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EFFECT OF USING BIOGEN AS FEED ADDITIVE ON THE PRODUCTIVE PERFORMANCE OF GROWING RABBITS

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ABSTRACT: *Twenty four healthy V-Line growing rabbits, 5 weeks of age and initial live body weight (LBW) of 722 ± 27 g, were selected and randomly assigned to one of four dietary experimental groups of 6 rabbits in each. The four groups of rabbits received basal diet ad libitum (Control group; T1) and basal diet plus 0.5, 0.75 or 1.0 g Biogen / Kg diet in the other three treated groups (T2, T3 and T4, respectively). Growth performance traits till 14 weeks of age in terms of live body weight, daily weight gain, feed conversion ratio, carcass characteristics, blood traits and the economic impact of adding Biogen to growing rabbit diets were tested.*

The obtained results indicated that *LBW improved by about 4.29, 4.75 and 11.68%, respectively in T2, T3 and T4 groups supplemented with Biogen than the control (T1). Although there were no significant differences among tested groups in feed conversion ratio, the same groups recorded significant differences ($P<0.05$) in body weight gain, daily feed consumption, total feed consumption and performance index. Feeding growing rabbits with Biogen at the rate of 0.5 g/Kg diet is suitable to obtain healthy animals with fair values of both hematological and serum parameters. No significant differences among the four dietary treatments in both body and eviscerated weights (g) as well as most organ weights (g). The addition of Biogen at the rate of 0.75 g /Kg diet increased the economic efficiency and consequently the return from feeding such feed additive to growing rabbits.*

Conclusively*, it can be concluded from the results of this study that adding Biogen at the rate of 0.75 g/Kg feed to a rabbit's diet will be of*

positive impact on their sanitary status of the digestive system and consequently on growth performance traits, during 5 to14 weeks of age, without any negative effects.

Keywords: *Biogen, weight, feed conversion, blood, carcass, economic efficiency.*

INTRODUCTION

The use of feed additives, *e.g*. antibiotics, acidifiers, antioxidants, vitamins, minerals, amino acids, binders and enzymes to improve feed utilization in the livestock sector is an applied approach in different countries. This kind of feeding strategy is built upon the fact that supplying the host with enough available nutrients improves feed conversion ratio (FCR), thus become more important than looking to find the cost effectiveness of feed resources (Maertens and Gidenne, 2016). The use of antibiotics in animal feeding regimens was spread in the past century, but scientists found deleterious effects on human health as reviewed by El-Deeb and El-Gohary (2018). According to Attia *et al.* (2015) several attempts tried out a number of natural molecules as feed additives in animal nutrition alternatively to antibiotics. So, they looked for suitable alternatives that did not cause diseases in the long term for consumers of products from animals fed such compounds.

In recent decades, especially after banning antibiotics in 2006 by the European Community, different probiotics have been evaluated, such as oligosaccharides from different sources, e.g. yeast cell walls found mainly to act as ready to use nutriment by intestinal microflora (Bovera *et al.*, 2010). Attia *et al.* (2011a) indicated that this type of nutrients helps in optimize and improve the digestibility and health of animal. Several studies examined oligosaccharide-based products as an alternative to antibiotics in growing rabbit diets (Maertens *et al.*, 2004 and Bonai *et al.*, 2010) and rabbit dams' diets (Maertens *et al.*, 2013). Among these types of products, several experiments on many natural molecules (namely probiotics) as supplements and/or additives were tried out in animal nutrition as alternatives to antibiotic. Probiotics are of broad spectrum since it may include fungi, bacteria and yeast cells. Most of bacteria in the probiotic preparations are containing the genus *Bacillus* and *Lactobacillus*.

