J.Animal and Poultry Prod., Mansoura Univ., Vol. 7 (1): 15 -22, 2016

GROWTH PERFORMANCE AND HEMATOLOGICAL PARAMETERS OF TURKEY POULTS AS AFFECTED BY EFEECTIVE MICROORGANISMS.

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ABSTRACT

The aim of this study was to determine the effects of dietary supplementation with effective microorganisms (EM) on the growth performance and some blood parameters in turkey poults. A total of 180 unsexed poults of the Bronze turkeys strain at age of 2 wk was randomly divided into five groups with three replicates (12 in each). Birds in the 1^{st} group (G1) were fed basal diet without additives (control), while those in the 2^{nd}, 3^{rd} and 4^{th} groups were fed the same diets supplemented with EM at levels of 5, 10 and 15 ml/kg diet, respectively. Birds in the 5^{th} group were fed the same diets supplemented with Lincomycin (2 g/kg diet). Live body weight (LBW), averages of daily gain (ADG) and feed intake (ADFI) and feed conversion ratio (FCR) were recorded at 2, 4, 8 and 12 wk of age. At the end of experimental period (12 wk of age), blood samples were taken to evaluate some hematological parameters including count of red (RBCs) and white (WBCs) blood cells as well as hemoglobin (Hb) concentration. Economic feed efficiency (EFE) was calculated. Results showed beneficial effects of adding 15 ml EM (G4) or 2 g Lincomycin per kg diet on LBW of poults, being the heaviest ($P \leq 0.05$) in G4 and G5. ADG was the highest ($P \leq 0.05$) in G4 and G5 as compared to control (G1) and other groups (G2 and G3) at 4-8, 8-12 and 2-12 wk of age. ADFI was higher ($P \leq 0.05$) in all treatment groups (G2-G5) than in G1 at the interval from 2 to 4 wk of age. ADFI was the highest in G2 and the lowest in G3 at other intervals and during the whole feeding period ($P \leq 0.05$). FCR at 2-4 wk of age was better ($P \leq 0.05$) in G4 and G5 than in G1. At 4-8, 8-12 or 2-12 wk of age, FCR was higher ($P \leq 0.05$) in G3, G4 and G5 than in G1 and G2, being the best ($P \leq 0.05$) in G5 and the poorest in G1. WBCs Count was higher ($P \leq 0.05$) in G4, and lower in G3 than in G1. but did not differ in G2, G5 from that in G1. RBCs Count and Hb concentration decreased ($P \leq 0.05$) only in G5. From the economic point of view, birds in G4 showed the highest EFE relative to control group (148%).

In conclusion, using effective microorganisms (15 ml EM/kg diet) instead of antibiotics (2 g Licomycin/kg diet) as growth promoters in diet of poults during the growing period (2-12 weeks of age) had beneficial effects on growth performance, healthy status and economic feed efficiency.

Keywords: Turkeys, antibiotic, effective microorganisms, growth, blood.

INTRODUCTION

During the last years, the poultry industry has increasingly developed due to new changes in factors affecting poultry production including nutrition, genetics and management in order to maximize the efficiency of growth performance and meat yield. But now, this industry has focused more on how to deliver safe foods for human. Consequently using antibiotics in poultry feeding was banned by the European Union in 2006 due to the potential development of antibiotic resistant human pathogenic bacteria after long use (Phillips, 1999; Ratcliff, 2000).

Accordingly, a new challenge is facing to develop alternatives of antibiotics that could enhance the natural defense of animals and reduce the massive use of antibiotics. In this respect, probiotics, enzymes, herbal products, prebiotics and synbiotic could be possible solutions. Many studies showed the positive effects of probiotic on performance of broiler (Apata, 2008; Awad *et al.*, 2009), hens (Capcarova *et al.*, 2010), turkeys (Capcarova, 2008), pigeons (Malíková *et al.*, 2013) and waterfowl (Weis *et al.*, 2008; Hrnčár *et al.*, 2013).

