:										
A1B1 = R1	17.00	14.60	23.27	30.33	20.60	19.23	22.30	16.03	23.93	20.80
A1B2 = R2	19.93	18.10	25.63	27.60	22.23	21.47	23.73	18.27	24.43	22.37
A1B3 = R3	18.50	18.33	22.93	26.90	22.93	24.40	25.83	15.03	21.10	21.77
A1B4= R4	18.63	16.27	26.50	28.03	22.97	24.80	23.57	16.70	17.63	21.70
A2B1 = R5	16.13	20.40	22.07	26.83	23.27	20.70	21.97	18.33	23.67	21.47
A2B2= R6	12.47	20.97	23.90	26.27	26.03	20.60	20.87	19.83	22.93	21.57
A2B3 = R7	15.87	19.93	24.73	27.10	24.50	20.43	24.20	16.97	22.40	21.77
A2B4= R8	16.67	19.30	25.87	21.90	22.87	24.67	25.00	20.63	26.93	22.67
A3B1 = R9	19.90	17.90	23.03	27.00	23.50	25.00	20.07	19.87	23.07	22.13
A3B2= R10	16.77	17.37	23.73	25.07	22.70	23.07	20.80	19.20	22.93	21.30
A3B3= R11	17.30	16.73	26.67	29.07	24.53	23.03	21.97	18.80	24.50	22.50
A3B4= R12	16.67	19.37	29.93	23.93	22.33	24.33	21.60	18.43	19.77	21.70
SEM	1.39	1.65	1.98	1.56	1.50	1.43	1.90	1.70	1.96	0.86
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*a-b: For each of the main effects, means within the same column with different superscripts differ significantly (P<0.05). SEM=standard error of means; NS: not significant; *: significant; **: highly significant.*

The increase of DE concentration in high starch diets stimulated growth rate without affecting feed intake (Gutierrez et al., 2002). Amber *et al.* (2004) supplemented *Lactobacillus acidophilus* (probiotic) found a positive effect on average daily gain (+ 9.6 %) and negative effect on FCR (- 6.5 %). Gidenne *et al*. (2002), reported that the improvement in live body weight and body weight gain of the rabbits fed enzymes may be due to the enhancing effect of enzymes on micro flora growth in gut and cecum as well as increase in volatile fatty acids (VFAs) production and organic matter digestibility.

The effect of feeding diets containing three levels of corn without or supplemented with enzyme or prebiotic or both on carcass characteristics of growing rabbits are illustrated in Table (6). Apart from the effect of feed which contains 5% corn a significant increased (P< 0.05) on lungs weight than diets containing 10% or 15% corn. Apart from the effect of feed supplements, feeding the diet without any supplements increased (P< 0.05) weights of lungs, while when supplemented diet with enzymes increased

(p<0.05) liver weight and kidneys increased (P<0.05) with feeding on diets without supplements or with supplemented enzyme or enzyme plus prebiotic compared with those of the diet supplemented with prebiotic only. The effect of dietary interaction, showed addition of enzyme with diet containing 5% corn or diet containing 10% corn without supplements lead to a significant (P<0.05) increased in weight of viscera.

Table (4): Effect of fed diets containing three levels of corn supplemented with enzyme or prebiotic or both on daily feed intake (DFI) of growing rabbits from 6 to 15 weeks of age.

