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Original Research Article

IMPACT OF BIOMOS AND AGRIMOS DIETARY SUPPLEMENTATION ON GROWTH PERFORMANCE, FEED UTILIZATION AND IMMUNOLOGICAL PARAMETERS OF NILE TILAPIA (*Oreochromis niloticus*) FINGERLINGS

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Abstract: This study aimed to evaluate the potential benefits of *Biomos*® and *Agrimos*® as prebiotics in Nile tilapia diets. Seven experimental treatments were formulated from 30% protein basal diet to contain *Biomos*® and *Agrimos*® at levels of 0.1, 0.2 and 0.3 % for each, in addition to the control diet without any additives. Three hundreds and fifteen fingerlings of Nile Tilapia *(O. niloticus)* with average initial weight (7 ± 0.5 g), were randomly allocated into 7 treated groups allotted into 21 glass aquaria (three replicates of 15 fish / each treatment). Each aquarium measured 60× 35× 40 cm^2. The fish were fed at 3% fish biomass along the experiment which lasted for 15 weeks. The results revealed significant improvements in growth and all feed utilization parameters in the prebiotic supplemented groups. The diets containing *Biomos*® (0.1%) and *Agrimos*® (0.2%) revealed the highest growth and protein utilization parameters values. Experimental fish carcass composition was relatively affected by the different dietary treatments. The hematological, biochemical and immunological parameters of the experimented groups indicated significant increase in *Biomos*® and *Agrimos*® treated groups. The achieved results demonstrated that *Biomos*® and *Agrimos*® at levels of 0.1% and 0.2%, respectively could be used in Nile tilapia diets without negative effects on growth, feed utilization, blood and immunological parameters. Hence, Biomos® and Agrimos® could be added to commercial diets to improve tilapia fingerlings immune response.

Key words: agrimos; biomos; growth; immunity; *Oreochromis niloticus*

Introduction

Aquaculture in Egypt is the main source of fish production. It represents 77% of the absolute fish production of which 85% were delivered by the developed pond-based aquaculture around the Nile Delta lakes (1). Tilapia is the most generally developed species in these ponds which speaks to over 65% of the all out aquaculture production (2) because of the expanded dimension of intensification and cultured regions (3). Heightening of aquaculture production frameworks exposes fish to various ecological stressors like; poor water quality,

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over-crowdness, improper handling and transport which may contrarily influence their growth and health, as well as limiting the outcome of aquaculture systems (4-6).

Nutrition assumes an essential job in the growth, development and wellbeing upkeep of fish (7). Few years ago, fish meal was utilized as the primary protein source in tilapia diets. Because of the expanding cost and insecure supply of this ingredient, many attempts have been attempted to enhance the growth performance and decline the production expenses of cultivated tilapia. This was done through utilizing probiotics or prebiotics as safe supplements which have neither residues in the farmed fish nor harmful effects for the consumers (8-10).

Prebiotics are non-digestible dietary carbohydrates which get away from the assimilation in the upper gastrointestinal tract. Prebiotics advantageously influence the host by specifically invigorating the growth and/or activating the metabolism of health-promoting bacteria in the gastrointestinal tract (11, 12). Likewise, they modify the gut bacterial composition through changing the kind of substrate gave to the current gut microbiota (13, 14).

Mannan oligosaccharide (MOS) is a yeast cell wall derived feed ingredient. It works locally in the gut enhancing assimilation and gut wellbeing in animals through diminishing the colonization of undesirable bacteria. Furthermore, MOS functions as a prebiotic, favoring development of helpful bacteria in the gut (15, 16). AGRIMOS® is a particular mix of MOS and ß-glucans separated from the yeast cell walls of *Saccharomyces cerevisiae;* that are especially critical to help the non-specific immune system of the animal (17). Although few investigations revealed the dietary prerequisites of biomos and Agrimos to maintain growth, while, immunological responses still not very much archived particularly on the fish resistance level (17).

The current study was directed to evaluate the potential benefits of Biomos® and Agrimos® dietary supplementation on growth performance, feed utilization, body chemical composition, internal organs indices, hematological parameters, immunological response and economical efficiency of Nile Tilapia (*O. niloticus*) fingerlings under Egyptian conditions.

Material and methods

This study was conducted in fish Aquaculture Research Unit in Kafr El-Sheikh Governorate. All handlings of fish were directed according to the guidelines for animal care and use for scientific purposes built up by the Ethics Committee of the Faculty of Agriculture, Kafrelsheikh University, Egypt (Approval Date: 18-03-2018).