Role of probiotics to improve animal performance may due to maintain the normal intestinal microflora by competitive exclusion and antagonism (Kabir *et al.*, 2005; Kizerwetter-Swida and Binek, 2009) and enhance the non-pathogenic enteric bacteria (Mountzouris *et al.*, 2007; Yaman *et al.*, 2008). Recently, interested increasing in using Effective Microorganisms (EM) as a new branch of probiotics for poultry production have shown very good results for performance and disease control in poultry production. EM is a microbial preparation developed in Japan, consisting of live microorganisms which beneficially influence the host by improving the intestinal microbial balance (Fuller, 1989) including bacteria, yeasts and/or fungi.

The beneficial effects of EM were reported on improving growth performance of broilers including; feed intake, weight gain, feed conversion ratio (Yongzhen and Weijiong, 1994), egg production of chickens (El-Deep, 2011), and reducing the ammonia concentrations within the chicken houses (Yongzhen and Weijiong, 1994). On the other hand, performace of Muscovy ducks, broilers, chickens, laying hens and Japanese quail (Chantsawang and Watcharangkul, 1999) and Fayoumi laying hens and Horro Chicken (Wondmeneh *et al.*, 2011) were not affected by supplemented EM in drinking water and/or feed.

No available information in the literature concerning the use of microbial preparations in Turkey diets as a growth promoter instead of antibiotics. Therefore, the present study aimed to investigate the possibility to find antibiotic alternatives in turkey diet by using effective microorganisms (EM®) as a new branch of probiotics and its effects on growth performance parameters and some blood hematology of growing turkeys.

MATERIALS AND METHODS

This study was conducted at Turkey Research Branch, Mahallet Moussa Research Station, Kafrelsheikh Governorate, belonging to the Animal Production

Research Institute, Agricultural Research Center, Ministry of Agriculture, during the period from March to June, 2014.

Birds and feeding system:

A total of 180 unsexed poults of the Bronze turkey strain at two weeks of age was used in this study. The experimental poults were divided into five experimental groups (36 poults in each) in three replicates for each group (12 poults in each). Poults in all experimental groups were housed in open pens.

Feed and water were available *ad-libitum* throughout the experimental period of 10 weeks (from 2 up to 12 wk of age). All poults were kept under similar hygienic, environmental and managerial conditions.

Two basal diets were provided to birds during the experimental period the 1st diet, contained 26% crude protein and 2931 Kcal /kg as metabolizable energy from 2 to 8 wk of age (Brooding period). While, the 2nd diet, contained 21.37% crude protein and 3057 Kcal /kg as ME from 8 to 12 wk of age. Diets were supplemented with the required vitamins as recommended by NRC (1994). Composition of the basal diets is shown in Table (1).

Table (1): Composition and calculated CP and ME of the basal diets.

Ingredient (%)	Brooding diet (2-8 wk)	Growing diet (8-12 wk)
Yellow corn %	50.00	69.00
Soybean meal (44 % CP)	39.00	20.00
Fish meal (64 % CP)	10.00	10.00
Di-Calcium phosphate	---	0.10
Ground limestone	0.25	0.30
DL-methionine	---	0.10
L-Lysine	0.10	0.15
Premix *	0.25	0.10
Salt (sodium chloride)	0.25	0.25
Total	100	100
Calculated chemical analysis:		
Crude protein %	26.76	21.37
Metabolizable energy, ME (Kcal /kg)	2931	3057

- **Each 3 kilograms of premix contains the vitamin premix and trace minerals. The vitamin premix contributed the following: vit. A, 12.000.000 IU; vit. D3, 2.200.000 IU; vit. E, 10000 mg; vit. K, 2000 mg; vit. B1, 1000 mg; vit. B2, 4000 mg; vit. B12, 10 mg; vit. B6, 1000 mg; niacin, 20000 mg; pantothenic acid, 10000 mg; folic acid, 1000 mg and biotin, 50 mg. The trace mineral premix contributed the following: copper sulfate, 10000 mg; potassium iodide, 1000 mg; manganese oxide, 55000 mg; zinc oxide, 50000 mg; selenium, 100 mg; iron, 30000 mg.**

Experimental groups: The experimental birds were divided into five experimental groups as follows:

G_1: Birds were fed basal diet without supplementation (control).

