



EFFECTS OF ADDING MANNAN OLIGOSACCHARIDE AND β _GLUCANS IN DIET ON PRODUCTIVITY AND IMMUNITY LEVEL OF RABBITS

Marwa, Kharboush A. ; El-Raffa, A.M.; El-Dlebshany, Amira E.; Ataa A.M.A. and *Fahmi, K.N.

Poul. Prod..Dept., Fac. of Agric.e, Alexandria Univ.Nutr.and Clinic.Nutr. Dept., Fac. of Veter. Medic. , Cairo Univ

Corresponding author: amiraeldlebshany@yahoo.com

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ABSTRACT:This study was designed to investigate the effect of adding combination of Mannan Oligosaccharide and β _Glucans (Agrimos) in diet on productivity and immunity level of does and follow this effect of adding on growing rabbits. At the first experiment: A total of 64 V-Line Does at 5 months of age with an average body weight (3.4 \pm 0.23) Kg divided randomly into 2 treatment groups (n =32 does per group) which received two experimental diets (the basal diet for control group and 2 kg Agrimos /Ton basal diet for treatment group). At the second experiment: From the third parity at 4 week of ages a total number of 108 unsexed weaned V- Line rabbits which produced of each group does (control and treatment does) from the first experiment, was divided into three equal groups each group consisted of 36 rabbits (1st group was fed a basal diet and served as control; 2nd group was fed a basal diet with 1kg Agrimos/ ton and 3rd group was fed a basal diet with 2kg Agrimos/ ton.). Results of the current study are summarized as follows: The does which fed diet contained 2 kg Agrimos /Ton basal diet for treatment group recorded higher litter size at birth (10.41) than its fed basal diet (9.44) with significant differences. Also, the corresponding values of bunny number at weaning were (7.19) higher than its (6.62) but without significant differences. Also, the treated does (2 kg Agrimos /Ton basal diet) resulted in increases of white blood cells (WBC*10³), lymphocyte, Mid and IgG comparing with control does (8.98*10³, 52.59%, 10.82% and 691.39 mg/ml vs 8.29*10³, 44.55%, 10.16% and 597.75 mg/ml, respectively). These results indicated that improving of immunity level for treated doe rabbits by adding Agrimos in diet. Mean of body weight gain from 4 to 10 wks of age for growing rabbits which producing of treated does (1253.53 g/2wks/rabbit) had higher growth than its producing of control does (1076.60 g/2wks /rabbit) with significant differences. Also, the highest body weight gain from 4 to 10 wks of age (1292.00 g/2wks/rabbit) was obtained of fed 1 kg Agrimos/ ton basal diet for growing rabbits producing of treated does during the period of weaning to 10 wks of age. Means of white blood cells (WBC*10³), lymphocyte and Mid for growing rabbits which producing of treated does (9.83*10³, 46.49% and 11.53%, respectively) were higher values than its producing of control does (9.15*10³, 42.87% and 10.81, respectively). In conclusion, adding Mannan Oligosaccharide and β _Glucans (Agrimos) in rabbits diets significantly improved litter size at birth and immunological status of doe rabbits. And also, body weight gain from 4 wks to 10 wks and immunological status of growing rabbits.

Key Words: Mannan Oligosaccharide- β _Glucans– productivity- immunity-rabbits.

INTRODUCTION

During the commercial husbandry of rabbits problems always occur with infections of stomach and intestine. Prebiotics have been shown to alter gastrointestinal microflora, alter the immune system, reduce pathogen invasion including pathogens such as *Salmonella* spp. and *E. coli* (Cummings and Macfarlane, 2002). Prebiotics usually refers to oligosaccharides which are not digested by the animal enzymes (Falcao et al., 2007).

Oligosaccharides such as Mannan Oligosaccharide are supposed to selectively stimulate the beneficial microbes that already live there. Oligosaccharides have two clear advantages relative to probiotics: a technological one, because there are no critical problems with the thermal processing of the feed and the acid conditions of the stomach, and a safety one, because they do not introduce foreign microbial species into the gut (Falcao et al., 2007). Mannan oligosaccharides are indigestible complex polysaccharide molecules derived from yeast cell walls. Mannose is a monosaccharide that forms the building block of MOS. The small intestine does not contain the digestive enzymes required to break down mannan oligosaccharide bonds, therefore they arrive at the large intestine intact after ingestion and passage through the small intestine (Strickling *et al.* 2000). In rabbit production, mannan oligosaccharides (MOS) are considered promising prebiotics (Bovera *et al.*, 2010). Attia *et al.* (2015a) reported that all the supplements and prebiotics (MOS 35 mg/kg BW) had similar ability to decrease the number of services to achieve pregnancy and to increase fertility than the control group; groups receiving supplements or prebiotics (MOS) had greater litter size, body weight of kits at birth and number of kits born

alive than the control; groups receiving supplements or prebiotics (MOS) highest growth of kits, milk yield and milk conversion ratio during days 1-28 of age than the control group. β -glucans are carbohydrate polymers consisting entirely of glucose. β -glucans have been reported to modulate cytokine profiles and phagocyte activity and natural killer cell function (Anders et al., 2008). The β -glucan component in the *Saccharomyces cerevisiae* cell wall, with the function of maintaining the rigidity and shape of the cell, is often named simply glucan or yeast glucan. That polysaccharide consists mainly of a linear central backbone of D-glucose linked in the β -(1 \rightarrow 3) position with glucose side branches (β -(1 \rightarrow 6)-linkage) of various sizes, which occurs at different intervals along the central backbone (Gardiner, 2000). The innermost layer of the yeast cell wall is built of β -glucans, proteins, mannan and small amounts of chitin (Vetvicka, 2001). Shendare *et al.* 2008 reported that the inclusion of growth promoter Mannan oligosaccharide & β -glucans shows significantly higher body weight gain, improvement in feed efficiency and less mortality as compared to the control diet. This study was designed to investigate the effect of adding combination of Mannan Oligosaccharide and β -Glucans in diet on productivity and immunity level of does and follow this effect of adding on growing rabbits.