Diet preparation

A basal diet was formulated from commercial ingredients including fish meal, soybean meal, yellow corn, wheat bran, vitamins, minerals mix and fish oil. The dry ingredients were grounded utilizing a feed processor into little size particles. Seven diets were formulated from the basal diets by adding the prebiotics at different concentrations. Contents and chemical composition of each diet were exhibited in Table (1; A & B).

The ingredients were weighed and blended by a mixture blender for 20 minutes. A constant Biomos and Agrimos levels was added for all diets except control diets. After homogenous blending, every hundred gram diet was gradually added to the blend as indicated by (18). The diets were cooked on water exaporator for 20 minutes. The diets were pelleted through grain machine and the pellets were dried at room temperature for 24 h before utilized. The pellets were gathered and spared in plastic bags and stored in a refrigerator at 4^0C through the experimental period to dodge nutrients deterioration.

The utilized feed additive, Biomos® and Agrimos®, were commercial natural enhancers blend; (Bio-Mos®; Alltech, Inc., Nicholasville, KY, USA), (Agrimos®; LALLEMAND ANIMAL NUTIION, FRANCE).

Experimental design

The experiment was performed using 315 Nile Tilapia (*O. niloticus*) fingerlings (weighing on average 7 ± 0.5 g). They were collected from a private fish farm in Al Reyad, tolompate

7, Kafr El-Sheikh Governorate. All collected fish were kept in a fiberglass tank, for three weeks for accommodation; where fish were fed a commercial diet (containing 30% dietary protein level (CP). After the accommodation period, the fingerlings were randomly divided into 7 groups of 45 fingerlings / each group allotted into three replicates of 15 fingerlings / each replicate). Fingerlings were put in glass aquariums of 60 × 35 ×40 cm in size contained 70 L of water, (15 fish/ aquarium) and were equipped with effective aeration system. The seventh Groups 1 (control group) were fed a commercial diet, Group 2to 4 were fed diets supplied with 1, 2, 3 kg/ ton) of Biomos. While, groups 5 to 7 were fed diets supplemented with 1, 2, 3 kg/ ton of Agrimos.

Fish were fed the experimental diets for 12 weeks at a rate of 3% of the all-out stocking biomass/aquarium. Diets were applied twice a day (at 8:00 am & 14:00 pm). Fish were weighed at fortnightly intervals along the experimental period and the feed amounts were corrected by the change in live body weight. Fish excreta and feeding wastes were expelled by siphoning and about half of water in every aquarium was day by day replaced by dechlorinated new water.

Determination of fish growth parameters

The fish were totally weighed (15 fish/each replicate) using an electronic balance**.**

Total weight gain (TWG), average daily gain (ADG), specific growth rate (SGR), survival rate (SR %), feed conversion ratio (FCR), and protein efficiency ratio (PER), were calculated according to following equations:

Total weight gain (TWG) (g) = last body weight – beginning body weight (19).

Average Daily Gain (g/fish/day) = TWG (g)/trial period (d).

Specific growth rate (SGR % / day) = [Ln last body weight- Ln introductory body weight] × 100/trial period (d) (20).

SR= Total number of fish at the end of the experiment × 100/ absolute number of fish at the start of the experiment.

FCR= feed consumption (g)/Live weight gain. (21).

PER=Live weight gain (g)/protein intake (g). (21).

Determination of diet proximate analysis

Dry matter, crude protein, ether extract, crude fiber and ash contents of the experimental diets and the whole body of fish at the end of the experiment were performed according to AOAC (22).

Hematological investigations

Toward the finish of the experiment, twelve fishes from every group (4 fishes /every replicate) were randomly sampled and weighed. Anti-coagulated blood samples were taken from the caudal vein for blood analysis and differential leukocyte count. Due to the small fish size, blood samples collected from 3-4 fish were pooled according to Urbinate & Carneiro (23).

Red blood cells count (RBCs$\times 10^6$/mm) and white blood cells count (WBCs$\times 10^3$/mm) were determined according to the method described by Stoskopf, (24). Hemoglobin concentration (Hb g/dl) was estimated according to the method of Zinkl (25). Packed cell volume (PCV %) was estimated by the micro-haematocrite method described by Decie & Lewis (26).

