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EFFECT OF SPIRULINA LEVELS ON NEW-ZEALAND WHITE RABBITS PERFORMANCE

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ABSTRACT: Twenty-four weanling New Zealand white rabbits (NWZ) at five weeks of age and nearly similar average body weight (682-693 g) randomly divided into four treatment groups (6 rabbits per group), each group was subdivided into three replicates (two rabbits per replicate). The 1st group fed the basal diet and given tap water without supplements as a control group, the 2nd and 3rd groups were given tap water and fed diet supplemented with spirulina at levels of 0.1 and 0.2% diet, respectively the experiment (8 weeks). Growth performance (live body weight, feed intake, daily weight gain and feed conversion ratio) and carcass traits were studied. Results obtained showed that, significant ($P<0.01$) promoting effect on *Spirulina platensis* at (0.1 and 0.2%) in the diet, significantly ($p<0.05$ or $p<0.01$) higher DBWG through 5-9 and 5-13 weeks of age with insignificant affect between them than in the control. While DBWG was significantly ($P<0.01$) higher in rabbits received diet, supplemented with 0.2% *spirulina* when compared with control and other treatment groups. the average of feed intake and feed conversion ratio of rabbits supplemented with spirulina at levels 0.1 and 0.2% in the diet were improved significantly ($p<0.05$ or $p<0.01$), when compared with control. The studied carcass traits (fore part, hind part, liver, head, heart, lung, kidney and dressing percntage) were significantly higher in growing rabbits fed on diet contained 0.1 and 0.2% spirulina compared with control group.

Key words: Rabbits, growth, performance, prebiotics, spirulina.

INTRODUCTION

Feed management is a cornerstone in ensuring pet rabbits welfare, and this is supported by the fact that the main reason pet rabbit owners consult veterinarians is because of health problems caused by incorrect nutrition **(Harrenstien, 1999).**

Recently, manufactures produced microorganisms commercially as growth promotors to substitute antibiotics in animal feeds to avoid its harmful effect on human health. The addition of prebiotic to the rabbit diets has been found to improve growth performance and feed conversion ratio in growing and breeding rabbits **(El-Hindawy *et al.*, 1993; Abdel-Azeem *et al*., 2009)**.

Lipopolysaccharides are the main components of the outer membrane of Gram-negative bacteria, induce strong immune responses Lipopolysaccharides of *Escherichia coli* (LPS)had a role in releasing IL-1, IL-6, or tumor necrosis factor (TNF) by macrophages (**Silhavy *et al.*, 2010).**

Spirulina (Arthrospira) is microscopic blue green algae, and it is considered one of the richest sources of organic nutrients which make it a good nutritional supplement in human and animal feed worldwide. Spirulina could potentially be used in poultry and animal

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nutrition to improve the productivity and quality of obtained meat **(Peiretti and Meineri, 2008).** It can act as a good growth and immune-modulator **(Jamil *et al*., 2015)** Spirulina has been trialed in the feed rations of commercially farmed meat rabbits. Using of Spirulina as a feed additive in rabbit diets not affect rabbit growth (**Peiretti and Meineri, 2008),** or carcass yields **(Peiretti and Meineri, 2011).**

Therefore, the aim of the present study was to investigate the effect of adding Inmunair 17.5 as prebiotic in drinking water and Spirulina platensis in the diet on growth performance and carcass traits of growing NZW rabbits.

MATERIALS AND METHODS

The present work was carried out at Department of Animal Production, Faculty of Agriculture, Zigzag University, Egypt. The practical part was carried out at Middle East for Veterinary vaccines (ME-VAC) El-Salhiya El-Gadida City, Sharkia Governorate, Egypt.

Twenty-four weanling New Zealand white rabbits (NWZ) rabbits at five weeks of age and nearly similar average body weight (682-693g) were randomly divided into three treatment groups (8 rabbits per group). Each group was subdivided into four replicates (Two rabbits per replicate). The 1st group fed the basal diet and given tap water without any supplement as a control group. The 2nd and 3rdh group were given tap water and fed diet supplemented with Spirulina at levels of 0.1 and 0.2% in the diet, respectively at all the period of experiment (8 weeks).

Animals were housed in galvanized wire cages, each cage was 40×30×25 cm in well ventilated place at laboratory animal house in ME-VAC. Tap water was automatically available all the time by stainless steel nipples. The rabbits were fed on basal diet that formulated to the level of the nutrient requirements of growing rabbits from 5 to13 weeks of age according to **NCR (1977).**

The composition andcalculated chemical analyses of experimental basal diet are presented in Table 1.

All rabbits were raised under the same management, hygienic and environmental conditions. Average ambient temperature and relative humidity during the experiment entire period were (27-29^{o}C) and (55-70%), respectively. The experimental period was extended for 8 weeks (5-13weaks of age).

