Impact of Manna Oligosaccharide (Bio-Mos®) and Esterified Glucomannan (MTB-100 ®) Dietary Supplementation on Performance and Health Status of Barki Lambs Under Egyptian Conditions.

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***Abstract*—A total of forty five fattening Barki lambs (15 animal/treatment) were fed on one customized complete pelleted basal diet (control) to which mannanoligosaccharide (MOS, Bio-Mos®) and esterified glucomannan (EGM ,MTB-100 ®) were supplemented at level of 1kg / ton in a four months experiment. Dietary supplementations of the diet with MOS as well as EGM had a positive effect on body weight development and % of body weight gain. The EGM-supplemented group had demonstrated significant increase in the serum globulin compared to control and MOS- fed groups. The results also revealed a non significant difference in rumen fluid ecology (Score, pH, ammonia nitrogen and total volatile fatty acids, TVFAs).**

In conclusion both of the additives used (Bio-Mos® and MTB-100 ®) have a positive effect on growth performance parameters with no adverse effect of rumen ecology when included to fattening Barki lambs diet under Egyptian environment.

***Index Term*—Esterified glucomannan, lambs, mannanoligo-saccharide, rumen ecology.**

I. Introduction

All animals need to be well fed and healthy if they are to grow to their potential so the nutrition of an animal is therefore of great importance if this is to be achieved in practice.

According to EAS (Egyptian agricultural statistical center) total number of sheep in Egypt at 2007 was 54,674,69 while total amount of mutton produced was 9384.7 tons[1] . The human population in Egypt has been increasing at a rapid rate, a trend that increases the pressure on meat consumption and widens the food gap.

A key in lamb's production is their ability to add weight with least cost and feed efficient formulas which is ultimately defining profitability.

Following weaning practice, lambs undergo excessive weaning stress which may affect appetite; metabolism and immune response eventually may affect growth performance of the lambs.

In recent years the use of probiotics, prebiotics and symbiotics that enrich certain bacterial population in the digestive system is considered as an alternative to antibiotic growth promoters (AGP) in many species.

The use of AGP has been shown without doubt beneficial improvement in performance parameters as well as prevention of diseases. Because of the concern that the use of antibiotics as feed additive might contribute to an increase of bacterial antibiotic resistance, the European Union had decided to ban antibiotics as feed additives from 1st January, 2006 onwards. Increased awareness of the potential problems associated with the use of antibiotics has stimulated research efforts to identify alternatives to their use as feed additives.

Feed additive is an ingredient or combination of ingredients added to the basic feed mix or parts therefore to fulfill a specific need. It is usually used in micro quantities requiring careful handling and mixing [2]. The European Council (regulation no 1831, 2003) has stated some criteria for additives used in animal nutrition; a feed additive shall be allocated to one or more of the following categories, depending on its functions and properties:

1) Technological additives: any substance added to feed for a technological purpose.

2) Sensory additives: any substance which its addition to feed improves or changes the organoleptic properties of the feed or the visual characteristics of the feed.

3) Nutritional additives: as water soluble and fat soluble vitamins.

4) Zootechnical additives: any additive used to affect favourably the performance of animals in good health and is friendly to the environment.

5) Coccidiostats and histomonostats: used to prevent coccidiosis and histomoniasis.

For many years, feeding management (forage to concentrate ratio, forage and grain particle size, bunk management) and using non-nutritive additives (ionophores, malate, direct-fed microbials, and buffers) may help reduce ruminal acidosis and other health related problems [3].

Yeast products which have beneficial effects in livestock production are generally characterized to have a minimum concentration of viable cells 10^9 per g dry product [4].

Bio-Mos® is prepared from the cell walls of Saccharomyces cerevisiae yeast. The glucans, the mannans and chitin are the principal components of yeast cell walls[5] .The idea to use yeast MOS in animal feeds evolved from the concept that certain sugars, particularly mannose, could be used to largely block the colonization of intestinal pathogens [6], [7].

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Esterified Glucomannan (MTB-100) is defined as polymers of glucose that can be derived from the cell walls of saccharomyces cerevisiae which has immunomodulating activities and effective in counteracting the toxic effects of naturally contaminated feed with mycotoxins [8].