Such tried molecules (probiotics) produced in commercial names, *e.g*. Biogen, which contained all of these items or some yeasts, hydrolytic enzymes, saccharides and some useful bacterial strains. Some studies used such products to improve efficacy of feed utilization by rabbit does and their offspring (Fahim *et al.*, 2021). The advantage of using products such as Biogen may be due to its

content from colloidal silica that proved to be significantly advantageous for culturing cells (Taub *et al.*, 1998), which may provide these products its viability. Biogen contains beneficial microbes, e.g. *Bacillus subtilus* and organic acids such as lactic acid, which were found to affect the host animal throughout the microbial balance of its gastrointestinal tract (Azzaz *et al.*, 2019). Zeedan *et al.* (2014) concluded that Biogen–Zinc, as a probiotic, supplementation in dairy Damascus goats' ration improved nutrients digestibility, nutritive value, increased kids both born and weaning weights, milk yield and its composition, associated with better-feed conversion efficiency and economic efficiency as well.

Therefore, the aim of this study was to find out the impact of adding different levels of Biogen as a dietary additive on the growth performance traits, health status and economics of V-line rabbits, during period 5-14 weeks of age.

MATERIALS AND METHODS

This study was conducted at El-Serw Research Station, Animal and Poultry Research Institute, Agriculture Research Center, Ministry of Agriculture, Egypt.

Animals housing and management:

Twenty four healthy V-Line growing rabbits, 5 weeks of age and initial live body weight (LBW) of 722 ± 27 g, were selected and randomly assigned to four dietary experimental groups of 6 rabbits in each. Rabbits were experimented for their growth performance traits, during the period of 5 to 14 weeks of age starting with mean LBW almost similar in all treatments. All rabbits were kept on in a grower cage and fed their respective experimental diets. The used rabbits received basal diet *ad libitum* (Control group; T1) and the other three treated groups fed basal diet in addition to 0.5, 0.75 or 1.0 g Biogen / Kg diet in T2, T3 and T4, respectively.

The basal diet presented in Table (1) was prepared according to the feed composition tables for rabbits' feedstuffs established by feed composition tables for Animal And Poultry Feedstuffs used in Egypt (2001). Calculated analysis computed according to De Blas and Mateos (2010). The used Biogen manufactured by General Pharma Group and contained cell yeast walls (*Sacchromyces cerevisiae*), β-glucan-mannan oligo saccharide (500 g), *Bacillus subtilus* (200 g), lactic acid (50 g), colloidal silica (50 g) and calcium carbonate as carrier in one Kg.

Growth performance traits:

Live body weight (LBW) and daily feed consumption (DFC) were recorded. Daily weight gain (DWG) and feed conversion ratio (FCR) were

Table (1): Composition and calculated analysis of the basal diet

Ingredients	**%**
Barley grain	24.60
Alfalfa hay	31.00
Soy bean meal (44 %)	13.25
Wheat bran	28.00
Di-calcium phosphate	1.60
Limestone	0.95
Sodium chloride	0.30
Mineral-vitamin premix[(1)]	0.30
Total	**100**
Calculated analysis:	
Crude protein (%)	18.13
DE (Kcal / kg)	2752.6
Crude fiber (%)	12.27
Ether extract (%)	2.64
Total digestible nutrients (TDN %)	61.18
Calcium (%)	1.18
T. Phosphorus (%)	0.59
Available phosphorus (%)	0.42
Lysine (%)	0.78
Methionine (%)	0.35
Methionine + Cysteine (%)	0.58
Price (LE/kg)[(2)]	4.42

[(1)] **One kilogram of mineral–vitamin premix provided**: Vitamin A, 150,000 IU; Vitamin E, 100 mg; Vitamin K3, 21mg; Vitamin B_1, 10 mg; Vitamin B_2, 40 mg; Vitamin B_6, 15 mg; Pantothenic acid, 100 mg; Vitamin B_{12}, 0.1 mg; Niacin, 200 mg; Folic acid, 10 mg; Biotin, 0.5 mg; Choline chloride, 5000 mg; Fe, 0.3 mg; Mn, 600 mg; Cu, 50 mg; Co, 2 mg; Se, 1 mg and Zn, 450 mg.

[(2)] Price of one Kg (Egyptian pound / Kg) for different ingredients: Barley grain, 4.5.; Alfalfa hay, 3.6.; Soybean meal, 7.25; Wheat bran, 3.4.; Di-calcium, 12; limestone, 0.50; Premix, 28; Sodium chloride, 2 and Biogen, 200.

determined every 21 days and mortality rate were calculated. The performance index (%) was computed using the formula of North (1981) and Amber *et al.* (2004) on a group basis:

Performance index (%) = Final live body weight (Kg) / Feed conversion ratio x 100.