MATERIALS AND METHODS

The present study was carried out at the Poultry Research Center, Poultry Production department, Faculty of Agriculture, Alexandria University, during the period from November 2013 to June 2014.

2. Experimental animals:

The rabbits (*Oryctolagus cuniculus*) used in the current study were known as the V

line rabbits. Line V is a developed maternal line originated in 1981 at the Department of Animal Science of the Universidad Politecnica de Valencia, Spain (*Baselga, 2002*). Litter size at weaning was considered as the criterion for selection in this line. A set of V line rabbits was imported to poultry research centre, Alexandria University at the end of year 1998 (El-Raffa, 2000) multiplied for five years and after that the selection was continued under the same criterion.

2. Housing and Management:

Breeding does and bucks were housed individually in commercial type wire cage batteries with standard dimensions of (75× 50× 40 cm) for length, width and height, respectively allocated in two rows along the house. Cage of each doe was provided with a metal box with dimensions of (40× 35× 30 cm) for kindling. The batteries used were suspended 110 cm above floor level. Cages of all does were cleaned at the same above the first experiment. Mating was carried out in the morning, each doe was transferred to buck's cage to mated and returned to her cage after mating bred pregnancy was diagnosed by abdominal palpation at the 14 days post mating to determine pregnancy.

Does were failed to conceive were immediately returned after palpation to the buck for another service till conception was occurred. On the 26th day of pregnancy, the nest boxes were supplied with thick layer of rice straw was placed in the bottom of the nest box to help the doe in preparing a worm comfortable nest for her bunnies. Nesting boxes were attached to the cages of pregnant does. At the 33rd day of pregnancy, the birth was released by an injection of oxytocin in case the doe had not littered until then. Litters born were examined and recorded for total litter size born, litter size born alive and litter weight at birth. Does were reamed 10-11 days after kindling (semi-intensive system). At four weeks of age, bunnies were weaned, sexed,

individually weighted, and ear-numbered by tattoo machine and transferred to the progeny cages in groups of 4 rabbits per cage for the fattening period.

Growing rabbits were housed in galvanized wire cage battery with standard dimensions of (50× 45×40 cm) for length, width and height, respectively. The batteries used were suspended 110 cm above floor level. The cage of each battery has girded wire floor separated the rabbits completely from its excreta. All rabbits were kept under the same hygienic and environmental conditions during the experimental period.

3. Experimental designs:

3.1. The First Experiment:

A total of 64 V-Line Does at 5 months of age with an average body weight (3.4± 0.23) Kg of V-Line females and with 16 bucks (1 buck :4 does) at 6 months of age an average body weight (3.22± 0.20) Kg allocated for two treatments (figure 1). Rabbits were randomly divided into 2 treatment groups (n =32 doe per group) which received two experimental diets (the basal pellet diet contained 17.87% crude protein, 14.62% crude fiber, 2.70% fat and 2592 kcal/kg diet and provided with all required vitamins and minerals as recommended by N.R.C, 1994). Data were collected on each doe of the two groups for three successive parturitions during the experiment period of the study.

1. Control group which received the basal diet.

2. Treatment group which received 2 kg Agrimos (Mannan Oligosaccharide and β _Glucans) /Ton of the basal diet.

3.2. The Second Experiment (Growing rabbit):

From the third parity at 4 week of ages a total number of 108 unsexed weaned V-Line rabbits which produced of each group

does (control and treatment does) from the first experiment, was divided into three equal groups (36 rabbits in each) used in the present experiment. Each group was divided into three equal replicates.

The three groups which produced of each of control or treatment does were fed the same basal diet and submitted to the following treatments (figure 1).

1st group was fed a basal diet and served as control.

2nd group was fed a basal diet with 1kg Agrimos/ ton.

3rd group was fed a basal diet with 2kg Agrimos/ ton.

4. Data collected

4.1. Reproductive performance:

Data were collected on does traits were conception rate (CR), number born alive (NBA) and number born dead (NBD) and litter size at birth (LSB) and bunny number at weaning (NW), for litters produced by 32 does from each treatment which inseminated by fertile bucks for 3 consecutive parities.

4.2. Live Body Weight Gain (LBWG):

Individual body weight was biweekly taken from the beginning of 4 week of age until the end of the experiment at 10 weeks of age. Weighing was done in the morning before receiving feed and water. Live body weight gain was calculated by subtracting the initial live body from final ones of each growth through studied period.