The objective of this trial is to evaluate the effects of dietary supplementation of mannanoligosaccharide (MOS ,Bio-Mos®) and esterified glucomannan(EGM, MTB-100 ®)on growth performance, some selected serum parameters as well as rumen ecology of fattening Barki lambs under Egyptian conditions.

II. Materials and Methods

A total of forty- five weaned male healthy Barki lambs with average age of 3.5 months and average weight of 20 ± 1 kg were used in this experiment. The animals were allotted into three groups (15 animal/ group) and fed on one customized complete pelleted basal diet. The ingredients, nutrient composition and calculated analysis of the complete pelleted diet used throughout 4 months experimental period are shown in TABLE I. Feed intake was adjusted [9].While wheat straw and fresh water were offered ad-libitum. Group 1 (Control) was fed on the basal diet (BD), group2 and 3 were fed on mannanoligosaccharide (MOS, Bio-Mos®, IFT) and esterified glucomannan (EGM ,MTB-100, IFT) at level of 1Kg/ Ton , respectively.

Lambs were weighed at the start of the trial (0-d), and on 30 days intervals up to 120 days. Blood samples were collected before the commencement and at the end of the trial. Serum total proteins, alkaline Phosphates activity (ALP) and blood glucose were measured using diagnostic kits (Stainbio Laboratory, Texas, USA) while Serum alanine aminotransferase (ALT), aspartate aminotransferase (AST) were measured using Diagnostic kits((QCA, Amposata, Spain). At the end of the experiment; ruminal fluid samples were taken individually from 5 animals/group at 5-hours post feeding for pH determination using pH meter (Digi-Sense LED pH meter), analysis of TVFAs and ammonia nitrogen (NH3–N) according to[10], [11] respectively. Analysis of variance was put into function to examine the significance of difference between means due to various treatments [12].

III. Results and Discussion

A. Growth Performance Parameters

The results of body weight development, body weight gain and feed conversion ratio (FCR) are illustrated in TABLE II, TABLE III, Fig. 1 and Fig. 2, respectively. Results show that initial body weight was relatively homogenous and did not differed between treatments which indicate good random allocation of animals at the commencement of the experiment. Results also showed that dietary fortification with MOS at a level of 1 Kg/ ton resulted in a significant increase ($p< 0.05$) in final body weight (51.0 vs. 48.4) compared to control group. Moreover, there was also a significant increase ($p<0.05$) in body weight development between MOS-supplemented group compared to EGM -fed group at the end of experimental trial (51.00 vs 49.62). Regarding the % of body weight gain (TABLE III) it was observed that MOS-fed group showed 1.3 increase in percent of weight gain during last month, and a total increase of 5.8 % of weight gain compared to control. Results of FCR (Fig. 2) were inconsistent throughout the experimental period, however, the group fed MOS achieved a marked improvement compared to other groups at the end of the experiment. The similar positive impact of MOS supplementation on body weight development and body weight gain of fattening Barki lambs was also reported by [13] who observed that lambs fed MOS diet at a level of 0.08% of the diet achieved faster gain and better feed efficiency than early weaned lambs fed standard diet. The growth performance improving effect of MOS might be attributed to the suggestions of [14], [15] who demonstrated the improved health status as a consequence of enhanced gastrointestinal health potentiating the animal's ability to defend against threat pathogens. Moreover, there is a positive effect on the level of antibody titers, immunoglobulin and macrophage activity which ultimately lead to better health and better growth performance. MOS have been shown to elicit a positive response on the immune system as well as serving as an alternate attachment sites in the gut for gram negative pathogenic organisms through mannose specific type-1 fimbriae that adhere to intestinal epithelial cells to initiate diseases [7]. On the other hand, results indicated that dietary fortification with EGM at a level of 1 Kg / ton resulted in a significant increase ($p< 0.05$) in body weight development at the end of experimental trial (49.62 vs 48.40) compared to control group. Meanwhile, it was observed that EGM-fed group showed 1.25 increase in percent of body weight gain during last month as compared to control. Also dietary supplementation of EGM at the aforementioned levels resulted in a little overall improvement in the % of total weight gain compared to control (101.6 vs 100). Results of FCR (Fig. 2) showed no marked difference between EGM and control groups. The growth stimulating effect due to EGM dietary supplementation in fattening Barki lambs may be due to its' immunomodulator effect. Numerous reports have documented the ability of β-(1-3)-glucan to non specifically activate cellular and humoral components of the host immune system [16].