G_2: Birds were fed basal diet supplemented with EM® (5 ml/kg diet).

G_3: Birds were fed basal diet supplemented with EM® (10 ml/kg diet).

G_4: Birds were fed basal diet supplemented with EM® (15 ml/kg diet).

G_5: Birds were fed basal diet supplemented with Lincomycin® (2g/kg diet.

Effective Microorganisms:

The EM used as a probiotics product in this study. It is commercial product produced by Ministry of Agriculture, Egypt. It was composed of different types of micro-organisms; *Lactobacillus* $2\times10^5/cm^3$: (*Lactobacillus plantarum* (ATCC8014), *Lactobacillus casei* (ATCC7469); *Streptococcus* $2\times10^5/cm^3$: *Streptococcus lactis* (IFO12007), *Streptomyces albus* (ATCC3004), *Streptomyces griseus* (IFO3358), *Rhodopseudomonas* $1\times10^5/cm^3$: *Rhodopseudomonas palustris* (ATCC17001), *Rhodobacter sphaeroides* (ATCC17023), Yeast $2\times10^6/cm^3$: *Saccharomyces cerevisiae* (IFO 0203), *Candida* $1\times10^3/cm^3$ *utilis* (IFO 0619), Fungi $100\times10^3/cm^3$: *Aspergillus oryzae* (IFO 5770) and *Mucor hiemalis* (IFO 8567). It was mixed to the basal diet at the levels of 5, 10 and 15 ml/kg diet, placed in well-tied bags for 5 days pre-feeding.

Experimental procedures:

Growth performance parameters:

Throughout the experimental period from 2 up to 12 weeks of age, individual live body weight (LBW) and cumulated feed intake were were recorded at 2, 4, 8 and 12 weeks of age then total weight gain and feed conversion ratio were calculated at 2-4, 4-8, 8-12 and 2-12 wk intervals. Also, mortality rate during the experimental period was recorded and economic feed efficiency (EFE) was computed as the following:

EFE% = {(price of total gain - total feed cost) x 100}/ total feed cost.

Blood sampling:

At the end of experimental period (12 weeks of age), blood samples were collected to evaluate some hematological blood parameters. Blood samples (3 ml) were taken from 3 birds/group by brachial vein puncture in tubes containing (EDTA) as anticoagulant for hematological examination.

Statistical analysis

Data obtained were statistically assessed by the analysis of variance (ANOVA) through General Linear Model procedure of SAS (2004) software. Duncan's (1955) multiple range test was used to test the significance of difference between means by considering the differences significant at $P \leq 0.05$.

RESULTS AND DISCUSSION

Growth performance:

Live Body weight:

Results shown in Table (2) revealed that live body weight of poults was significantly ($P \leq 0.05$) affected by dietary supplementation of EM.The heaviest LBW was recorded for G4 and G5 as compared to control (G1) at 4, 8 and 12 wk of age. Such results indicated beneficial effects of adding 15 ml EM (G4) or 2 g Lincomycin per kg diet on LBW of poults, being insignificantly ($P \geq 0.05$) heavier for poults fed diet supplemented with Lincomycin than those fed diet supplemented with 15 ml EM/kg.

Table (2): Effect of dietary supplementation with effective microorganisms (EM) or antibiotic (Lincomycin) on live body weight (g) of poults at different ages during the experimental period.

Age (wk)	Control (G1)	EM level/kg diet			Lincomycin	±SEM
		5 ml (G2)	10 ml (G3)	15 ml (G4)	2g/kg diet (G5)	
2	80.69	80.47	78.69	77.25	75.52	1.86
4	190.80^{b}	197.38^{ab}	206.08^{ab}	209.41^{a}	213.22^{a}	5.46
8	772.80^{b}	810.33^{b}	842.08^{b}	929.94^{a}	987.97^{a}	23.63
12	1655.69^{c}	1722.50^{bc}	1836.72^{b}	2074.86^{a}	2168.97^{a}	59.43

$^{a, b \text{ and } c}$: Means denoted within the same row with different superscripts are significantly different at $P \leq 0.05$.