Hematological and serum biochemical parameters:

At the end of the experimental time, blood samples were taken in vial tubes containing EDTA as an anticoagulant from three rabbits per treatment to

determine some hematological traits which included RBCx10^{12}, HCT%, HEB (g/dl), WBCx10^{9}, N%, N/L, M% and E%**.** Another blood samples were collected without anticoagulant and kept at room temperature then the tubes were centrifuged at 3500 rpm for 20 minutes to separate clear serum. Afterward, blood serum was used to determine serum total protein, albumin, triglycerides, total cholesterol and liver enzymes activities by using appropriate commercial kits.

Carcass characteristics:

At the end of the study, five rabbits were taken randomly from each treatment, fasted for 12 hrs, weighed and slaughtered to estimate some of carcass traits. Carcass parts were presented as a percent of LBW, which included carcass weight as empty body weight, heart, liver, kidney weights as giblet weight and head weight.

Economic efficiency:

Economic efficiency (%) for weight gain was expressed as Kg rabbit production thought the study and estimated using Kilmer and Armbruster (1984) equation as following:

Economic efficiency (%) = (Net return, LE / Total feed cost, LE).

Where: Net return = Total return – Total feed cost.

Statistical analysis:

The obtained data was statistically analyzed using the General Linear Models (GLM) Procedure utilizing SAS Computer Software Package (SAS, 2004). The following model was used according to Snedecor and Cochran (1982) as follows:

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

Where: Y_{ij}=An observation; μ = Overall mean; T_i = Effect of Biogen levels (i= 1, 2, …4) and e_{ij}= Experimental error.

The Differences among treatments' means were tested using Duncan´s Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth performance and feed utilization:

Data in Table (2) clearly show that LBW in the Biogen added groups (T2, T3 and T4) at the end of the experimental period (14 weeks of age) improved by about 4.29, 4.75 and 11.68%, respectively than the control (T1). In the meantime, T4 found to be the best treatment in DWG (27.4 g *Vs.* 23.6, 24.6 and 24.8 g in T1, T2 and T3, respectively), during the whole experimental period. It is obvious that

Table (2): Effect of Biogen inclusion in the diet of growing rabbits on some growth performance traits, during different experimental periods

Treatment groups	LBW (g)				DWG (g)			
	5	**8**	**11**	**14**	**5-8**	**8-11**	**11-14**	**5-14**
T1	0.702	1.344	1.825^{ab}	2.191^{b}	30.6	22.9^{b}	17.4^{b}	23.6^{b}
T2	0.737	1.306	1.785^{b}	2.285^{ab}	27.1	22.8^{b}	23.8^{a}	24.6^{b}
T3	0.730	1.323	1.847^{ab}	2.295^{ab}	28.3	25.0^{b}	21.3^{ab}	24.8^{ab}
T4	0.720	1.380	2.059^{a}	2.447^{a}	31.5	32.3^{a}	18.5^{ab}	27.4^{a}
SEM	0.017	0.054	0.113	0.105	2.6	3.4	1.6	1.8
Significance	NS	NS	*	*	NS	*	*	*

a, b, c Means in the same row with different superscripts, differ significantly (P< 0.05)..
NS= Not significant; * P< 0.05 ; SEM = Standard Error of Mean;
T_1: Control diet, T_2, T_3 & T_4: 0.5, 0.75 and 1.0 g Biogen / Kg diet.
LBW: Live body weight, DWG: Daily weight gain

the significant (P<0.05) effect of adding Biogen to the diets of V-Line growing rabbits after 8 weeks of age with the superiority of the highest addition rate (1 g / Kg feed). This improvement in LBW and DWG can be attributed to the active compounds of the added Biogen components which may stimulate the digestive enzymes responsible for the improvement in nutrients' digestibility and absorption (El-Hack *et al.*, 2016 and Abouelezz *et al.*, 2019).