4.3. Immunity level:

At the first experimental, Blood samples were carried out every one day after

parturition from five doe (randomly chosen) in the treated groups and continued throughout the experimental period. However, at the end of second experimental period (10 weeks of age), total number of 30 animals were fasted overnight then sacrificed (5 rabbit/group). Blood samples were withdrawn from the central ear artery in clean and dried Wiesserman tubes, heparin was used as anticoagulation but in part of samples, it was with held to obtain serum. Serum was obtained by centrifugation the blood at 3000 rpm for 20 minutes, and was stored at- 20 C for later analysis.

4.3.1. Blood hematological parameters:

White blood cells (WBC x 10³) counts:

White blood cells counts were counted in fresh blood sample as the method described by Helper (1966), and Hawkeye & Dennett (1989), were counted on an AOB right line haemocytometer using a light microscope at 400 X magnification after diluting blood samples 200 times with a physiological saline (0.9% NaCl solution) before counting.

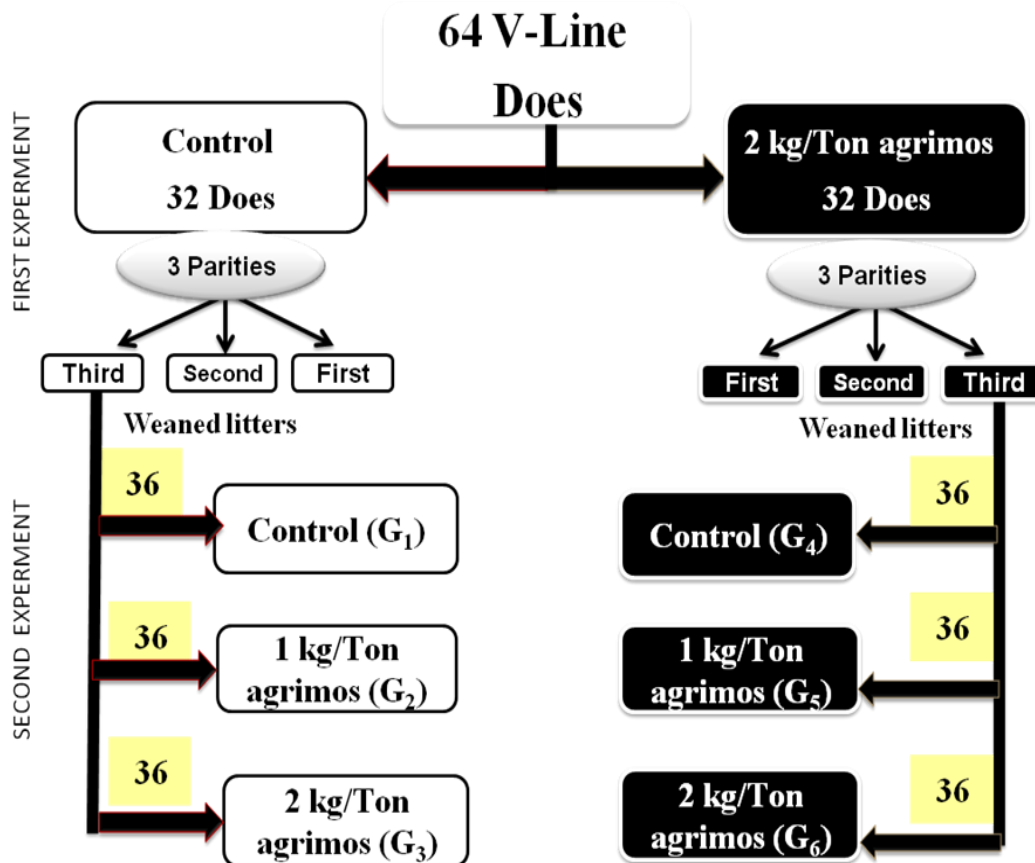
White Blood Cell Differential count:

Determines the percentage of Lymphocyte; Heterophils; mid-range percent (Mid%) and Heterophils / Lymphocyte ratio (H/L).

4.3.2. Blood biochemical characteristics:

Serum immunoglobulin types IgG (mg/mL):

Serum immunoglobulin types IgG were determined using ELISA technique



Figure(1) : A representative drawing for the experimental design .

5. Statistical Procedure:

The statistical analyses of the data were carried out by using the international software program (SAS, 2003). Data were analyzed by adapting the following fixed linear model: The application of the least significant ranges among different treatment means was done according to Duncan (1955).

The following statistical model was used in the first experiment:

$$Y_{ijk} = \mu + T_i + P_j + (TP)_{ij} + e_{ijk}$$

Y_{ijk} = The observation of the parameter measured,

μ = The overall mean,

T_i = The effect of dietary treatment for doe rabbits, $i = (1, 2)$,

P_j = The effect of parity, ($j=1, 2$ and 3),

$(TP)_{ij}$ = Interaction between parity and treatment,

e_{ijk} = The experimental random error.

The following statistical model was used in the second experiment:

$$Y_{ijk} = \mu + D_i + T_j + (DT)_{ij} + e_{ijk}$$

Where:

Y_{ijk} = The observation of the parameter measured,

μ = The overall mean,

D_i = The effect of treatment Does at first experiment, $i = (1, 2)$,

T_j = The effect of dietary treatment for growing rabbits, $j = (1, 2, 3)$,

$(DT)_{ij}$ = Interaction between Doe and treatment,

e_{ijk} = The experimental random error.