It is of interest to note that effect of dietary EM or antibiotic supplementation on LBW appeared with advancing age, being marked effect at 8 wk of age and more pronounced effect at 12 wk of age in comparison with poults fed the control diet, which showed significantly ($P \leq 0.05$) the lightest LBW at all ages studied (Table 2).

The present results indicated significant ($P \leq 0.05$) increase of LBW for poults fed the highest EM level (15 ml/kg diet) as compared to lower levels. In the same way, El-Deep (2011) found that LBW was significantly ($P \leq 0.05$) increased when Inshas chickens were fed diet supplemented with high EM level (10 ml/kg diet) as compared to other levels.

Several methods for using EM to improve growth of poultry, in this way, A study was conducted by Ni and Li (1998) who reported that using of EM in drinking water at a level of 1ml EM/l improved the growth of poultry, increased egg production and the length of laying period. The egg production of some chicken was increased by 13%. For broilers, the rate of weight gain was faster, with better quality meat and efficiency of feed utilization. The ratio of feed to meat production was reduced by 10.24 % and the economic benefit was raised by 18.41%. In accordance with the present study, a positive effect of probiotics supplementation on LBW of birds was reported by several authors. In this respect, several authors showed that dietary probiotics supplementation have a significant influence on growth performance of broiler chickens (Islam *et al.,* 2014; Willis and Reid, 2008) and birds (Tollba *et al*., 2007; Abdalla *et al*., 2008; Madkour *et al*., 2008; Ashayerizadeh *et al*., 2009).

Concerning the observed improving of LBW in association with the antibiotic growth promoters in our study, several authors reported that supplementation of different types of antibiotics as growth promoters can improve growth performance and influence the microflora in the intestinal tract and affect the immune function of the intestinal in poultry. In this line, Khan and Nagra (2010) showed that the addition of Lincomycin as antibiotic growth promoter to broiler diets improved LBW as compared to control. Also, Sun (2004) found that the addition of Lincomycin to broilers diet significantly ($P \leq 0.05$) improved final body weight compared with control.

On the other hand, other authors (Karaoglu and Durdag, 2005; Gunal *et al*., 2006) found that insignificant effect of probiotics on LBW of birds as compared to control. Also, Li *et al.* (2006) showed that broiler diet supplemented with Lincomycin did not significantly ($P \leq 0.05$) affect growth performance of broilers. Finally, Proudfoot *et al*. (1990) concluded that the use of Lincomycin at a level of 2.2 mg/kg may not be effective in improving either the biological or economic performance of the broiler chicken.

Body weight gain:

Data presented in Table (3) showed that average daily gain (ADG) of poults was significantly ($P \leq 0.05$) affected by dietary supplementation, being the highest in G4 and G5 as compared to control (G1) and other groups (G2 and G3) at 4-8, 8-12 and during the whole experimental period (2-12) weeks of age. These results reflected the change in LBW of poults in all groups by advancing age, especially with dietary supplementation of 15 ml EM (G4) or 2 g Lincomycin/kg diet, by 26 and 32% as compared to control diet during the whole experimental period, but the differences between both additions were not significant.

Table (3): Effect of dietary supplementation with effective microorganisms (EM) or antibiotic (Lincomycin) on daily body weight gain (g) of poults at different age intervals of the experimental period.