Dietary treatment	Daily feed intake (g)									
	Week									
	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	6-15
Corn levels % (A):										
5% (A1)	47.47	56.67	64.72	76.94	90.68	102.4	112.96	124.6	132.44	89.88
10% (A2)	47.86	55.08	64.72	76.28	89.50	101.3	111.72	123.1	131.66	89.03
15% (A3)	47.89	55.83	64.19	76.68	89.94	101.6	113.64	123.8	132.94	89.62
SEM	0.24	0.50	0.69	0.84	1.1	1.23	1.15	1.40	1.76	0.86
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Supplements % (B):										
0.0 % (B1)	47.82	55.55	64.37	75.59	89.78	100.8	111.41	121.89	130.70	88.67
0.05% E (B2)	47.70	56.04	65.04	76.48	89.56	101.1	111.55	122.74	131.26	89.04
0.05% P (B3)	47.52	56.41	65.19	77.07	90.70	102.4	113.28	125.30	133.30	90.14
0.05%E+0.05%	47.93	55.44	63.59	77.39	90.13	102.7	114.85	125.59	134.15	90.19
SEM	0.28	0.58	0.80	0.97	1.17	1.43	1.33	1.62	2.04	0.99
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
AB Interaction:										
A1B1 = R1	46.67	55.45	62.44	73.78	88.56	98.78	108.11	118.89	126.78	86.6
A1B2 = R2	47.89	57.67	66.55	79.00	92.44	103.33	113.89	125.67	134.55	91.20
A1B3 = R3	47.66	57.00	66.00	77.11	90.22	101.55	113.39	126.11	132.67	90.20
A1B4= R4	47.67	56.55	63.89	77.89	91.50	105.94	116.45	128.05	135.78	91.53
A2B1 = R5	48.11	55.66	66.33	76.56	89.78	101.22	111.33	122.22	131.11	89.17
A2B2= R6	48.11	55.22	64.78	75.22	88.78	101.34	110.89	121.89	129.67	88.43
A2B3 = R7	47.45	56.00	65.11	77.11	90.33	102.34	111.56	124.22	132.34	89.60
A2B4= R8	47.77	53.45	62.67	76.22	89.11	100.34	113.11	124.11	135.56	88.90
A3B1 = R9	48.66	55.55	64.33	76.44	91.00	102.56	114.78	124.55	134.22	90.23
A3B2= R10	47.11	55.22	63.78	75.22	87.45	98.67	109.89	120.67	129.56	87.50
A3B3= R11	47.45	56.22	64.44	77.00	91.55	103.56	114.89	125.56	134.89	90.63
A3B4= R12	48.33	56.33	64.22	78.06	89.78	102.00	115.00	124.61	133.11	90.13
SEM	0.484	1.001	1.39	1.676	2.032	2.474	2.309	2.809	3.529	1.719
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

a-b: For each of the main effects, means within the same column with different superscripts differ significantly (P≤0.05). SEM=standard error of means; NS: not significant.

The higher gut content in rabbits fed low starch diets depended on the higher dietary fiber concentration and explained the lower dressing percentage (Gidenne, 1992). Other traits of carcass and meat were non significant affected by dietary starch level. In fact rabbit carcass and meat quality substantially changed only when diet presented great nutrient excess or lack, being the ontogenetic factors (slaughter weight and age, sex, etc.) more effective (Xiccato, 1999).

The economic efficiency (%) results (Table, 7) showed that feeding growing rabbits on ration which was containing 10% corn and supplemented with enzymes plus prebiotic (R8) or feeding diet contained 15% corn without supplements (R9) improved the feed efficiency was observed (102.84 and 102.46 %,

respectively).

Table (5): Effect of fed diets containing three levels of corn supplemented with enzyme or prebiotic or both on feed conversion ratio (FCR) ratio of growing rabbits from 6 to 15 weeks of age.

Dietary treatment	Feed conversion ratio (g feed: g gain)									
	Week									
	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	6-15
Corn levels % (A):										
5% (A1)	2.60^{b}	3.51^{a}	2.66	2.76^{b}	4.14	4.65^{ab}	4.83^{b}	7.70^{a}	6.25^{a}	4.17
10% (A2)	3.22^{a}	2.77^{b}	2.78	3.02^{a}	3.75	4.74^{a}	4.94^{ab}	6.59^{b}	5.54^{b}	4.08
15% (A3)	2.76^{b}	3.17^{ab}	2.55	2.95^{ab}	3.88	4.30^{b}	5.41^{a}	6.69^{b}	6.08^{ab}	4.09
SEM	0.12	0.17	0.36	0.07	0.13	0.14	0.18	0.33	0.23	0.05
Significance	**	*	NS	*	NS	*	*	*	*	NS
Supplements % (B):										
0.0 % (B1)	2.76	3.26	2.93	2.72^{b}	4.05	4.73	5.26	6.81^{ab}	5.57^{b}	4.13
0.05% E (B2)	3.08	3.04	2.68	2.94^{ab}	3.82	4.70	5.21	6.55^{b}	5.70^{b}	4.11
0.05% P (B3)	2.79	3.11	2.68^{b}	2.80^{b}	3.84	4.62	4.80	7.76^{a}	6.02^{ab}	4.10
0.05%E+0.05%	2.81	3.19	2.37^{b}	3.18^{a}	3.99	4.20	4.96	6.86^{ab}	6.53^{a}	4.10
SEM	0.14	0.20	0.16	0.08	0.15	0.17	0.21	0.38	0.26	0.06
Significance	NS	NS	NS	**	NS	NS	NS	*	*	NS
AB Interaction:										
A1B1 = R1	2.77	3.88	2.69	2.45	4.36	5.19	4.93	7.43	5.31	4.17
A1B2 = R2	2.45	3.23	2.59	2.94	4.18	4.83	4.97	7.06	5.58	4.11
A1B3 = R3	2.61	3.11	2.94	2.88	4.01	4.30	4.45	8.57	6.37	4.16
A1B4= R4	2.58	3.81	2.42	2.78	4.00	4.29	4.94	7.74	7.72	4.23
A2B1 = R5	3.05	2.80	3.26	2.87	3.89	4.89	5.09	6.71	5.55	4.16
A2B2= R6	3.92	2.64	2.72	2.87	3.43	4.93	5.36	6.17	5.69	4.11
A2B3 = R7	2.99	2.83	2.67	2.85	3.75	5.04	4.72	7.45	5.94	4.11
A2B4= R8	2.92	2.82	2.47	3.49	3.93	4.09	4.57	6.04	4.96	3.93
A3B1 = R9	2.47	3.10	2.83	2.84	3.89	4.11	5.76	6.29	5.86	4.07
A3B2= R10	2.85	3.27	2.72	3.01	3.85	4.35	5.29	6.43	5.83	4.11
A3B3= R11	2.77	3.39	2.42	2.66	3.77	4.53	5.23	7.24	5.75	4.04
A3B4= R12	2.93	2.93	2.22	3.27	4.03	4.21	5.37	6.79	6.90	4.15
SEM	0.241	0.346	0.272	0.147	0.259	0.286	0.358	0.652	0.455	0.102
Significance	NS	NS	NS	NS	NS	NS	NS	NS	*	*

