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EFFECT OF GRADED LEVELS OF (MANNAN OLIGOSACCHARIDE AND B-GLUCANS) AS A GROWTH PROMOTER ON PRODUCTIVE PERFORMANCE AND PHYSIOLOGICAL PERFORMANCE OF BROILER CHICKENS

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ABSTRACT: This experiment aimed to investigate the effect of incorporating graded levels (0, 0.2, 0.4, and 0.6%) of Agrimos® (Mannan Oligosaccharide and β-glucans as a source of antibiotic growth promoters (AGP) addition to growing chicken diets on growth performance, blood haematological and biochemical parameters throughout the fattening period of broiler chickens.A total number of 192 broiler chicks (Cobb500) were individually weighted and randomly assigned to four equal groups (48 each treatment). Each group is divided into four replicates, with 12 birds in each. Birds given 0.4 and 0.6% Agrimos® powder were substantially (P≤ 0.05) better in terms of body weight at 42 day and body weight gain through 0-21 days and at 42 days of age, as well as feed conversion ratio, than birds fed 0% and 0.2% Agrimos® powder through 0-21 days.The obtained results of the experiment showed that broiler chicken fed with 0.4 and 0.6% feed Agrimos® powder were substantially (P≤ 0.05) better in terms of final body weight and body weight gain, as well as feed conversion ratio, than birds fed 0% and 0.2% Agrimos®. Furthermore, the data revealed that birds fed a meal enriched with 0.6% Agrimos® powder had considerably (P≤ 0.05) higher feed conversion ratio at 42 days. The mean values of red blood cells, hemoglobin, packed cell volume, and white blood cells were within the normal range, and will not negatively impact on the health status of broiler chickens. Furthermore, total protein, globulin, and HDL-cholesterol concentrations in the diet containing 0.4 or 0.6% Agrimos® enhanced compared with the 0.0 and 0.2% treatments.While the opposite is observed with ALT, AST, glucose, total cholesterol, triglycerides, and low-density lipoprotein concentrations-Generally, it can be concluded that Agrimos® level 0.6% an alternative to antibiotic growth promoters in broiler chickens diet at the fattening period had a beneficent effect of productive performance and improved the physiological status and blood parameters.

Keywords: Agrimos, Broiler, productive performance, Lipids profile, Hematology Parameters.

INTRODUCTION

Today the intensive farming for poultry husbandry sector is instigated, which results in antibiotic residues in chicken-derived products, and eventually, antibiotic resistance is of great public health concern because the antibiotic-resistant bacteria associated with the chickens may be pathogenic to humans, in public concern over the usage of antibiotic growth promoters (AGP). As a result, several countries have banned the use of AGP, prompting dietitians to look for natural alternatives. Natural alternatives to sub therapeutic antimicrobials are increasingly being used to improve the performance and safety of broiler products (Abudabos et al., 2018).

Many feed additives, like enzymes, probiotics, and medicinal herbs, become accessible within the previous decade. Herbal feed additives are made up of various herbs, spices, and essential oils. As a result, feed additives that can reduce the risk of digestive diseases while also improving performance are valuable tools for poultry nutritionists.

Prebiotics like oligosaccharides that are not digested by mammalian enzymes (Gibson et al., 2010). Oligosaccharides like Mannan Oligosaccharide are thought to preferentially promote the beneficial microorganisms that already exist. Oligosaccharides offer two distinct benefits over probiotics: a technological advantage due to the lack of essential difficulties with feed thermal processing and stomach acid conditions, and a safety advantage due to the absence of alien microbial species in the gut (Falcão-e-Cunha et al., 2007). Prebiotics improve broiler digestion by increasing digestive enzyme activity (intestinal amylase and protease). And enhance intestinal architecture, increase absorption area, and improve the bird's energy and protein consumption. Prebiotics inhibit harmful bacteria while preserving helpful microorganisms in the gut. and have the ability to alter the intestinal environment by encouraging the designed to prohibit of harmful microorganisms and the selective colonization of good microbes, hence improving poultry performance measures (Biggs et al., 2007).