The earned benefit from using Biogen may be referred-back to the bypass of its constituents to the late digestion stage in the caecum. This opinion is supported by Bovera *et al.* (2010) who reported that as probiotics are not degraded in the stomach, they reach the intestine without any changes, thus supply a ready to use nutriments for intestinal microflora. Also, Attia *et al.* (2011) indicated that the digestion capacity improved and reflected positively on growth performance and animal health status in New Zealand White bucks fed different levels of bee pollen.

Regarding body weight gain of the growing V-line rabbits during the whole experimental period (5-14 weeks), data in Table (3) indicated that there are significant differences (P<0.05) among the tested groups in BWG, DFC, TFC and PI. These differences were not significant in FCR%. It is of interest to note that adding Biogen increased DFC as well as TFC with the superiority of the highest rate of added Biogen (T4). The consumed feed in the T4 group produced the highest (P<0.05) BWG compared to the other three tested groups (T1, T2 and T3). This improvement estimated by 15.98% for T4 *Vs.* 3.96 and 5.10 for T2 and T3, respectively, compared to T1 (The control).

Table (3): Effect of Biogen inclusion in the diet of growing rabbits on body weight gain (BWG), daily and total feed consumption (FC, g/rabbit) and feed conversion ratio (%), during the whole experimental period (5-14 weeks)

Parameters	**Experimental groups**					
	T1	**T2**	**T3**	**T4**	**SEM**	**Significance**
Total BWG (Kg)	1.489^{b}	1.548^{b}	1.565^{ab}	1.727^{a}	0.110	*
Daily FC (DFC)	112.00^{b}	115.67^{b}	110.33^{b}	127.00^{a}	3.210	*
Total FC (TFC)	7044.33^{b}	7301.67^{b}	6936.67^{b}	7993.33^{a}	202.938	*
FCR (g feed/g gain)	4.73	4.72	4.43	4.63	0.060	NS
Performance index (PI)	46.32^{c}	48.41^{b}	66.59^{a}	52.85^{bc}	3.947	*

a , b , c Means in the same row with different superscripts, differ significantly (P< 0.05).
NS= Not significant; * P< 0.05 ; SEM = Standard Error of Mean;
T_1: Control diet, T_2, T_3 & T_4: 0.5, 0.75 and 1.0 g Biogen / Kg diet.

The utilization of feed ingredients is closely tights to the availability of some nutrients such as minerals and water-soluble vitamins which is responsible for accelerating metabolism and thus increasing energy availability to the host (Attia *et al.*, 2014). Broadway *et al.* (2015) reported that such biotic products have positive both directly and indirectly effects on the immune system and its subsequent biomarkers, thus alleviating the negative effects accompanying to stress and/or disease. They added that these products may establish a healthy gastrointestinal tract simultaneously that reflected on enhancing growth and performance by increasing dry matter intake (DMI) and average daily gain (ADG) especially during stress periods. They also concluded that, yeast supplements appear to empower the ability to improve animal health and metabolism while decreasing morbidity, therefore increase profitability of animals.

Bovera *et al.* (2012 a & b) stated that feed additives in dietary treatments could increase feed digestibility due to increasing digestibility of structural carbohydrates as a direct result of the higher fermentative activity of the caecal microflora for structural carbohydrates and proteins.

The PI recorded the highest (P<0.05) value when rabbits fed the high amount of Biogen (T3 & T4) compared to the control and the other tested group (T1 & T2). These results are on line with Abdel-Azeem *et al.* (2007) who found that adding 2.5 g Biogen / Kg of rabbit diets improved significantly performance index (PI).

On the other hand, Hussein and El-Desoky (2011) found that PI values were not significantly affected with enzyme addition to the diets of growing rabbits.

Generally, several authors attributed the positive effect of different probiotic materials on growth performance to its antioxidant, antifungal, anti-inflammatory, immunomodulatory, antiviral, antibacterial and antiparasitic properties as reviewed by Attia *et al.* (2015).