Individual live body weight (BW), daily weight gain (DWF), feed intake (FI) and feed conversion ratio were recorded weekly during the experimental period. At the end of the experiment (13 weeks age), three rabbits were randomly chosen from each treatment group. The assigned rabbits were fasted for 16 hours before slaughtering, individually weighted as pre-slaughtered weight. Animals were slaughtered by cutting the jugular veins of the neck. When completed bleeding was achieved, slaughter weight was recorded. After skinning, the carcass was opened down and all viscera were removed.

The empty carcass, heart, liver, kidney and spleen were separately weight, dressing percentage was calculated according to **(Maria *etal*.,2012)**

Statistical Analysis

The differences among treatments were statically analyzed with a one–way ANOVA test in a completely randomized design according to **Snedecor and Cochran (1982)** as the following model:

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

Where:

Y_{ij}= dependent variable, μ= the overall mean, T_i = the fixed effect of treatment, e_{ij}=residual error. The significant differences among means were compared using Duncan's new multiple-range test **(Duncan, 1955)**.

RESULTS AND DISCUSSION

Growth performance as affected by *Spirulina platensis* on growth performance [average body weight (BW), daily body weight gain (DBWG), feed intake (FT) and feed conversion ratio (FCR)] are presented in Table 2.

Live Body Weight and Weight Gain

Concerning BW, the results obtained showed, significant ($p<0.01$) promoting effect on the live body weight and weight gain at 13 weeks of age in rabbit received 1m/1liter in drinking water for

Table 1. Formulation and calculated chemical composition of the basal diet

Ingredient*	(%)	Calculated chemical composition **	
Clover hay	16.00	DE (Kcal/kg)	2562.46
Soybean meal (44% CP)	19.40	CF (%)	13.37
Yellow corn	16.00	CP (%)	17.29
Wheat bran	33.62	Lysine %	0.90
Wheat straw	12.00	Methionine + cysteine (%)	0.56
Vitam. and Min. mixture*	0.20		
Bone meal	1.30		
Limestone	1.10		
Salt	0.30		
DL-Methionine	0.08		
Total	100.00		

* Each 3 Kg of Vitamamins and minerals mixture contains: Vitam. A 10000 IU; Vitam. D3 2000 IU; Vitam. E 50 mg; Vitam. K3 1000 mg; Vitam. B1 1000 mg; Vitam. B2 5000 mg; Vitam. B6 1500 mg; Vitam. B12 10 mg; Pantothenic acid 60 mg; Niacin 150 mg; Folic acid 1000 mg; Biotin 50 mg; Choline 12000 mg; Iodine 20 mg; Manganese 90 mg; Zinc 210 mg; Copper 10 mg; Iron 30 mg; Iodine 1000 mg; Selenium 100 mg; Cobalt 100 mg and Magnesium 40 mg.

Calculated composition according to **NRC (1977).

Table 2. Growth performance ($\bar{X}$ ± SE) of New Zealand White rabbits as affected by *Spirulina* addition

Treatment	Control	Spirulina 0.1%	Spirulina 0.2%	Sign.
Live body weight (g)				
5 week	695±69.8	683.7±51.4	689.3±52.2	NS
9 week	1409±91.2	1391.8±50.3	1420.1±50.0	NS
13 week	1809.0±112.6^{b}	1993.9±59.4^{ab}	2010.5±61.2^{a}	*
Daily body weight gain (g/day)				
5-9 week	25.5±.99^{b}	25.5±0.7^{b}	28.5±0.2^{a}	*
9-13 week	14.3±1.2^{c}	21.5±1.1^{b}	25.1±0.4^{b}	*
5-13 week	19.9±0.9^{b}	23.4±0.7^{a}	23.6±1.1^{a}	**
Feed intake (g/day)				
5-13week	75.72±6.3^{b}	81.4±7.2^{a}	82.65±6.9^{a}	*
Feed conversation				
5-13week	3.98±0.02^{a}	3.47±0.03^{b}	3.50±0.01^{b}	*

Means in the same column within each classification bearing different letters are significantly different NS = Not significant and ** ($P \leq 0.01$).

three days and 0.2% *spirulina platensis* in the diet compared with other treatments groups. On the other hand, the group fed 0.2% *Spirulina platensis* in the diet and control supplemented with 0.1% *Spirulina platensis* showed insignificant higher final BW (13weeks of age) than in control. The results showed that the average BW of rabbits given diet supplemented with 0.1or 0.2% *Spirulina platensis* were heaver by about 14.3, 9.2 and 10%, respectively when compared with control group.