Mannan-oligosaccharides (MOS) and β-glucans are the two main components of yeast cell wall (YCW) that have been thought to contribute to its beneficial effects on host health and performance (Shao *et al.,* 2013). β-glucans are carbohydrate polymers that are fully composed of glucose. It has been observed that β-glucans influence cytokine profiles, phagocyte activity, and natural killer cell function (Anders et al., 2008).This study was designed to investigate the impact of dietary supplementation of Mannan Oligosaccharide (MOS) and β-glucans on some performance, blood hematology, and biochemistry of broiler chicks.

MATERIALS AND METHODS

Birds and experimental diets

The current study's experimental work was carried out at the Animal Production Department, Faculty of Agriculture, Sebha University, Libya. A total number of 192 *(Cobb500)* one-day-old of broiler chicks with the similar mean live body weights–from local commercial hatchery lab. Birds were individually weighted and randomly assigned to four equal groups (48 each treatment). Each group is divided into four replicates, with 12 birds in each. Each replicate for broiler chickens were reared in 1.5 × 1.5 m ground enclosures with wood shavings litter. Birds fed stater ration from one to 21 day of age, after that they fed the

finisher diet from 22 to 42 day of age Table 1.

All birds were housed under the identical managerial, sanitary, and environmental circumstances. Feeding and clean fresh water were provided *ad libitum*.

Individual body weights were weighed, and feed consumption (FC) was recorded weekly for each replicate. All chicks were given vaccines against against Newcastle via drinking water at the age of 18 and 28 d of old. Likewise, to protect chicks against infectious bronchitis (IB) disease they were vaccinated at 7 d of age and against Gambro at the age of 12 d Chicks were raised from the first d to 7th d together and under the same conditions. Body weight gain (BWG) and feed conversion ratio (FCR) were calculated for each replicate based on the BWG and FC during the same period. Four experimental diets are shown in Table (1). In this concern, graded levels of the Agrimos® were incorporated into experimental diets which were classified as follow:

Diet (1): Basal diet without Agrimos®, and served as control diet.

Diet (2): Basal diet with Agrimos®, at level 0.2%.

Diet (3): Basal diet with Agrimos®, at level 0.4%.

Diet (4): Basal diet with Agrimos®, at level 0.6%.

All diets had nearly iso-nutritive value according NRC (1994.

Chemical properties of Agrimos®

Agrimos® is a specific combination of Mannan Oligosaccharide (MOS) (26%±2%) and glucose (β-glucans) (27% ±2%) extracted from the yeast cell walls of *Saccharomyces Cerevisiae* which are separated by centrifugation, at high temperature and at a controlled pH and cell wall is spray dried. Agrimos®, a nutritional supplement manufactured by Lallemand Animal Nutrition, NA 6120 W. Douglas Ave. Milwaukee, WI 53218.

Blood Parameters

At the end of the experiment (at 42 day of age), blood samples were randomly taken from four birds for each treatment (one bird per replicate). About 3 mL of blood samples were collected before slaughtering from the brachial vein into vacationer tubes ethylene demine tetra acetic acid (EDTA) as an anticoagulant for hematological examination. Parameters determined include packed cell (PCV, %), red blood cells (RBC, 10^6/mm^3), white blood cells (WBC, 10^3/ mm^3) and hemoglobin, g/ 100 ml).

Another tube was also used without anticoagulant to collect serum blood for determination some blood biochemical constituents. Then, blood samples were centrifuged at 3500 rpm for 20 minutes to separate plasma or serum and were stored at -20°C for further analyses. Colorimetric methods using commercial kits produced by diamond diagnostics were used to estimate plasma total protein (g/dl), albumin (g/dl), globulin (g/ dl) level was calculated by subtracting the values of the total protein from albumin values─total cholesterol (mg/dl), high-density lipoprotein (HDL, mg/ dl) and low-density lipoprotein (LDL, mg/ dl), triglyceride (mg/ dl), glucose (mg/ dl), and alanine amino transferase (ALT, IU/ L) and aspartate amino transferase (AST, IU/ L) enzymatic activities. Albumin/globulin (A/G) ratio was calculated by dividing the values of the albumin per globulin values.