RESULTS AND DISCUSSION

4.1. The first experiment on doe rabbits:

4.1.1. Effect of Mannan Oligosaccharide and β _Glucans supplementation in diet for different parities on reproductive traits:

Results in Table (1) show that the effect of Mannan Oligosaccharide and β _Glucans level (2 kg Agrimos/ ton feed) supplementation in diet of doe rabbits V-line on conception rate (%) (CR), number born alive (NBA), number born dead (NBD), litter size at birth (LSB) and bunny number at weaning (NW). Analysis of Variance data indicated that the NBD and LSB was significantly ($P \leq 0.05$) higher in Agrimos treatment than control does. The percentages of that increase of Agrimos treatment compared with control were 70.27 %, 10.28 % respectively, but CR; NBA and NW were not significant affected. Moreover, the results of Table (1) revealed that overall mean of LSB at the parity three was increased significantly compared with parity two by 9.39% but were not significant with parity four, but CR; NBD and NW were not significant affected by parity number.

Concerning of the interaction effect between the Agrimos levels and the parity number were not statistically significantly effect on C.R; NBA; NBD; LSB and NW.

Results herein are in a good agreement with that obtained by Wu *et al.*, (2011) who noted dietary supplementation of 0.064% β -1,3-1,6-glucan or 0.128% β -1,3-1,6-glucan had no adverse effects on the reproductive performance and body weight of does.

In line with the present findings, Attia *et al.*, (2015a) reported that groups receiving prebiotics (MOS) of V-line doe rabbits had greater litter size than the control. The prebiotics (MOS 35 mg/kg BW) had similar ability to decrease the number of services to achieve pregnancy and to increase fertility than the control group.

4.1.2. Effect of Mannan Oligosaccharide and β _Glucans supplementation in diet for different parities on immunity parameters:

The effects of Mannan Oligosaccharide and β _Glucans level (2 kg Agrimos/ ton feed) supplementation in diet on does rabbits V-Line blood white blood cells count (WBCs); Lymphocyte; Heterophils; Lymphocyte/ Heterophils ratio (H/L); mid-range percentage (Mid %) and immunoglobulin G (IgG) in blood at one day after parturition presented in Table (2). It is clear from the data that the Lymphocyte was significantly ($P \leq 0.05$) higher in Agrimos treatment than control group at one day after parturition. The percentage of that increase of Agrimos treatment compared with control was 18.05 %.

Additionally, the doe rabbit's Lymphocyte/ Heterophils ratio (H/L) was significantly ($P \leq 0.05$) higher in control treatment than Agrimos does at one day after parturition. The percentage of that increase of control treatment compared with Agrimos was 19.64 % which indicate that 2 kg Agrimos/ ton feed supplementation in diet improved immunity level of doe rabbits. Whereas, WBC; Heterophils and Mid % were not significant, additionally blood IgG tend to be higher insignificantly in Agrimos treatment than control does at one day after parturition. The doe rabbit's IgG was significantly ($P \leq 0.05$) increased with the increasing of the parity number at one day after parturition. The percentages of that increase compared with the parity two were (29.07 % and 35.34 %) with the parity three and four, respectively. But, WBCs; Lymphocyte; Heterophils; H/L and Mid % were not significant. Also, it can be observed that the interactions effect between the Agrimos level and the parity number were statistically significant ($P \leq 0.05$) on Lymphocyte; H/L and IgG, whereas there was a non-significant different in on WBC; Heterocyte and Mid

% between the Agrimos level and the parity numbers.

It is clear from the data that Lymphocyte value was significantly ($P \leq 0.05$) higher in Agrimos level and parity numbers (53.79, 52.04 and 51.94) than the 0 kg agrimos and the different parity numbers (44.22, 43.82 and 45.60), respectively.

Also, blood IgG was significantly ($P \leq 0.05$) higher in all group compared with control does in parity two. The percentages of that increase compared with the control were (50.8, 62.6, 44.7, 65.0 and 68.5 %), respectively. But, H/L ratio was significantly ($P \leq 0.05$) lower in Agrimos level and parity numbers (0.55, 0.58 and 0.56) than the 0 kg agrimos and the different parity numbers (0.65, 0.71 and 0.66), respectively. May be, this data indicates that the addition of Agrimos with 2 kg/ton may be the reason for the increase blood IgG level in does rabbits V-Line in parity number two. These results are generally similar to those reported by Wu *et al.*, (2011) and Attia *et al.*, (2015a). Who noted dietary supplementation with 0.064% β -1,3–1,6-glucan significantly inhibited delayed-type immune reaction of Th1 and significantly reduced serum IgG concentration of does at the late gestation stage but increased serum IgM and IgG concentrations at the late lactation stage.

4.2. The second experiment on growing rabbits:

4.2.1. Effect of Mannan Oligosaccharide and β _Glucans supplementation in diet on live body weight gain (LBWG) of growing rabbits:

Summarized in Table (3) are average live body weight gain of V-line growing rabbits as affected by dietary inclusion levels of Agrimos throughout the entire growth periods 4-6, 6-8, 8-10 and 4-10 weeks of age as experimental period. Analysis of variance data indicated that body weight gain of the two treatments was gradually increased with the increasing of the rabbit's age. Body weight gain of growing rabbit

from treated does (2kg/ton Agrimos) was significantly ($P \leq 0.05$) higher by 21.39 % and 16.43 % than that of untreated does at 8-10 and 4-10 weeks.