With regard to DBWG, results in Table 2 show that, addition of *Spirulina platensis* at (0.1 and 0.2%) in the diet, significantly ($p<0.05$ or $p<0.01$) higher DBWG through 5-9 and 5-13 weeks of age with insignificant affect between them than in the control. While DBWG was significantly ($P<0.01$) higher in rabbits received diet, supplemented with 0.2% *spirulina* when compared with control and other treatment groups.

Improvement of growth performance (BW and DBWG) by *Spirulina platensis* supplementation to diet may be attributed to the synergetic effect of the chemical constituents of *Spirulina platensis* dried supplemented has an excellent nutrition profile (high carotenoids, high proteins which includes all of the essential amino acids and rich in mineral and Vitamamins **(Ross and Dominy, 1990).** Spirulina has shown to enhance immune function, reproduction and growth as reported by **(Qureshi *et al*., 1994; Khan *et al*., 2005).** Feeding *Spirulina* containing diet may increase the lactobacillus population and enhance the absorbability of dietary vitamamins **(Mariey *et al*., 2012).** In this respect, the effect of *Spirulina platensis* levels on rabbits was studied by **Kaoud (2013)** who showed that supplement of dry powder *spirulina platensis* (1 kg/ten of feed) for 6 week s to Hubbard broils chickens diet were significantly increased body weight and daily body weight gain as compared with control group. The same conclusion was reported by **Shanmugapriya and Saravana (2014) and Shanmugapriya *et al.* (2015)**, who showed that broiler chicken fed diet contained *Spirulina platensis* treatment (**Jamil, 2015).** Noted that the body weight of broiler chicks was significantly ($p<0.05$) increased in treatment groups fed with *Spirulina* diet (0.2, 4, and 8% *Spirulina*/kg) from 7^{th} to 28^{th} days. Contradicting results were obtained by **Saad (2007)** who revealed that, adding *Spirulina platensis* at level of 1 and 0.5 g/kg diet had insignificant effect on BW at 6, 8, 10 and 12 weeks of age and at the end of the experimental period (14 weeks of age). BWG during 4-8, 9-12 and 13-14 weeks of age. **Raach-Moujahed *et al*. (2011)** found that feeding Spirulina to diets to chicks for 38 days and increasing Spirulina rate in diet did not significantly affect body weight or daily body weight gain.

Moreover, **Abdel-Azeem *et al.* (2009)** found that live body weight and body weight gain of rabbits significantly ($p<0.01$) improved by prebiotics (400 mg bioplus 2 B/Kg feed) supplementation, on the other hand, **(Matusevicus *et al*., 2006)** found that addition of Bioplus 2B at level of 400mg/kg did not affect significantly the body weight and daily weight gain of rabbits, during the period between 35and 66 days of age.

Feed Intake and Feed Conversion Ratio

The effect of experiment of dietary *spirulina* supplementation on the average of feed intake and feed conversion ratio significantly ($p<0.05$ or $p<0.01$) improved as a result of improved daily body weight gain (Table 2) and showed the similar pattern which observed with the results of body weight gain. It is worth noting that, average feed intake of rabbits given 0.1and 0.2% *spirulina* in the diet were improved by about 5.6, 6.9 and 8.3%, respectively. The corresponding values of FCR were 18.12 and 12.1%, respectively when compared with control group (**Fuller, 1997).** Explained improvement of FCR values by prebiotics by the balance of microbial population reacted in the digestive tract and role of lactobacillus in preventing the harmful bacteria. **Ezzat *et al.* (1988)** reported similar result in lactobacillus preparation and expiration and explained that a possible increase in gut motility may occur in the presence of excessive number organism , there by altering nutrient availability for absorption, in addition to that other beneficial bacterial population may be altered, disrupting cohabitation of the established micro flora **(Miles,1993).** These results agree with **(Abdel-Azeem *et al*., 2009),** who found that average feed intake and feed conversion ratio in the growing rabbits were improved in group fed 200 mg lincofeed/diet. **Saad (2007)** indicated that, the highest value of feed intake was recorded by

chicks fed diet containing *Spirulina platensis* (0.5or1g/kg diet) compared with control group. **Shanmugapriya and Saravana (2014) and Shanmugapriya *et al.* (2015)** indicated that chick fed 10% of *Spirulina platensis* improved feed intake and feed conversion ratio compared with control group, however, **(Zahroojian; *et al.;* 2013)** showed that, feed intake and feed conversion ratio of laying hens were not significantly affected by the diet treatment of *Spirulina* levels (0, 1.5, 2.0 and 2.5%) at 63 weeks of age.

Carcass Traits

The average value of some carcass traits of growing rabbits as affected by additives supplementation are shown in Table 3. From results in Table 3, it could be noticed that, most carcass traits studied (carcass weight, fore part**,** hind part, liver, head, heart and lung, kidney and dressing) except spleen and lion were significantly ($p<0.5$ or $P<0.01$) higher in growing rabbit fed on diet contained 0.1 or 0.2% *Spirulina*, compared with control.