Statistical analysis

Collected data were subjected to statistical analyses by using the international software program GLM procedure (SAS, 2003). Data were

analyzed using one-way ANOVA and the experimental design was based on a completely randomized design. Tukey's test was carried out to compare the means of treatment at a 5% probability ($P \leq 0.05$). The statistical model used for this feeding trial was $Y_{ijk} = \mu + T_{ij} + E_{ijk}$, where Y_{ijk} = observation; μ = population mean; T_{ij} = effect of diet (AGRIMOS® powder); and E_{ijk} = experimental error.

RESULTS AND DISCUSSION

Productive performance

Table (2) shows the effect of Agrimos® supplementation on broiler performance. The results demonstrated that birds fed diets supplemented with 0.6% and 0.4% Agrimos® powder improved considerably ($P \leq 0.05$) live body weight, BWG, and FCR compared to those fed diets supplied with 0% and 0.2% Agrimos.

No significant differences in feed consumption were observed among the dietary interventions. The findings were in consistent with those of Taye et al. (2021), who showed that combining β-glucans with MOS resulted in heavier live body weights when compared to control group.

The improvement in body weight was linked to the phenomenon that carbohydrate may bind to the fimbria of bacteria, limiting harmful microorganism colonization of the gastrointestinal tract and also reduced pathogen colonization, hence boosting broiler performance. Likewise, the findings agreed with those published by Saleem et al. (2018) and Waqas et al. (2018). In contrast, Awaad et al. (2011) reported that combination of β-glucans and MOS at higher dose level (2kg/ton) has expressed nonsignificant differences on body weights of ochratoxicated broiler chickens . Also, the findings of Kamaran et al. (2013) , Corrigan et al. (2011) and Oliveira et al. (2008), contradict those of the current study. Furthermore, Moon et al. (2016) discovered that β-glucans addition to broiler diets had no statistically meaningful effect.

The MOS-based prebiotic improves broiler performance by inhibiting pathogenic bacteria with type-1 fimbriae (mannose-sensitive lectin), modulating intestinal architecture, and increasing the production of mucin and brush border enzymes (Ferket, 2004).

In terms of feed intake and feed conversion ratio (FCR), the current study disagreed with Ghahri et al. (2013), who reported a significant improvement in feed intake and FCR in the prebiotics supplemented group. In contrary, the current results agreed with Kamran et al. (2013), who concluded that prebiotic supplementation had no significant effect on feed intake and FCR.

Willis and Reid (2008) reported that prebiotic supplementation reduced the presence of *Clostridium jejuni* but had no significant effect on feed intake and FCR when prebiotics were used in the basal diet, whereas Mohan et al. (1996) reported that prebiotics incorporation with the basal diet improved feed intake and FCR and remained consistent in both the growing (0-21 d) and finishing periods (21–42 d).

hematological parameters and blood biochemical parameters

Table (3) shows the effect of mannan oligosaccharide (MOS) and β-glucans supplementation on hematological markers. Feeding meals enriched with 0.2%, 0.4%, and 0.6% mannan oligosaccharide (MOS) and β-glucans powder had considerably lower glucose level ($P \leq 0.05$) than the control group. Furthermore, as compared to the control group, broilers given a diet enriched with

mannan oligosaccharide (MOS) and β-glucans powder did not show a significant increase (P≤ 0.05) in total WBC, RBC, hemoglobin, PCV, and lymphocyte.

The effect of mannan oligosaccharide (MOS) and β-glucans supplementation on biochemical markers is shown in Table (4). The results show that feeding diets supplemented with mannan oligosaccharide (MOS) and β-glucans powder (0.4% and 0.6%) resulted in a significant (P≤ 0.05) decrease in (ALT, AST), total cholesterol, triglycerides, A/G ratio, and low-density lipoprotein (LDL) when compared to the control group and group 0.2% mannan oligosaccharide (MOS) and β-glucans.