In respect of the Agrimos levels effect regardless the treated does, the results revealed that there was increased with the increasing of the Agrimos levels, but non-significant on live body weight gain entire growth periods 4-6, 6-8, 8-10 and 4-10 weeks of age as experimental period.

Also, it can be observed that the interactions effect between the treated does and the Agrimos levels were statistically significant ($P \leq 0.05$). The total values of the interaction from (8 to 10 and 4 to 10 weeks of age) were significantly ($P \leq 0.05$) higher with the higher AGRIMOS levels compared with the control and the lower levels. Interesting enough at the experimental period that body weight gain of the treated rabbits was significantly ($P \leq 0.05$) better after 4 weeks when the Agrimos was added to the diet compared with the control group. In that, average gain of G4 and G5 were higher by 36.08% and 33.16%, respectively over that G1 at 8-10 and 4-10 weeks.

In connection, Kocher *et al.* , 2004 suggested that the MOS increased body weight gain; the use of Agrimos[®] stimulated the overall daily gain compared to the OTA group Awaad *et al.*, (2011); Bovera *et al.*, (2010) mannan-oligosaccharides showed a positive effect on growth performance. The best results were obtained with a concentration of 1.0 g/kg diet of MOS. Shendare *et al.*, (2008) reported that the inclusion of growth promoter Mannan oligosaccharide & β -glucans shows significantly higher body weight gain as compared to the control diet. Mannan oligosaccharides administered continuously or intermittently increased ($P < 0.05$) body weight gain in respect of the control group (Attia *et al.*, 2015b). Rabbits fed diets 100 and 150 ppm of Fibosel β -glucans), respectively showed a 13.5 %

higher body weight gain, as average, than rabbits fed the control diet (Garcia-Ruiz *et al.*, 2008).

4. 2.2. Effect of Mannan Oligosaccharide and β _Glucans supplementation in diet on immunity parameters of growing rabbits:

Changes in White blood cells count (WBCs); Lymphocyte percent (Lymph%); Heterophils percent (Hetero%); Heterophils/ Lymphocyte ratio (H/L); mid-range percent (Mid%) in blood and Immunoglobulin G (IgG) concentration (mg/ml) in blood serum added Mannan Oligosaccharide and β _Glucans (Agrimos) in V-line growing rabbits diet are presented in Table (4). Analysis of variance data indicated that a slightly increase but not significant in WBC count and Mid % of Agrimos treated does (2kg Agrimos/ton), also IgG concentration was not significantly different between growing rabbits of control and treated does. But the Lymphocyte % was significantly ($P \leq 0.05$) higher by 8.4 % in treated does than control group. While, the percentage of that increase of control group compared with treated does by 2 kg Agrimos in Heterophils cells and H/L ratio was (4.6 % and 13.3 %), respectively.

In respect of the Agrimos levels affect regardless the treated does the growing rabbit's serum Immunoglobulin G (IgG) concentration was significantly ($P \leq 0.05$) increased with increasing the Agrimos levels at 10 weeks of age. The percentages of that increase compared with the controls were (1.4% and 13.2%) with (1 and 2 kg Agrimos/ Ton diet) at the end of experimental period, respectively. It can be observed also that White blood cells count (WBCs); Lymphocyte percent (Lymph %); Heterophils percent (Hetero %) and mid-range percent (Mid %) in blood of Agrimos levels were increased with increasing the Agrimos levels, but not significantly affected at 10 weeks of age.

Also the interaction effect between treated

does and the Agrimos levels was not statistically significant in WBCs count at the end of experimental period. While, the interaction effect was statistically significant ($P \leq 0.05$) on Lymph %, Hetero %, H/L, Mid and IgG concentration. The higher percentage was recorded with the control group (G1) and growing rabbits treated with 1 kg Agrimos (G2) than other groups at Hetero % and H/L, while, the higher percentage at Lymph %, Mid % and IgG were recorded with G5 and G6 of growing rabbits than other groups. These results are agreement with Savage *et al.*, 1996, Santin *et al.*, 2001, Shane, 2001 and El-Sheikh *et al.*, 2009. Who showed that MOS had the ability to stimulate elevated antibody levels, especially IgG and IgA levels. The results may be due to that the immune system has evolved primarily to protect the host against invading pathogens including viruses, bacteria, yeasts, protozoa and multi-cellular parasites.

CONCLUSION

The results concluded that adding Mannan Oligosaccharide and β _Glucans (2 kg Agrimos/ton basal diet) in doe rabbits diet of V-line was efficient in improving litter size at birth, bunny number at weaning, litter bunnies weight till weaning and immunity level. Moreover, adding Mannan Oligosaccharide and β _Glucans (1 kg Agrimos/ ton basal diet) in growing rabbits diet had beneficial effects on body weight gain and immunity level for growing rabbits from 4 wks to 10 wks of ages.

Table (1): Least Square Means \pm SE of Conception rate (CR %), number born alive (NBA), number born dead (NBD)and litter size at birth (LSB)) and bunny number at weaning (NW) added Mannan Oligosaccharide and β _Glucans (Agrimos) in V-line doe rabbits diet.