Our results Agree of with **Mariey *et al.* (2014**) who found that absolute weight of carcass, giblets and total edible part of broiler chicks was significantly ($p<0.05$) increased by dietary Spirulina groups compared with the control group. **(Shanmugapriya and Saravana, 2014)** reported that, represent meat weight , breast weight ,gizzard, liver and heart weight were increased and abdominal fat was decreased in chick fed diet containing 0.1% of Spirulina platensis compared with control and other treatment groups.

Conclusion

It could be use each of supplements and *Spirulina* (0.1% or 0.2%) as diet supplement for NZW rabbits which gave the best growth performance and carcass traits.

Table 3.Carcass traits ($\bar{X}$ ± SE) of New Zealand White rabbits as affected by Spirulina addition

Treatment	Control	Spirulina 0.1%	Spirulina 0.2%	Sign.
Carcass traits				
Carcass weight	911.0±16.6^{a}	1249.3±14.0^{B}	1258.8±10.1^{b}	*
Lion	221.7±14.8	286.3±16.8	289.1±19.3	NS
Forepart	240.0±10.0^{a}	291.0±10.5^{ab}	291.3±12.3^{ab}	*
Hind part	263.3±10.2^{a}	399.3±14.9^{b}	402.4±12.9^{b}	*
Liver	38.3±3.3^{a}	51.0±3.5^{B}	51.0±2.6^{b}	*
Head	130.0±12.9^{a}	191.7±12.5^{b}	193.±10.1^{b}	**
Heart and lung	8.7±0.7^{a}	16.3±2.9^{c}	16.5±1.0^{c}	*
Kidney	8.0±0.6^{a}	12.7±1.7^{b}	13.0±1.5^{b}	*
Spleen	1.0±02	1.3.0±0.3	1.4.0±0.4	NS
Dressing	57.0%	65.7%	62.6%	*

Means in the same column within each classification bearing different letters are significantly different. NS = Not significant and ** ($P \leq 0.01$).

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تأثيـــر مســـتويات الإســـبيرولينـــا علـــى أداء الأرانـب النيـوزيلنـديـة البيضـاء النامية

هند أحمد العقاد[1]- أسامة محمد عبدالمنعم[2]- ياسمين إبراهيم محمد موسى[2] – صلاح حمزه[3]

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تهدف هذه الدراسة إلى تقيم أثر الاسبيرولينا على أداء النمو فى الأرانب النامية عند عمر 5-13 أسبوع واستخدم فى هذه التجربة عدد 24 أرنب نيوزيلندي أبيض فى عمر 5أسابيع ومتساويين تقريبا فى وزن الجسم الإبتدائي 695 جم وزعت عشوائيا إلى 4 مجاميع (3 مكررات ولكل مكرره 2 أرنب) وقد تم إسكان كل مكرره في قفص مجلفن بأبعاد 40×30×25سم التجربة 8 أسابيع، ولقد أعطيت المجموعة الأولى عليقة وماء صنبور بدون إضافات (الكنترول) والمجموعة الثانية عليقه بدون إضافات وماء مضاف إليه فى بداية التجربة والمجموعة الثانيه والثالثه أعطيت طلحب الاسبيرولينا لمستوى (0.1 و0.2 عليقة على التوالي وماء الصنبور بدون إضافات وقد تم دراسة تأثير إضافة هذه المواد على أداء النمو (وزن الجسم – وزن الجسم المكتسب – معدل استهلاك الغذاء – ومعامل التحويل الغذائي) وكذلك على صفات أجزاء الذبيحة خلال الفترة العمرية (5-13 أسبوع)، وقد أظهرت النتائج تحسن معنوي ($p<0.05$) فى وزن الجسم عند الأسبوع وزن الجسم المكتسب عند الاسبوع 5 و9 و13 ومتوسط الغذاء المأكول ومعدل الكفاءة التحويلية فى الأرانب (0.1 و 0.2%)/ كجم عليقة طحلب الاسبيرولينا عند مقارنتها بالكنترول، تحسنت معظم أجزاء الذبيحة المدروسة (الجزء الأمامى- الجزء الأوسط - الكبد - الرأس - القلب - الرئة- الكليتين- ونسبة التصافى) ماعدا الجزء الخلفى والطحال تحسنا معنويا فى الأرانب التى أعطيت المعضد الحيوي(1مل/1 لتر ماء) فى ماء الشرب أو (0.1 و0.2%)/كجم عليقة طحلب الاسبيرولينا، ونستنتج من هذه الدراسة أن استخدم (0.1 و0.2%) /كجم عليقة طحلب الاسبيرولينا أعطى أفضل أداء للنمو وخصائص الذبيحة.

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