Regarding liver function enzymes (ALT and AST), the findings indicated that the prebiotic has hepatoprotective properties. Our findings agreed with those of Yalçýnkaya et al. (2008), who found that included MOS (prebiotic) in the broiler feed resulted in a considerable reduction in AST and ALT levels. In the same context, Salim et al. (2011) discovered that prebiotics reduced AST and ALT levels in both infected and non-infected broiler chicks.

With respect to serum cholesterol, triglycerides, HDL, and LDL values which differed significantly amongst the four groups. These findings contradicted the findings of Yalçýnkaya et al. (2008), who found that using MOS in broiler feed did not significantly lower blood cholesterol and triglyceride levels when compared to the control group. Moreover, Ashayerizadeh et al. (2009) observed that the prebiotic (Biolex-MB) had no effect on cholesterol, triglyceride, HDL, LDL, or VLDL levels in broiler chicks. While, these findings contradicted those of Kannan et al. (2005), who found that using 0.5 g kg-1MOS derived from yeast in the feed of broiler chicks significantly lowered blood cholesterol levels on day 35 th when compared to the control.

On the other hand, the group of birds fed a diet supplemented with (0.4 and 0.6%) mannan oligosaccharide (MOS) and β-glucans powder showed a significant increase (P≤ 0.05) in high density lipoprotein (HDL), total protein , albumin, and globulin compared to the control group and group 0.2% mannan oligosaccharide (MOS) and β-glucans.

At 42 days, the broiler chicks given 0.6% mannan oligosaccharide (MOS) and β-glucans with basal diet had substantially higher globulin levels. In this concern, Helal et al. (2015) observed that there was a substantial rise (P≤ 0.05) in total protein levels and a significant decrease (P≤ 0.05) in albumin in broilers given prebiotics as compared to the antibiotic supplemented group and control. In the current investigation, when MOS was supplemented with a baseline diet, both protein and albumin levels increased when compared to the basal diet and antibacterial drugs. The current results were disagreed with Wang et al. (2015), who found that total protein levels were lowered (P≤ 0.05) after prebiotic supplementation with a baseline diet.

In terms of immune response criteria, the findings were in accordance with Griminger's (1986) findings, who premised that higher protein and albumin levels may indicate the improvement of disease resistance and immunological response in broiler chickens.

IN CONCLUSION,

under the conditions of the present study, feeding additives mixture Agrimos® (Mannan Oligosaccharide and *β*-glucans) as alternative antibiotic growth promoters to broiler chickens enhanced body weight gain and feed conversion, and positively altered hematological and biochemical parameters, with better effects of the high dose (0.6% Agrimos®).

Table (1): Ingredients and chemical composition of experimental starter and finisher diets for broiler chickens *(% of feed).*

Ingredients	**Starter diet 1 to 21 days**	**Finisher diet 22 to 42 day**
Yellow Corn	52.40	60.00
Soybean Meal 44%	29.00	26.05
Corn Gluten Meal	10.00	6.19
Di-calcium phosphate	2.20	2.05
Lime stone	1.10	1.00
Salt (NaCl)	0.25	0.25
Vegetable oil	4.55	4.00
L-lysine	0.15	0.15
DL-Methionine	0.05	0.01
Vitamin and Mineral Premix *	0.30	0.30
Total	100	100
Calculated analysis		
Crude potein (%)	22.09	18.02
Metabolizabll energy (kcal/ kg)	2975	3161
C/P ratio	134.67	175.41
Crude fat, %	3.79	6.3
Crude fiber	2.42	2.61
Calcium %	1.05	0.99
Available phosphorus,%	0.45	0.40
Methionine %	0.52	0.41
Lysine %	1.14	0.98

* Each 1 kg Premix contained: Vit A 3350000 IU Vit D3 760 000 IU Vit E 6700 IU Vit K3 335 mg Vit B1 334 mg Vit B2 1670 mg Vit B6 500 mg Vit B12 3.4 mg Niacin 10 000 mg , Ca.D. Pantothenate 3 334 mg Biotin 16.7 mg Folic acid 334 mg, Trace minerals: Iron 13 350 mg, Copper 3 335 mg Zinc 16 700 mg Manganese 25 000 mg Iodine 500 mgCobalt 84 mg Selenium 100 mg, Additives: Ethoxyquine 600 mg, and Carrier (Ca co3) up to 1 kg. **According to tables of NRC (1994).