*a-b: For each of the main effects, means within the same column with different superscripts differ significantly (P≤0.05). SEM=standard error of means; NS: not significant; *: significant; **: highly significant.*

Table (6): Effect of fed diets containing three levels of corn supplemented with enzyme or prebiotic or both on some carcass characteristics of 15-week-old growing rabbits.

Dietary treatment	LBW (g)	Dressing (%)	Skin wt. (g)	Lungs wt. (g)	Viscera wt. (g)	Liver wt. (g)	Heart wt.(g)	Kidneys wt. (g)	Total dressing (%)
Corn levels % (A):									
5% (A1)	2146.3	57.48	382.1	18.61^{a}	347.9	70.23	5.82	17.47	61.83
10% (A2)	2202.9	55.96	387.9	16.38^{b}	361.3	74.8	5.73	17.09	60.38
15% (A3)	2165.4	57.07	395.4	14.84^{c}	322.9	67.45	6.34	17.88	61.31
SEM	51.90	0.58	11.32	0.47	12.96	3.42	0.40	0.62	0.55
Significance	NS	NS	NS	**	NS	NS	NS	NS	NS
Supplements % (B):									
0.0% (B1)	2168.3	56.42	393.89	17.89^{a}	348.3	69.98^{ab}	5.2	17.5^{a}	60.69
0.05% E (B2)	2181.1	56.30	378.3	16.17^{bc}	366.1	80.23^{a}	6.21	19.1^{a}	61.14
0.05% P (B3)	2171.1	57.52	381.7	15.3^{c}	332.8	68.49^{ab}	6.49	15.4^{b}	61.67
0.05%E+0.05%	2165.6	57.1	400.00	17.1^{ab}	328.9	64.61^{b}	5.96	17.9^{a}	61.18
SEM	59.94	0.67	13.07	0.54	14.96	3.95	0.46	0.71	0.64
Significance	NS	NS	NS	**	NS	*	NS	**	NS
AB Interaction:									
A1B1 = R1	2070.0	56.41	381.7	21.1	333.3	66.83	4.70	18.00	60.73
A1B2 = R2	2286.7	56.89	398.3	18.07	446.7	78.53	6.07	19.77	61.45
A1B3 = R3	2140.0	58.21	361.7	16.30	313.3	78.30	5.87	14.30	62.79
A1B4= R4	2088.3	58.43	386.7	18.97	298.3	57.23	6.63	17.80	62.35
A2B1 = R5	2291.6	55.26	386.7	17.47	410.0	81.77	5.40	17.40	59.83
A2B2= R6	2131.7	55.31	371.7	16.53	331.7	82.63	5.70	18.10	60.30
A2B3 = R7	2166.7	56.41	383.3	15.50	355.0	63.57	6.77	15.27	60.34
A2B4= R8	2221.7	56.84	410.0	16.00	348.3	71.23	5.07	17.60	61.05
A3B1 = R9	2143.3	57.61	413.3	15.10	301.7	61.33	5.50	17.10	61.53
A3B2= R10	2125.0	56.69	365.0	13.90	320.0	79.53	6.87	19.43	61.68
A3B3= R11	2206.7	57.93	400.0	14.03	330.0	63.60	6.83	16.63	61.87
A3B4= R12	2186.7	56.03	403.3	16.33	340.0	65.37	5.17	18.37	60.14
SEM	103.81	1.16	22.64	0.94	25.92	6.84	0.79	1.24	1.11
Significance	NS	NS	NS	NS	**	NS	NS	NS	NS