Age (wk)	Control (G1)	EM level/kg diet			Lincomycin	±SEM
		5 ml (G2)	10 ml (G3)	15 ml (G4)	2g/kg diet (G5)	
2~4	7.86^{c}	8.35^{bc}	9.09^{ab}	9.44^{a}	9.83^{a}	0.30
4~8	20.78^{b}	21.89^{b}	22.71^{b}	25.73^{a}	27.66^{a}	0.70
8~12	31.53^{b}	32.57^{b}	35.52^{b}	40.89^{a}	42.17^{a}	1.48
2~12	22.50^{c}	23.45^{bc}	25.11^{b}	28.53^{a}	29.90^{a}	0.83

$^{a, b \text{ and } c}$: Means denoted within the same row with different superscripts are significantly different at $P \leq 0.05$.

These results are in agreement with those obtained by El-Deep (2011), who found that body weight gain of Inshas chickens was significantly ($P \leq 0.05$) increased with EM as compared to control. Also, Ni and Li (1998) found that body weight gain of broilers increased ($P \leq 0.05$) with dietary EM supplementation. Similar results were obtained by Yoruk *et al*. (2004); Safalaoh (2006); Xu *et al*. (2006) and Madkour *et al*. (2008), who found that body weight gain was improved in chicks fed diets with probiotics. Also, Willis and Reid (2008), who found that live body weight gain was significantly higher in broilers supplemented with probiotics. In addition, Shareef and Al-Dabbagh (2009) have shown that adding yeast (*Saccharomyces cerevisiae*) in feed for three weeks at rates of 1, 1.5 and 2% significantly increased body weight gains of all treated broiler chicks.

Regarding the impact of Lincomycin addition, several authors found that diets supplemented with Lincomycin increased body weight gain compared with unsupplemented diet (control). In this respect, Jiang *et al.* (2013) showed that daily weight gain of Lingnan yellow broiler was significantly improved as affected by antibiotics (Lincomycin, Zinc Bacitracin and Colistin). Khan and Nagra (2010) showed that the addition of Lincomycin as antibiotic growth promoter to broiler diets caused in improving weight gain. Sun (2004) found that the addition of Lincomycin to broilers diet significantly ($P \leq 0.05$) improved body weight gain compared with control.

On the other hand, other authors reported insignificant difference between body weight gain compared with control groups of broilers fed diet supplemented with Lincomycin (Proudfoot *et al*., 1990; Li *et al.*, 2006).

Feed intake:

Results of Table (4) revealed that feed intake was significantly ($P \leq 0.05$) higher in poults in all treatment groups (G2-G5) than in the control group (G1) at the interval from 2 to 4 weeks of age. However, feed intake was significantly ($P \leq 0.05$) the highest in G2 and the lowest in G3 at other intervals and during the whole feeding period, while poults in G4 and G5 showed nearly similar feed intake, being significantly ($P \leq 0.05$) higher than in control group (G1) at 4-8, 8-12 and 2-12 wk of age intervals.

Table (4): Effect of dietary supplementation with effective microorganisms (EM) or antibiotic (Lincomycin) on daily feed intake (g) of poults at different age intervals of the experimental period.

Age (wk)	Control (G1)	EM level/kg diet			Lincomycin	±SEM
		5 ml (G2)	10 ml (G3)	15 ml (G4)	2g/kg diet (G5)	
2-4	16.33^{b}	17.23^{a}	17.45^{a}	17.23^{a}	17.10^{a}	0.14
4-8	54.90^{b}	55.26^{a}	49.69^{d}	52.90^{c}	55.33^{a}	0.11
8-12	109.90^{b}	112.50^{a}	103.10^{e}	106.80^{c}	104.10^{d}	0.13
2-12	69.18^{b}	70.55^{a}	64.60^{d}	67.32^{c}	67.19^{c}	0.07

$^{a, b, c \ldots e}$: **Means denoted within the same row with different superscripts are significantly different at $P \leq 0.05$.**

In agreement with the present results, Jiang *et al.* (2013) studied the effect of different antibiotics as growth promoters (Lincomycin, Zinc Bacitracin and Colistin) on feed intake of Lingnan yellow broiler. They showed that average total feed intake was significantly improved as affected by antibiotics as compared to control. Also, Khan and Nagra (2010) and Sun (2004) showed that the addition of Lincomycin as antibiotic growth promoter to broiler diets caused in improving feed consumption compared with control group.