Table(2): Effect of dietary supplementation of Agrimos® (Mannan Oligosaccharide and *β*-glucans) on productive performance of broiler chickens during at 0- 21 and 22-42 days of age.

Traits	**Agrimos® Levels**					
	0%	**0.2 %**	**0.4 %**	**0.6 %**	***SE***	***P* -value**
Overall mean LBW (g/bird)	2449.25^{C}	2446.80^{C}	2563.85^{b}	2635.31^{a}	15.219	≤0.05
BWG (g/bird)						
0–21 d of age	695.02^{C}	706.82^{C}	825.81^{b}	872.34^{a}	7.6771	≤0.05
22–42 d of age	1712.02	1700.21	1696.33	1721.28	17.191	<0.724
Overall mean BWG Gain	2407.29^{C}	2406.06^{C}	2522.14^{b}	2593.61^{a}	15.206	≤0.05
Feed consumption (g/bird)						
0–21 d of age	986.231	988.778	969.167	994.953	20.577	0.8335
22–42 d of age	3079.29	3082.13	3029.08	3100.89	28.734	0.3716
Overall mean FC (g/bird)	4065.52	4070.91	3998.25	4095.84	39.937	0.3900
Feed conversion ratio (FCR)						
0–21 d of age	1.41^{a}	1.40^{a}	1.18^{b}	1.14^{b}	0.0348	≤0.05
22–42 d of age	1.80	1.74	1.80	1.80	0.0418	0.754
Overall mean FCR	1.69^{a}	1.66$^{a\ b}$	1.59$^{a\ b}$	1.57^{b}	0.0232	≤0.05

$^{a, b, c}$Means within the same row with different superscript letters are significantly different at (P≤0.05)

Table (3): Effect of dietary supplementation of Agrimos® (Mannan Oligosaccharide and *β*-glucans) on hematological parameters of broiler chickens at 42 days of age.

Parameters	**Agrimos® Levels**					
	0%	**0.2 %**	**0.4 %**	**0.6 %**	***SE***	***P*-value**
WBC's, 10^3/mm^3	21.02	21.58	21.21	21.23	0.49785	0.8827
RBC's, 10^6/mm^3	2.89	2.91	2.87	2.81	0.05396	0.6006
Hemoglobin, g/dl	9.26	9.29	9.27	9.27	0.09837	0.9974
PCV, %	32.46	32.82	32.19	32.50	0.74049	0.9456
Lymphocytes, %	53.03	52.95	53.73	53.39	1.1081	0.9564
Glucose, g/dl	117.85^{a}	94.27^{b}	96.31^{b}	95.62^{b}	1.4130	≤0.05

$^{a, b, c}$Means within the same row with different superscript letters are significantly different at (P≤0.05)

Table (4): Effect of dietary supplementation of Agrimos® (Mannan Oligosaccharide and *β*-glucans) on blood biochemical parameters of broiler chickens at 42 days of age.