B. Blood Parameters

The initial results of some selected serum parameters of Barki lambs at the commencement of the experiment are presented in TABLE IV. The effect of dietary fortification with MOS and EGM on some blood serum variables at the end of the experimental trial is shown in TABLE V. The obtained initial results for some selective serum variables of Barki lambs are within the normal values reported by [16] which embrace the normal and good health status of the lambs at the commencement of the experiment. The supplementation of EGM significantly ($p< 0.05$) increased both blood globulin and albumin levels as compared to control and MOS groups, respectively (3.6&3.2 vs 2.8&2.9; 3.5&2.7). The immunomodulatory effect of EGM may be attributed to the ability of β-(1-3)-glucan to non-specifically activate cellular and humoral components of the host immune system and to enhance the functional activity of macrophages [17]. Furthermore, β - (1-3) - glucan also stimulate the

proliferation of monocytes and macrophages and have potent hematopoetic activities [18].

C. Rumen Ecology Parameters

The results of the effect of different dietary treatments on rumen ecology parameters of fattening Barki lambs at end of the experimental period are shown in TABLE VI. Results revealed a non significant difference in rumen fluid parameters for ruminal microflora and microfuna score, pH, ammonia nitrogen and TVFAs. There were insignificant changes in TVFAs level in both groups in comparison to control one. Another study showed that MOS supplementation did not affect TVFAs concentration and ruminal pH in early lactating Holstein dairy cows [19]. It was found that Saccharomyces cerevisiae yeast had promenant potentiality as a growth promoting feed additive in feedlot lamb production and it may serve as an alternate to antibiotics and ionophores for weaned lambs [4]. More research activities should be conducted to evaluate the effects of different prebiotics inclusion in lamb's diet on rumen ecology.

IV. Tables

TABLE I: Ingredients, Nutrient Composition and Calculated Analysis of the Complete Pelleted Diet Used Throughout 4 Months Experimental Period

Ingredients (on as fed bases)	**%**
AlfaAlfa hay	**15.3**
Ground yellow corn	**61**
Soybean meal (44%)	**16**
Wheat bran	**6.4**
Ammonium chloride	**0.5**
Premix[a]	**0.3**
Buffer[b]	**0.5**
Nutrient composition (%)	
DM	**89**
Crude protein	**14.8**
NDF	**15.49**
ADF	**6.55**
NFC	**50.73**
TDN	**72.8**
Calcium	**0.42**
Phosphorous	**0.44**

a=HY-MIX MISR (feed additives company) It contains vitamin A: 7000000 IU, Vitamin D_3 :1000000 IU, Mn: 60 gm, vitamin E: 25000 mg, zinc: 60 gm, Cu: 7 gm, Iodine: 0.4 gm, Se: 0.2 gm, cobalt:0.2 gm. Calcium carbonate added to 3 kg.

b=buffer contains 55% sodium bicarbonate and45% magnesium oxide(Alfachem company)

TABLE II: Body Weight Development of Fattening Barki Lambs Fed Diets Containing MOS and EGM During Experimental Period

Month	Control	MOS	EGM
Initial weight	20.84 ± 0.46^{a}	21.83 ± 0.24^{a}	21.60 ± 0.20^{a}
1st month	26.10 ± 0.42^{c}	27.80 ± 0.25^{a}	26.90 ± 0.20^{b}
2nd month	32.60 ± 0.27^{c}	34.50 ± 0.19^{a}	33.50 ± 0.20^{b}
3rd month	40.40 ± 0.38^{c}	42.90 ± 0.14^{a}	41.50 ± 0.14^{b}
4th month	48.40 ± 0.42^{c}	51.00 ± 0.15^{a}	49.62 ± 0.15^{b}

1-Values are means ±SE

2- ^{a,b,c} The values with different superscripts at the same row are significantly different at $P < 0.05$