Hematological and serum biochemical parameters:

Data in Table (4) exploring the measured values of some blood traits of the tested groups. The addition of 0.5 g Biogen/Kg diets of growing rabbits improved significantly ($P<0.05$) hemoglobin level, lymphocyte (L) and neutrophils (N) percentages, while it significantly ($P<0.05$) decreased N/L percentage, triglycerides, cholesterol and liver enzymes (AST & ALT). This indicated that the feeding growing rabbits with Biogen at the rate of 0.5 g/Kg diet is suitable to obtain healthy animals with fair values of both hematological and serum parameters. Haiam Abd Elhalim *et al.* (2007) found that the addition of Biogen, zinc bacitracin or their mixture to the diet of laying hens significantly ($P\leq0.05$) decreased egg yolk total lipids and serum triglyceride, total lipids and cholesterol, while treatments significantly ($P\leq0.05$) increased serum total protein and did not affect liver enzymes as compared with the control group. They also, added that the change in serum protein has a relation to feed conversion, absorption and utilization of nutrients. Moreover, Burdick Sanchez *et al.* (2015) reported that a yeast-based product was able to alleviate some of the negative effects accompanying to heat stress in high-producing dairy cattle. On the other hand, Belhassen *et al.* (2016) found that dietary administration of *S. cerevisiae* to growing rabbits did not alter its blood parameters.

Carcass characteristics:

Perusal of data in Table (5) showed that there were no significant differences among the four dietary treatments in both body and eviscerated weights (g) as well as most organ weights (g). The highest values of carcass traits were recorded when rabbits received 0.75 g Biogen/Kg diet (T3) compared to the other three dietary treatments (T1, T2 and T4).

Table (4): Effect of Biogen inclusion in the diets of growing rabbits on some Blood Hematological Serum biochemical and parameters of growing rabbits

Parameters	Experimental groups					
	T1	T2	T3	T4	SEM	Significance
Blood hematological parameters:						
RBCs ($x10^6$)	6.45	6.54	6.62	5.89	0.44	NS
Hemoglobin (Hb, g/dl)	10.33^b	10.50^b	12.57^a	11.83^a	0.25	*
HCT (%)	49.00	39.43	37.07	42.77	3.91	NS
WBCs ($x10^3$)	4.00	3.73	4.33	3.97	0.31	NS
Lymphocytes (%)	66.00^{ab}	56.33^b	72.33^a	58.67^b	3.59	*
Added	32.00^a	32.33^a	24.67^b	22.33^b	1.96	*
Monocytes (%)	9.00	10.00	9.33	10.00	0.44	NS
N/L (%)	0.48^b	0.57^a	0.34^c	0.39^c	0.03	*
Serum biochemical parameters:						
Total protein (g/dl):	4.87	4.78	5.27	4.60	0.23	NS
Albumin (g/dl)	2.50	2.40	2.50	2.37	0.06	NS
Globulin (g/dl)	2.37	2.39	2.29	2.38	2.38	NS
Triglycerides (mg/dl)	128.33^b	131.67^{ab}	121.67^b	145.00^a	4.56	*
Cholesterol (mg/dl)	85.67^a	62.00^b	56.67^b	64.00^b	3.38	*
LDL(mg/dl)	33.80	29.43	37.63	26.93	1.13	NS
HDL(mg/dl)	42.33	41.35	39.33	42.33	1.74	NS
AST (U/dl)	66.33^a	67.67^a	50.67^b	56.00^b	1.83	*
ALT (U/dl)	47.00^{ab}	47.67^a	31.00^c	41.00^b	1.94	*

a , b , c Means in the same row with different superscripts differ significantly ($P< 0.05$)..
NS= Not significant; * $P< 0.05$; SEM = Standard Error of Mean;
T_1: Control diet, T_2, T_3 & T_4: 0.5, 0.75 and 1.0 g Biogen / Kg diet.
LDL: Low density lipoprotein; HDL: High density lipoprotein, AST: aspartate aminotransferase; ALT: alanine aminotransferase; L: lymphocyte and N: Neutrophils.