*a-b: For each of the main effects, means within the same column with different superscripts differ significantly (P≤0.05). SEM=standard error of means; NS: not significant; *: significant; **: highly significant.*

Total dressing percentage= (carcass yield + edible organs/live body weight) X 100.

Table (7): Effect of fed diets containing three levels of corn supplemented with enzyme or prebiotic or both on economic efficiency of growing rabbits from 6 to 15 weeks of age.

Item	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
DMI (g/d)	86.60	91.20	90.2	91.5	89.17	88.4	89.6	88.90	90.23	87.5	90.63	90.1
Mean gain (g/d)	20.80	22.47	21.8	21.7	21.57	21.6	21.8	22.77	22.13	21.3	22.50	21.7
Feed cost (LE)	0.364	0.390	0.38	0.40	0.375	0.37	0.38	0.391	0.383	0.37	0.394	0.39
Meat price (LE)	0.728	0.783	0.76	0.75	0.751	0.75	0.76	0.793	0.775	0.74	0.788	0.75
Net revnue (LE)	0.364	0.393	0.37	0.35	0.376	0.37	0.37	0.402	0.392	0.36	0.394	0.36
Econ. Effic. (%)	100.0	100.8	95.9	88.8	100.3	99.2	96.9	102.8	102.4	97.4	100.0	90.2

CONCLUSION

Using corn in the rations of rabbits replacement of barley had no effect on growth performance and sanitary risk. Also, the using exogenous enzymes with prebiotics were slightly enhancing the growth performance and economic efficiency especially in the post-weaning period.

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تأثير التغذيه على مستويات مختلفة من الأذرة بدون أو بإضافة مخلوط الأنزيمات أو البريبيوتك على النمو والكفاءة الإقتصادية في علائق الارانب النامية

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استخدم عدد 108 أرنب (نيوزيلندى أبيض) عمر 6 أسابيع حديثى الفطام لدراسة تأثير التغذية على علائق تحتوى على ثلاث مستويات من الأذرة الصفراء مع إضافة مخلوط أنزيمات أو بريبيوتك أو مخلوط منهما على نمو وخصائص الذبيحة للأرانب النامية.

أجريت هذه الدراسة العاملية (4 × 3) حيث كان مستوى الأذرة 5 , 10 , 15 % وبدون أو بإضافة مخلوط الأنزيمات بمعدل (500 جم / طن عليقة) أو بريبيوتك بمعدل (500 جم / طن عليقة) أو مخلوط من كلاهما (500 جم مخلوط أنزيمات + 500 جم بريبيوتك / طن عليقة) / طن عليقة.

وزعت الأرانب عشوائيا (12 مجموعة تجريبية) حيث تحتوى كل منها على 3 مكررات بالتساوى فى المجاميع وكل مكررة تحتوى على 3 أرانب.

تم تغذية كل مجموعة على أى من العلائق التجريبية خلال الفترة من 6 – 15 أسبوع من عمر الأرانب وكان الغذاء والماء أمام الأرانب خلال فترة التجربة .

أشارت النتائج الى:

- زيادة وزن الأرانب معنويا عند عمر 7 أسابيع بالتغذية على علائق تحتوى على 5 , 15 % أذرة مقارنة بالتغذية على العليقة المحتوية على 10% أذرة ولكن لم تظهر فروق معنوية عند عمر 8 – 15 أسبوع.

- لم يظهر تأثير معنوى على كمية المأكول خلال فترة التجربة وكان متوسط المأكول 89,88 , 89,03 , 89,62 جم/يوم بالتغذية على علائق تحتوى 5 , 10 , 15 % أذرة على التوالى.

نستخلص من هذه الدراسة أنه تحسنت الكفاءة التحويلية بالتغذية على العليقة التى تحتوى على 10 % أذرة مع إضافة مخلوط أنزيمات مع البريبيوتك أو التغذية على العليقة التى تحتوى على 15 % أذرة بدون إضافات وكانت الكفاءة الأقتصادية 102,8 , 102,4 % على التوالى .