Feed conversion ratio:

Data of feed conversion ratio (FCR) in Table (5) showed that FCR at the interval from 2 to 4 wk of age was significantly ($P \leq 0.05$) better in G4 and G5 than in the control group (G1). During age intervals 4-8, 8-12 or 2-12 wk, FCR was significantly ($P \leq 0.05$) better in G3, G4 and G5 than in G1 and G2, being significantly ($P \leq 0.05$) the best in G5 and the poorest in G1.

Table (5): Effect of dietary supplementation with effective microorganisms (EM) or antibiotic (Lincomycin) on feed conversion ratio of poults at different age intervals of the experimental period.

Age (wk)	Control (G1)	EM level/kg diet			Lincomycin	±SEM
		5 ml (G2)	10 ml (G3)	15 ml (G4)	2g/kg diet (G5)	
2-4	2.17^{a}	2.12^{a}	2.00^{ab}	1.90^{b}	1.81^{b}	0.07
4-8	2.73^{a}	2.66^{a}	2.23^{b}	2.10^{b}	2.06^{b}	0.08
8-12	3.68^{a}	3.60^{a}	3.04^{b}	2.79^{bc}	2.64^{c}	0.12
2-12	3.18^{a}	3.11^{a}	2.64^{b}	2.45^{bc}	2.34^{c}	0.08

$^{a, b \text{ and } c}$: **Means denoted within the same row with different superscripts are significantly different at $P<0.05$.**

It is worthy noting that the best FCR in G4 and G5 (Table 5) was associated with significantly ($P \leq 0.05$) the lowest feed intake (Table 4) and highest weight gain (Table 3) of poults in both groups.

In accordance with the present results, feed efficiency of chickens was improved as affected by diet supplemented with EM (Safalaoh, 2006; Tollba *et al*., 2007). Also, other authors (Shareef and Al-Dabbagh, 2009) have shown that adding yeast (*Saccharomyces cerevisiae*) in feed for three weeks at the rate of 1, 1.5 and 2% in all treated broiler chicks, have significant increase on feed conversion. Concerning the addition of antibiotic as growth promoters, Jiang *et al.* (2013); Khan and Nagra (2010) and Sun (2004) found that the addition of Lincomycin to diet significantly ($P \leq 0.05$) improved feed conversion ratio of broilers compared with controls. On the other hand, no significant differences in FCR were observed when diet of broiler was supplemented with Lincomycin (Li *et al.*, 2006). However, Khan and Nagra (2010) showed that the addition of Lincomycin as antibiotic growth promoter to broiler diets caused insignificant effect in FCR between Lincomycin and control groups.

In general, improving growth performance parameters of poults fed EM as a growth promoter was associated with increasing meat quality (Islam *et al.*, 2014). The later authors found that probiotics supplementation have a significant influence on morphological changes of intestinal wall and immune response of broiler chickens. Also, Safalaoh (2006) concluded that EM have some beneficial effects in poultry production such as prevention of intestinal infections and improved nitrogen utilization. Moreover, Tariq *et al.* (2005) reported significant increase in digestibility of crude protein and crude fiber and growth performance of growing Rabbits supplemented with probiotic Lacto-sacc (Yeast culture & Lactic acid producing bacteria).

Hematological parameters:

Count of white (WBCs) and red (RBCs) blood cells as affected by the different dietary EM and lincomycin supplementation presented in Table (6) showed that WBCs count was significantly ($P \leq 0.05$) higher in G4, and lower in G3 than in G1 (control), while WBCs count did not differ significantly in G2, G5 from that in control (G1). Results also showed that RBCs count and hemoglobin concentration (Hb) significantly ($P \leq 0.05$) decreased only in G5. Which may suggest somewhat effect of antibiotic (Lincomycin) on reducing the production of RBCs count with their contents from Hb from spleen and/or breakdown of RBCs as affected by antibiotic.

Table (6): Effect of dietary supplementation with effective microorganisms (EM) or antibiotic (Lincomycin) on some hematological parameters of poults at end of the experimental period.