The significant differences noticed in both liver and kidney weights (g) can be attributed to their activity in producing biochemical secretions. In this concern, Abo-Eid *et al.* (2020) attributed the increases in both liver and kidney weights to inflammatory and biochemical changes in the diets of rabbits fed diets with aflatoxins. The obtained results supported by findings of Bovera *et al.* (2012a) who indicated that the additives have a little or no effect in improving rabbit performance when the sanitary status of the farm is satisfactory. So, feed additives return can be slightly found or it cannot be able to give further improvement in increasing feed digestibility (Bovera *et al.*, 2012a). Similar trends on carcass characteristics and organs were reported by Coloni *et al.* (2006) and Coloni *et al.* (2007) who reported that the orally administrated propolis alcohol

Table (5): Effect of Biogen inclusion in the diets of growing rabbits on its carcass quality traits

Traits	Experimental groups				SEM	Significance
	T1	T_2	T_3	T_4		
Carcass quality traits						
Pre- slaughter body weight (g)	2021.67	2363.33	2501.67	2221.67	128.39	NS
Carcass weight (g)	1260.00	1425.00	1545.00	1426.67	118.75	NS
(%)	62.32	60.30	61.76	64.22	0.702	
Heart weight (g)	6.243	5.943	7.617	6.827	0.798	NS
(%)	0.497	0.413	0.517	0.480	0.063	NS
Liver weight (g)	65.00^{b}	71.67^{b}	101.67^{a}	68.33^{b}	6.455	*
(%)	5.147	5.023	6.793	4.823	0.559	NS
Kidney weight (g)	16.17^{bc}	17.05^{b}	19.67^{a}	14.38^{c}	0.727	*
(%)	1.293	1.193	1.333	1.007	0.124	NS
Giblet weight (g)	87.413	94.663	128.97	89.537	8.425	*
(%)	6.94	6.64	8.35	6.28	0.392	NS
Back quarter weight (g)	410.00	490.00	496.67	475.00	42.801	NS
(%)	32.53	34.36	31.96	33.36	0.802	
Front quarter weight (g)	348.33	326.67	346.67	326.67	41.315	NS
(%)	27.65^{a}	22.89^{b}	22.42^{b}	22.90^{b}	0.838	*
Trunk weight (g)	275.00	388.33	440.00	368.33	41.147	NS
(%)	21.75^{b}	27.29^{a}	28.11^{a}	25.86^{a}	0.869	*
Spleen weight (g)	1.213	1.497	1.560	1.340	0.158	NS
(%)	0.097	0.107	0.110	0.093	0.018	
Dressing weight (g)	1347.41	1519.66	1673.97	1516.21	57.760	NS
(%)	66.65	64.30	66.91	68.25	0.820	

a , b , c Means in the same row with different superscripts differ significantly (P< 0.05)..
NS= Not significant; * P< 0.05 , SEM = Standard Error of Mean;
T_1: Control diet, T_2, T_3 & T_4: 0.5, 0.75 and 1.0 g Biogen / Kg diet.
Dressing weight= Carcass weight+Giblet weight

extract (0, 0.8 and 1.5 ml) did not affect the carcass characteristics of growing NZW rabbits slaughtered at 84 days of age.

Economic efficiency:

The data in Table (6) indicated that the highest level of added Biogen (1g /Kg diet; T4) increased the total cost of feeding the growing rabbits compared to the other two adding levels and the control (T2, T3 and T1, respectively). This resulted in reducing the economic efficiency and consequently the relative

Table (6): Economic impact of Biogen inclusion in the diets of growing rabbits

Parameters	Experimental groups					
	T1	T2	T3	T4	SEM	Sig.
Total FC (Kg/rabbit)	7.044[b]	7.302[b]	6.937[b]	7.993[a]	0.203	*
Feed cost (LE/Kg)	5.00[d]	5.10[c]	5.15[b]	5.20[a]	0.037	NS
Total feed cost (LE/rabbit)	35.22[b]	37.24[b]	35.72[b]	41.56[a]	1.03	*
Total weight gained (Kg/ rabbit)	1.49	1.55	1.57	1.73	0.11	NS
Price of Kg LBW (LE)	40	40	40	40	-	-
Total return (LE/rabbit)	59.56	61.93	62.58	69.09	4.38	NS
Net return (LE/rabbit)	24.34	24.70	26.86	27.53	4.99	NS
Economic efficiency (EE)	0.70	0.68	0.75	0.67	0.15	NS
Relative economic efficiency	100	1.22	1.36	1.21	0.28	NS