Items	Parameters	C.R	NBA	NBD	LSB	NW
<u>Treatment:</u>						
	0 kg Agrimos	0.77 \pm 0.04	8.34 \pm 0.36	1.11 ^b \pm 0.20	9.44 ^b \pm 0.32	6.62 \pm 0.29
	2 kg Agrimos	0.74 \pm 0.04	8.55 \pm 0.37	1.89 ^a \pm 0.33	10.41 ^a \pm 0.30	7.19 \pm 0.28
<u>Parity number:</u>						
	No. 2	0.72 \pm 0.05	8.33 \pm 0.39	1.06 \pm 0.30	9.39 ^b \pm 0.35	7.11 \pm 0.30
	No. 3	0.72 \pm 0.05	9.05 \pm 0.46	1.62 \pm 0.35	10.65 ^a \pm 0.35	7.24 \pm 0.36
	No. 4	0.85 \pm 0.05	7.85 \pm 0.51	1.98 \pm 0.37	9.79 ^{ab} \pm 0.47	6.23 \pm 0.40
<u>Interaction:</u>						
	0 kg\times Parity No.2	0.74 \pm 0.07	8.16 \pm 0.57	0.72 \pm 0.23	8.88 \pm 0.52	6.80 \pm 0.43
	0 kg\times Parity No.3	0.72 \pm 0.07	8.74 \pm 0.70	1.19 \pm 0.41	9.93 \pm 0.56	6.79 \pm 0.60
	0 kg\times Parity No.4	0.85 \pm 0.63	8.15 \pm 0.65	1.48 \pm 0.39	9.63 \pm 0.62	6.24 \pm 0.52
	2 kg\times Parity No.2	0.69 \pm 0.07	8.49 \pm 0.55	1.37 \pm 0.53	9.86 \pm 0.46	7.39 \pm 0.40
	2 kg\times Parity No.3	0.72 \pm 0.07	9.30 \pm 0.61	1.97 \pm 0.53	11.24 \pm 0.43	7.58 \pm 0.44
	2 kg\times Parity No.4	0.85 \pm 0.07	7.48 \pm 0.83	2.65 \pm 0.69	10.00 \pm 0.74	6.21 \pm 0.64

^{a, b}Means with different letters in the same column are significantly different at $P \leq 0.05$.

Table (2): Least Square Means \pm SE of WBCs; Lymphocyte; Heterocyte; H/L; Mid and IgG for different parities with added Mannan Oligosaccharide and β _Glucans (Agrimos) in V-line doe rabbits diet.

Items	Parameters	Immunity parameters				IgG (mg/ml)	
		WBC*10 ³	Lymph %	Heter %	H/L		Mid%
<u>Treatment:</u>							
	0 kg Agrimos	8.29 \pm 0.42	44.55 ^b \pm 0.71	29.85 \pm 0.58	0.67 ^a \pm 0.02	10.16 \pm 0.37	597.75 \pm 44.10
	2 kg Agrimos	8.98 \pm 0.37	52.59 ^a \pm 0.99	29.43 \pm 0.44	0.56 ^b \pm 0.02	10.82 \pm 0.47	691.39 \pm 36.37
<u>Parity number:</u>							
	No. 2	8.38 \pm 0.67	49.01 \pm 2.03	29.15 \pm 0.63	0.60 \pm 0.02	10.12 \pm 0.63	530.64 ^b \pm 53.23
	No. 3	8.50 \pm 0.34	47.93 \pm 1.71	30.32 \pm 0.52	0.64 \pm 0.03	10.79 \pm 0.40	684.90 ^a \pm 40.35
	No. 4	9.03 \pm 0.43	48.77 \pm 1.32	29.44 \pm 0.70	0.61 \pm 0.03	10.57 \pm 0.53	718.16 ^a \pm 36.33
<u>Interaction:</u>							
	0 kg\times Parity No.2	8.28 \pm 1.07	44.22 ^b \pm 1.43	28.91 \pm 0.92	0.65 ^{ab} \pm 0.02	10.08 \pm 0.83	433.80 ^b \pm 26.15
	0 kg\times Parity No.3	7.74 \pm 0.24	43.82 ^b \pm 1.13	30.81 \pm 0.78	0.71 ^a \pm 0.03	10.14 \pm 0.54	654.10 ^a \pm 55.71
	0 kg\times Parity No.4	8.86 \pm 0.71	45.60 ^b \pm 1.24	29.81 \pm 1.27	0.66 ^{ab} \pm 0.44	10.26 \pm 0.65	705.35 ^a \pm 61.08
	2 kg\times Parity No.2	8.48 \pm 0.92	53.79 ^a \pm 2.25	29.39 \pm 0.95	0.55 ^c \pm 0.31	10.15 \pm 1.05	627.48 ^a \pm 79.30
	2 kg\times Parity No.3	9.26 \pm 0.42	52.04 ^a \pm 1.86	29.82 \pm 0.71	0.58 ^{bc} \pm 0.02	11.44 \pm 0.47	715.70 ^a \pm 62.15
	2 kg\times Parity No.4	9.20 \pm 0.56	51.94 ^a \pm 1.11	29.07 \pm 0.71	0.56 ^c \pm 0.02	10.88 \pm 0.90	731.00 ^a \pm 48.16

^{a, b, c,} Means with different letters in the same column are significantly different at $P \leq 0.05$

Table (3): Least Square Means \pm SE of body weight gain (g/ rabbit) added different level of Mannan Oligosaccharide and β _Glucans (Agrimos) in V-line growing rabbits diet.