Experimental group	WBCs (x10^3/ul)	RBCs x10^6/ul)	Hb (g/dl)
G1 (control)	16.49^{ab}	2.28^{a}	14.22^{a}
G2 (5 ml EM/kg diet)	18.85^{ab}	2.40^{a}	14.47^{a}
G3 (10 ml EM/kg diet)	16.43^{b}	2.38^{a}	14.70^{a}
G4 (15 ml EM/kg diet)	19.17^{a}	2.29^{a}	14.07^{a}
G5 Lincomycin (2g/ kg diet)	17.24^{ab}	2.03^{b}	13.15^{b}
± SEM	0.82	0.063	0.19

$^{a\ and\ b}$: Means denoted within the same column with different superscripts are significantly different at P<0.05.

The EM is composed of different microbes that include bacteria, yeasts and/or fungi. Some of the benefits claimed to accrue from the use of EM include improved meat quality, improved animal health, and absence of toxic effects on bird growth (Zhang *et al.*, 2007). It was generally noticed that hemoglobin values nearly followed the same trend of RBCs count. These results agreed with (Tollba *et al.*, 2007). On the other hand, increasing count of WBCs as affected by the highest EM level (G4) may indicate that EM have an enhancement effect to the humoral and cell mediated immune response which agreed with that reported by (Miake *et al.*, 1985). Similarly, Tollba *et al.* (2007) indicated that an enhancement of immunity might be expected corresponding to adding probiotic.

Viability rate and economic feed efficiency:

It is worthy noting that viability rate was 100% in all experimental groups (Table 7). Although birds in G5 showed the highest total gain and consequently the highest price of total gain, birds fed EM at a level of 15 ml/kg diet (G4) showed the highest economic feed efficiency (EFE%) as compared to other groups (205.81 vs. 139.04-181.60%). From the economic point of view, also birds in G4 showed the highest EFE relative to control group (148%). This was due to cost of dietary supplementation with EM, being cheaper than Lincomycin.

These results agreed with those reported by El-Deep (2011), who concluded that the EM supplementation increased economic efficiency as compared control. Similar results were obtained by El-Huseiny *et al.* (2001) and Soliman *et al.* (2003).

Table (7): Economic efficiency of poults as affected by effective microorganisms (EM) and Lincomycin.

Item	Control (G1)	EM level/kg diet			Lincomycin
		5 ml (G2)	10 ml (G3)	15 ml (G4)	2g/kg diet (G5)
Viability rate (%)	100	100	100	100	100
Total feed intake (kg/bird)	4.84	4.93	4.52	4.71	4.70
Feeding cost (L.E.)/bird	18.39	18.88	17.40	18.22	21.15
Total gain (kg/bird)	1.57	1.64	1.75	1.99	2.09
Price of total gain (L.E.)/bird	43.96	45.92	49	55.72	58.52
EFE (%)	139.04	143.22	181.60	205.81	176.69
Relative EFE, %	100	103	130	148	127

Price of basal diet, EM, Lincomycin and weight gain are 4,15 L.E/kg, 4 L.E/l, 7.5 L.E/100g and 28 L.E/kg, respectively (according to 2014).

CONCLUSION

In conclusion, using effective microorganisms (15 ml EM/kg diet) instead of antibiotics (2 g Licomycin/kg diet) as growth promoters in diet of poults during the growing period (2-12 weeks of age) had beneficial effects on growth performance, healthy status and economic feed efficiency.

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تأثير الكائنات الحية الدقيقة النافعة على أداء النمو وقياسات الدم لكتاكيت الرومى.