a , b , c Means in the same row with different superscripts, differ significantly (P< 0.05).
NS= Not significant; * P< 0.05 , SEM = Standard Error of Mean;
T_1: Control diet, T_2, T_3 & T_4: 0.5, 0.75 and 1.0 g Biogen / Kg diet, LE = Egyptian pound
REE: Relative economic efficiency, Sign.: Significance

economic efficiency. The best economic return recorded for T3 compared to the other three tested groups. In this connection, Shahba (2011), on growing V-line rabbits, reported a significant improvement in economic efficiency when their feed supplemented with mannanoligosaccharides (MOS) compared to the control. On the other hand, Ismail *et al.* (2004) showed that feeding growing NZW rabbits (5–11 weeks of age) diets supplemented with yeast culture as Bio-MOS did not affect the economic efficiency compared to the control.

The positive trend of increased economic efficiency obtained herein is similar to that recorded by Attia *et al.* (2014) who found that efficiency and relative economic efficiency were significantly higher in growing NZW rabbits (35–91 days of age) supplemented-groups than the other un-supplemented ones.

In conclusion, the use of Biogen as a feed additive at the rate of 0.75 g/kg diet was superior to the other two tested levels (0.5 and 1 g) in maintaining the experimental growing rabbits' health and growth performance traits, during 5 to14 weeks of age, without any negative effects.

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تأثير استخدام البيوجين كإضافة علفية على الأداء الإنتاجي للأرانب النامية

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تم اختيار أربعة وعشرين أرانبًا نامياً من سلالة الفي لاين بعمر ٥ أسابيع ووزن جسم حي (LBW) يبلغ ٧٢٢ ± ٢٧ جم ، وتم توزيعها عشوائيًا على أربع مجموعات تجريبية تحتوي كل مجموعة على ٦ أرانب. غذيت المجموعات الأربع من الأرانب على العليقة الأساسية (المجموعة الضابطة "T1") وغذيت المجموعات الثانية والثالثة والرابعة على العليقة الأساسية بالإضافة إلى ٠.٥ أو ٠.٧٥ أو ١.٠ جم بيوجين / كجم عليقة (T2 و T3وT4 على التوالي). تم قياس مظاهر النمو حتى عمر ١٤ أسبوعًا من حيث وزن الجسم الحي ، والزيادة اليومية في الوزن ، ومعامل التحويل الغذائي ، وخصائص الذبيحة ، وصفات الدم والأثر الاقتصادي لإضافة البيوجين إلى عليقة الأرانب النامية. أشارت النتائج المتحصل عليها إلى أن وزن الجسم الحي تحسن بنحو ٤.٢٩ و ٤.٧٥ و ١١.٦٨٪ على التوالي في المجموعات المكملة بالبيوجين (T2 و T3 وT4) مقارنة بمجموعة الكونترول (T1). وبالرغم من عدم وجود فروق إحصائية بين المجموعات المختبرة في معامل التحويل الغذائي ، سجلت نفس المجموعات فروق معنوية ($P<0.05$) في الزيادة الوزنية للجسم الحي ، ومعدل الاستهلاك الغذائي اليومي، والاستهلاك الغذائي الكلي، ومؤشر الأداء. ووجد أن تغذية الأرانب النامية ببيوجين بمعدل ٠.٥ جم / كجم عليقة كان مناسباً للحصول على حيوانات صحية ذات قيم طبيعية لكل من معايير الدم والمصل. لم تسجل فروق إحصائية بين المعاملات الغذائية الأربعة في كل من وزن جسم الذبيحة والوزن منزوع الأحشاء (جم) وكذلك أوزان معظم الأعضاء (جم). أدت إضافة البيوجين بمعدل ٠.٧٥ جم / كجم عليقة إلى زيادة الكفاءة الاقتصادية وبالتالي العائد من تغذية مثل هذه الإضافات العلفية للأرانب النامية.

التوصية: يمكن الاستنتاج من نتائج هذه الدراسة أن إضافة البيوجين بمعدل ٠.٧٥ جم / كجم عليقة إلى عليقة الأرانب سيكون له تأثير إيجابي على الحالة الصحية للجهاز الهضمي وبالتالي على أداء النمو.