Items	Parameters	Body weight gain (g / rabbit)				
		4-6 wks	6-8 wks	8 -10wks	4-10 wks	
Does:	Control	111.08 \pm 16.78	342.76 \pm 24.52	622.76 ^b \pm 29.25	1076.60 ^b \pm 52.68	
	2 kg Agrimos	134.23 \pm 20.14	363.32 \pm 11.64	755.99 ^a \pm 27.01	1253.53 ^a \pm 38.54	
Treatment:	0 kg Agrimos	112.94 \pm 22.14	329.62 \pm 16.10	662.01 \pm 53.99	1104.57 \pm 71.95	
	1 kg Agrimos	105.16 \pm 22.09	329.85 \pm 30.39	694.63 \pm 43.75	1129.64 \pm 80.28	
	2 kg Agrimos	147.48 \pm 22.47	400.33 \pm 23.55	680.94 \pm 18.95	1228.75 \pm 25.47	
Interaction:	Control	0 kg Agrimos (G1)	96.90 \pm 28.37	318.78 \pm 22.51	576.98 ^b \pm 64.15	992.66 ^b \pm 93.37
		1 kg Agrimos (G2)	74.85 \pm 16.57	302.70 \pm 53.70	622.20 ^{ab} \pm 54.01	999.75 ^b \pm 100.95
		2 kg Agrimos (G3)	161.50 \pm 29.41	406.80 \pm 36.76	669.10 ^{ab} \pm 29.87	1237.40 ^{ab} \pm 23.10
	2 kg Agrimos	0 kg Agrimos (G4)	133.00 \pm 36.87	343.17 \pm 24.51	768.29 ^a \pm 62.06	1244.46 ^{ab} \pm 69.21
		1 kg Agrimos (G5)	143.04 \pm 40.12	363.79 \pm 6.59	785.17 ^a \pm 41.29	1292.00 ^a \pm 76.60
		2 kg Agrimos (G6)	124.11 \pm 37.34	389.56 \pm 24.12	700.67 ^{ab} \pm 8.09	1214.33 ^{ab} \pm 64.09

^{a, b} Means with different letters in the same column are significantly different at P \leq 0.05.

G 1, 2, 3, 4, 5 and 6 means Group1, 2, 3, 4, 5 and 6.

Table (4): Least Square Means \pm SE of White blood cells count (WBCs); Lymphocyte; Heterophils; Lymphocyte/ Heterophils ratio (H/L); mid-range percent. (Mid and Immunoglobulin G (IgG) added Mannan Oligosaccharide and β _Glucans (Agrimos) V-line growing rabbits

Parameters Items		Immunity					
		WBC*10 ³	Lymph %	Heter %	H/L	Mid%	IgG (mg/ml)
Does:							
Control		9.15 \pm 0.36	42.87 ^b \pm 0.75	28.71 ^a \pm 0.30	0.68 ^a \pm 0.02	10.81 \pm 0.21	663.36 \pm 18.31
2 kg Agrimos		9.83 \pm 0.43	46.49 ^a \pm 0.90	27.45 ^b \pm 0.36	0.60 ^b \pm 0.02	11.53 \pm 0.34	653.36 \pm 24.79
Treatment:							
0 kg Agrimos		9.22 \pm 0.47	43.10 \pm 0.62	27.81 \pm 0.48	0.65 \pm 0.01	10.66 \pm 0.3	627.70 ^b \pm 23.83
1 kg Agrimos		9.09 \pm 0.50	45.51 \pm 1.25	28.52 \pm 0.38	0.64 \pm 0.02	11.68 \pm 0.38	636.63 ^b \pm 25.26
2 kg Agrimos		10.16 \pm 0.48	45.44 \pm 1.22	27.92 \pm 0.41	0.63 \pm 0.03	11.19 \pm 0.27	710.75 ^a \pm 21.19
Interaction							
Control 2 kg Agrimos	0 kg Agrimos (G1)	8.96 \pm 0.59	42.83 ^b \pm 0.78	29.08 ^a \pm 0.47	0.68 ^a \pm 0.01	10.21 ^b \pm 0.35	659.53 ^{ab} \pm 40.37
	1 kg Agrimos (G2)	8.34 \pm 0.65	43.16 ^b \pm 1.24	28.94 ^a \pm 0.54	0.68 ^a \pm 0.02	11.40 ^{ab} \pm 0.36	637.58 ^{ab} \pm 23.69
	2 kg Agrimos (G3)	10.14 \pm 0.55	42.63 ^b \pm 1.81	28.10 ^{ab} \pm 0.53	0.67 ^a \pm 0.03	10.83 ^{ab} \pm 0.33	692.98 ^{ab} \pm 31.25
	0 kg Agrimos (G4)	9.47 \pm 0.76	43.36 ^b \pm 1.00	26.53 ^b \pm 0.61	0.61 ^{ab} \pm 0.02	11.11 ^{ab} \pm 0.66	595.88 ^b \pm 18.57
	1 kg Agrimos (G5)	9.84 \pm 0.72	47.86 ^a \pm 1.97	28.10 ^{ab} \pm 0.53	0.60 ^{ab} \pm 0.04	11.95 ^a \pm 0.67	635.68 ^{ab} \pm 49.14
	2 kg Agrimos (G6)	10.18 \pm 0.82	48.25 ^a \pm 1.11	27.73 ^{ab} \pm 0.66	0.58 ^b \pm 0.02	11.54 ^{ab} \pm 0.42	728.53 ^a \pm 30.14

^{a, b} Means with different letters in the same column are significantly different at $P \leq 0.05$

G 1, 2, 3, 4, 5 and 6 means Group1, 2, 3, 4, 5 and 6.