Parameters	Agrimos® Levels					
	0%	**0.2 %**	**0.4 %**	**0.6 %**	***SE***	***P-value***
Total cholesterol, mg/dl	121.75[a]	123.25[a]	113.00[b]	112.25[b]	1.2604	≤0.05
Triglycerides, mg/dl	67.17[a]	66.12[a]	54.13[b]	53.68[b]	1.4584	≤0.05
LDL-cholesterol, mg/dl	81.10[a]	68.57[b]	62.98[c]	62.21[c]	1.1461	≤0.05
HDL-cholesterol, mg/dl	38.41[b]	37.80[b]	47.31[a]	48.85[a]	1.2964	≤0.05
Total protein, g/dl	3.02[c]	3.08[c]	3.43[b]	3.85[a]	0.05933	≤0.05
Albumin, g/dl	1.17[ab]	1.13[b]	1.21[a]	1.20[a]	0.01425	≤0.05
Globulin, g/dl	1.85[c]	1.95[bc]	2.22[b]	2.65[a]	0.06471	≤0.05
A/G ratio	0.637[a]	0.581[a]	0.549[a]	0.453[b]	0.02106	≤0.05
ALT, IU/L	44.37[a]	42.94[a]	36.43[b]	36.86[b]	1.1322	≤0.05
AST, IU/L	55.45[a]	56.09[a]	47.27[b]	47.51[b]	0.86698	≤0.05

[a, b,] Means within the same row with different superscript letters are significantly different at (P≤0.05)

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الملخص العربي

تاثير اضافة المستويات المتدرجة من (المانان الويجوسكرايد و بيتا جلوكان) كمحفز للنمو على الاداء الانتاجي والفسيولوجي لدجاج اللحم

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اجريت هذه الدراسة بهدف تقييم التاثيرات الناتجة عن اضافة مستويات مختلفة متدرجة من الاجريموس (المانان الويجوسكرايد و بيتا جلوكان)بمستويات (0 ، 0.2 ، 0.4 ، 0.6٪) كمحفز للنمو على الاداء الانتاجي والفسيولوجي خلال فترة التجربة .

تم استخدام عدد 192 من كتاكيت اللحم وتوزيعها عشوائيا على 4 معاملات (48 لكل معاملة) وكل مجموعة مقسمة الى 4 مكررات بكل مكرر 12 كتكوت. كانت الطيور التي اعطيث 0.4 و0.6 % من الاجريموس افضل بشكل معنوي من حيث الوزن للجسم عند 42 يوم من العمر والزيادة الوزنية للجسم عند 0-21 يوم و42 يوم. وكذلك معامل تحويل العلف في الطيور المغداه على 0٪ و 0.2٪ الاجريموس خلال 0-21 يوم.

علاوة على ذلك ، أوضحت النتائج أن الطيور التي تم تغذيتها على وجبة غنية بالاجريموس بنسبة 0.6٪ كان لديها معامل تحويل علف افضل بشكل ملحوظ عند($P\leq 0.05$) عند عمر 42 يومًا. لم تكن هناك فروق معنوية في استهلاك العلف بين مستويات المدرجة التي تتغذى عليها الطيور ومجموعة الكنترول.

كانت قيم خلايا الدم الحمراء والهيموجلوبين وحجم الخلايا المعبأه وخلايا الدم البيضاء ضمن النطاق المعتاد للدجاج ، ولم تظهر أي علامات واضحة على وجود مشاكل صحية. علاوة على ذلك ، بالمقارنة مع المجموعة الضابطة و 0.2٪ من مسحوق الاجريموس ، فإن التغذية بنسبة 0.4 و 0.6٪ من مسحوق الاجريموس زاد بشكل كبير ($P\leq 0.05$) من البروتين الكلي والجلوبيولين و HDL.

بالإضافة إلى ذلك ، مقارنةً بالمجموعة الضابطة ، أدت مكملات الاجريموس إلى انخفاض مستويات ALT و AST والجلوكوز والكوليسترول الكلي والدهون الثلاثية والبروتين الدهني منخفض الكثافة. وفقًا لنتائج هذه الدراسة ، يمكن استخدام الاجريموس كخيار جيد كمحفزات نمو بديلة في علائق الطيور النامية ، ولم يكن هناك تأثير سلبي على أداء النمو وقياسات الدم الكيميوحيوية. نتيجة لذلك ، يُنصح بتضمين غذائي بنسبة 0.6٪ لتعزيز علف الطيور.