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الهدف من هذة الدراسة هو تحديد تأثيرات إضافة البروبيوتك إلى العلائق بالكائنات الحية الدقيقة النافعة (EM) على أداء النمو وبعض قياسات الدم فى كتاكيت الرومى. تم إستخدام عدد ١٨٠ كتكوت رومى غير مجنس من سلالة البرونز الأسود عند عمر أسبوعين تم تقسيمهم عشوائياً إلى خمسة معاملات بثلاث مكررات (١٢ كتكوت لكل مكررة). الطيور فى المعاملة الاولى تغذت على عليقة أساسية بدون أى أضافات (كنترول). بينما الطيور فى المعاملات الثانية, الثالثة والرابعة تغذت على نفس العليقة مضاف إليها الكائنات الحية الدقيقة النافعة (EM) بمستوى ٥, ١٠ و ١٥ مل/كجم عليقة أساسية على التوالى. الطيور فى المعاملة الخامسة تغذت على نفس العليقة مضاف إليها لينكومايسين (٢جم/كجم عليقة أساسية). تم تسجيل وزن الجسم الحى, متوسط الزيادة اليومية فى وزن الجسم, الغذاء المستهلك ومعامل التحويل الغذائى عند أعمار ٢, ٤, ٨ و ١٢ أسبوع من العمر. فى نهاية الفترة التجريبية (عند عمر ١٢ أسبوع), تم أخذ عينات الدم لتقدير بعض قياسات الدم متضمنة عدد كرات الدم الحمراء وكرات الدم البيضاء بالإضافة إلى تركيز الهيموجلوبين. أيضاً تم حساب الكفاءة الأقتصادية للغذاء. أظهرت النتائج تأثيرات إيجابية لإضافة ١٥مل EM (المعاملة الرابعة) أو ٢جم لينكومايسين/كجم عليقة على وزن الجسم الحى, حيث سجلت المعاملة الرابعة والخامسة الأثقل معنوياً. الزيادة اليومية فى وزن الجسم كانت الأعلى معنوياً فى المعاملة الرابعة والخامسة مقارنة بالكنترول (المعاملة الأولى) وباقى المعاملات الأخرى (المعاملة الثانية والمعاملة الثالثة) عند ٤- ٨ , ٨- ١٢ و ٢- ١٢ أسبوع من العمر. متوسط الغذاء اليومى المستهلك كان أعلى معنوياً فى جميع المعاملات من الكنترول (المعاملة الأولى) خلال الفترة ٢- ٤ أسبوع من العمر. متوسط العلف اليومى المستهلك كان الأعلى معنوياً فى المعاملة الثانية والأقل فى المعاملة الثالثة خلال الفترات التجريبية الأخرى وفى جميع الفترة التجريبية. معامل التحويل الغذائى عند ٢- ٤ أسبوع كان الأفضل معنوياً فى المعاملة الرابعة والخامسة عن الكنترول. عند ٤- ٨, ٨- ١٢ و ٢- ١٢ أسبوع من العمر, معامل التحويل الغذائى كان الأعلى معنوياً فى المعاملة الثالثة والرابعة والخامسة عن الكنترول والمعاملة الثانية, حيث كانت المعاملة الخامسة الأفضل معنوياً والمعاملة الأولى (كنترول) الأقل. عدد كرات الدم البيضاء كان الأعلى فى المعاملة الرابعة, والأقل فى المعاملة الثالثة عن الكنترول. عدد كرات الدم البيضاء لم يتأثر فى المعاملة الثانية, المعاملة الخامسة عن الكنترول. عدد كرات الدم الحمراء وتركيز الهيموجلوبين أنخفضت معنوياً فقط فى المعاملة الخامسة. من وجهة النظر الأقتصادية, أيضاً أظهرت الطيور فى المعاملة الرابعة أعلى كفاءة إقتصادية مقارنة بالكنترول (١٤٨%).

الخلاصة: إستخدام الكائنات الحية الدقيقة بمعدل ١٥مل EM/كجم عليقة بدلاً من المضادات الحيوية (٢ جم لينكومايسين/كجم عليقة) كمنشط للنمو فى عليقة الكتاكيت أثناء فترة النمو (٢- ١٢ أسبوع من العمر) لها تأثيرات إيجابية على أداء النمو, الحالة الصحية والكفاءة الأقتصادية لكتاكيت الرومى.