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الملخص العربي

تأثيرات إضافة المنان أوليجو سكريد والبيتا جلوكان في العليقة علي الإنتاجية ومستوي المناعة للأرانب

مروة عبدالله خربوش و أ.د. علاء محمد الرفه و أ.د. أميرة إسماعيل الدلبشاني و د. أحمد محمد عبد الهادي و* أ.د.

خالد نصر الدين فهمي

قسم إنتاج الدواجن - كلية الزراعة - جامعة الاسكندرية

*قسم التغذية والتغذية الأكلينيكية - كلية الطب البيطري- جامعة القاهرة

صممت التجربة لدراسة تأثير إضافة توليفة من المنان أوليجو سكريد والبيتا جلوكان (الأجريموس) في العليقة علي الإنتاجية ومستوي المناعة للأمهات الأرانب و تتبع تأثير استمرار الأضافة علي الأرانب النامية.

التجربة الأولى: كان العدد الكلي 64 أم V-line عند عمر 5 شهور بمتوسط وزن جسم ($23 \pm 3,4$) كجم تم تقسيمهم إلى مجموعتين عشوائيا (ن = 32 أم لكل مجموعة) . تم تغذيتهم علي عليقتين (عليقة أساسية للمجموعة المقارنة وعليقة مضاف إليها 2 كجم أجريموس / طن عليقة للمجموعة المعاملة) .

التجربة الثانية: أجريت التجربة علي 108 أرنب غير منجنس من سلالة V-line تم أخذهم من البطن الثالثة عند عمر 4 أسابيع و ذلك من كل مجموعة في التجربة الأولى (أمهات مقارنة و أمهات معاملة) و قسمت كل مجموعة إلى ثلاث معاملات متساوية كلا منها 36 أرنب (المجموعة الأولى غذيت علي العليقة الأساسية كمجموعة مقارنة - المجموعة الثانية غذيت علي العليقة الأساسية مضاف إليها 1 كجم أجريموس/طن - المجموعة الثالثة غذيت علي العليقة الأساسية مضاف إليها 2 كجم أجريموس/طن).

لخصت النتائج فيما يلي:

الأمهات التي غذيت علي عليقة مضاف إليها 2 كجم أجريموس / طن عليقة كمجموعة معاملة سجلت حجم بطن عند الولادة (10,41) أعلى من الأمهات التي غذيت علي العليقة الأساسية (9,44) مع وجود فرق معنوي. والقيم المقابلة أيضا لعدد الخلفة عند الفطام كان (7,19) أعلى من (6,62) ولكن بدون وجود فروق معنوية.

النتائج المتحصل عليها من الأمهات المعاملة (2 كجم أجريموس/طن عليقة) أظهرت زيادة في عدد كرات الدم البيضاء و الخلايا الليمفاوية و الـ Mid و IgG بالمقارنة بالأمهات الغير معاملة ($8,98 \times 10^3$ و 52,59% و 10,82% و 691,39 مجم/مل بالمقارنة بـ $8,29 \times 10^3$ و 44,55% و 10,16% و 597,75 مجم/مل علي الترتيب). مما أدى إلى تحسن مستوى المناعة للأمهات الأرنب المعاملة بإضافة الأجريموس في العليقة.

كان متوسط وزن الجسم المكتسب من 4 إلى 10 أسابيع من العمر للأرانب النامية الناتجة من أمهات معاملة (1253,53 جم/أرنب) أعلى في النمو عن التي نتجت من أمهات مقارنة (1076,60 جم/أرنب) مع وجود فروق معنوية. أيضا، كان أعلى وزن جسم مكتسب من 4 إلى 10 أسابيع من العمر (1292,00 جم/أرنب) تحصل عليه من التغذية بـ 1 كجم أجريموس/طن عليقة للأرانب النامية الناتجة من أمهات معاملة خلال الفترة من الفطام حتى عمر 10 أسابيع.

كانت متوسطات عدد كرات الدم البيضاء و الخلايا الليمفاوية و الـ Mid للأرانب النامية الناتجة من أمهات معاملة ($9,83 \times 10^3$ و 46,49% و 11,53% علي الترتيب) ذات قيم أعلى من الأرانب الناتجة من أمهات مقارنة ($9,15 \times 10^3$ و 42,87% و 10,81% علي الترتيب).

الخلاصة: إضافة المنان أوليجو سكريد والبيتا جلوكان (الأجريموس) في عليقة الأرانب حسنت بصورة معنوية حجم البطن عند الولادة و الحالة المناعية للأمهات وكذلك وزن الجسم المكتسب في الفترة من 4 إلى 10 أسابيع و الحالة المناعية للأرانب النامية.