TABLE III: Body Weight Gain of Barki Lambs Fed Diets Containing MOS and EGM During Experimental Period

Gain / Month	Control		MOS		EGM	
	Kg	%*	Kg	%	Kg	%
1st month	5.26	100	5.97	113.50	5.31	100.90.
2nd month	6.50	100	6.70	103.10	6.60	101.5.
3rd month	7.80	100	8.40	107.70	8.00	102.60
4th month	8.00	100	8.10	101.30	8.12	101.25
Total weight gain	27.56	100	29.17	105.80	28.00	101.60

-* Percent of body weight gain compared to control

TABLE IV: The Initial Results of Some Blood Serum Variables of Fattening Barki Lambs at the Commencement of the Experimental Period

Parameter	Alk. Phosphatase u/l	AST u/l	ALT u/l	Total proteins g/100 ml	Albumin g/100ml	Globulin g/100ml	Blood glucose mg/100ml
Initial results	0.14 ±0.01	42.3 ±1.6	31.5 ± 0.7	4.5±0.42	3.3±0.3	1.5±0.2	75.2±1.31

TABLE V: EFFECT OF MOS AND EGM ON SOME BLOOD SERUM VARIABLES OF FATTENING BARKI LAMBS AT THE END OF THE EXPERIMENTAL PERIOD

Parameter / Treatment	Alk. Phosphatase u/l	AST u/l	ALT u/l	Total proteins g/100ml	Albumin g/100ml	Globulin g/100ml	Blood glucose mg/100ml
Control	0.13±0.01[a]	40.7±0.13[c]	33.3±0.9[a]	6.0±0.21[a]	2.9±0.2[a]	2.8±0.3[b]	78.4±1.1[a]
MOS	0.17±0.02[a]	41.3±0.12[b]	34.3±0.2[a]	6.1±0.13[a]	2.7±0.12[b]	3.5±0.1[b]	81.7±1.1[a]
EGM	0.15±0.03[a]	42.0±0.16[a]	34.0±0.6[a]	5.9±0.1[a]	3.2±0.1[a]	3.6±0.1[a]	79.1±1.2[a]

TABLE VI: EFFECT OF DIFFERENT DIETARY TREATMENTS ON RUMEN ECOLOGY PARAMETERS OF FATTENING BARKI LAMBS AT THE END OF THE EXPERIMENT

Treatment / Parameter	Control	MOS	EGM
Score	+++	+++	+++
pH	6.30±0.08[a]	6.60±0.05[a]	6.40±0.06[a]
Ammonia -Nitrogen (mg\100ml)	6.50±0.02[a]	6.20±0.04[a]	6.60±0.06[a]
TVFAs (meq\100ml)	5.50±0.07[a]	5.30±0.09[a]	5.60±0.07[a]

1-Values are means ±SE
2- a,b,c The values with different superscripts are significantly different

V. FIGURES

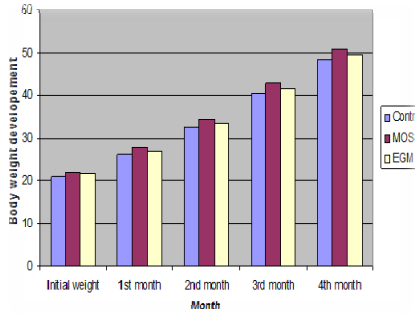

Fig. 1. Body weight development of fattening Barki lambs fed diets containing MOS and EGM during experimental period

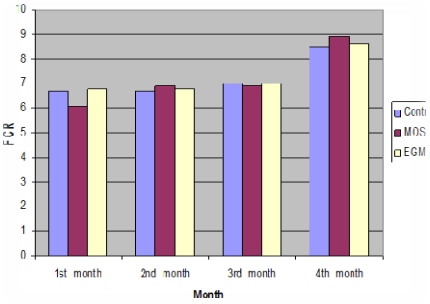

Fig. 2. FCR of fattening barki lambs fed diets containing MOS and EGM during experimental period

VI. CONCLUSION

It is to be concluded that, such feed additives as mannanoligosaccharides and esterifiedglucomannan are recommended to be included in fattening Barki lambs diet to embrace growth performance as well as immunity especially when used in a properly formulated diet.

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