Determination of internal organs indices

Toward the finish of the experiment, four fishes from every treatment were slaughtered and the abdominal cavity was directly opened to evacuate liver, kidney, spleen and gonads then weighed separately. Liver index (HSI), kidney index (KSI), spleen index (SSI) and gonads index (GSI) were calculated as follows:

Hepato somatic index (HSI %) = 100 × [liver weight (g) / body weight (g)] (27).

Kidney somatic index (KSI %) =100× [kidneys weight (g) /body weight (g)] (28).

n somatic index (SSI %) = 100× [spleen weight (g) / body weight(g)] (29).

Gonado somatic index (GSI %) =100× [gonads weight (g) / body weight (g)] (30).

Immunological parameters

Phagocytic activity (PA) and index (PI) were determined according to Kawahara et al., (31).

The nitro blue tetrazolium assay was used to investigate the respiratory burst activity as previously described (32). The lysozyme activity was examined by the technique described by Demers and Bayne (33) depending on the ability of lysozyme to lyses Gram positive lysozyme delicate bacterium; *Micrococcus lysodeikticus*.

Biochemical parameters

Total antioxidant capacity (TAC) of liver tissue was performed by the technique described by Prieto et al., (34). Catalase (CAT) activity was performed utilizing spectrophotometric assurance of hydrogen peroxide (H_2O_2) which framed stable complex with ammonium molybdate (35).

Statistical analysis

The obtained data were statistically analyzed utilizing general direct models technique adjusted by SPSS (36) for users guide, with a restricted ANOVA. Means were statistically compared for the significance ($P < 0.05$) using Duncan's multiple range test (37).

Results

In the current study, the physiological responses of *O. niloticus* fingerlings to Biomos® and Agrimos® were researched through assurance of fish development and hematological parameters. It was observed that there was a huge increase in absolute weight gain (TWG) and average daily gain (ADG) in all prebiotics treated groups except in T7 group compared with control group (T1). The most elevated qualities were noticed in the T2 and T6 groups. However, the specific growth rate (SGR) was fundamentally expanded in T2 group only. Survival rate percent (SR%) was significantly increased in T2, T3, T5, T6 groups with most noteworthy qualities reported in the case of T2 & T5 groups as shown in table (2: A).

The impacts of the two utilized prebiotics on feed intake, food conversion rate (FCR) and protein efficiency ratio (PER) were summarized in table (2: B). It was noticed that the best food conversion rate and protein efficiency ratio values were in T2 and T6 groups.

Chemical composition of the experimental fish body, average dry matter (DM), crude protein (CP), ether extract (EE), ash and nitrogen free extract (NFE) were determined and summarized in table 3. There was a critical difference in the DM in case of T2, T3, T6 and T7 groups with most astounding increment found in the T3 group. While, CP% was fundamentally expanded in T2, T5 followed by T3 group contrasted with other treated groups. On the other hand, ether extract was altogether diminished in all treated groups contrasted with control one. The most astounding estimation of ash content was recorded in T3 and T5 groups and the least incentive in T7 group.

RBCs, and WBCs count, Hb, and PCV demonstrated noteworthy increases in all prebiotics supplemented groups contrasted with the control one (Table 4). The highest level of RBCs count was recorded in T3 and T6 groups. The results of serum total proteins, albumin and globulin, showed non-significant increases in all probiotic treated groups contrasted with the control group except T4 group which expanded essentially. The T4 group demonstrated a huge decline in AST level. No noteworthy changes were observed in ALT in all groups.

Regarding immunological parameters, phagocytic activity and index, respiratory burst activity, lysozyme, total antioxidant and catalase activities were altogether expanded and increased in all groups with most extreme dimensions on account of group 2 and group 6, respectively (Table 5).

Discussion

In aquaculture, probiotics can be admitted either as feed added substances or as added substances to the water (38, 39). The shape and span of prebiotic and probiotic administration can impact their viability on fish health (8). The dietary supplementation of pre- and probiotics has been archived as a superior strategy of guaranteeing the effectiveness of the probiotic bacterial colonization in the fish gastrointestinal tract (7, 14, 40).

Aqua feeds industry are focusing mainly on getting double advantages of both upgraded development and resistant reaction of vast majority

Table 1A: Composition of the experimental diets offered for each group

Ingredients	Diet1 control	Diet2	Diet3	Diet4	Diet5	Diet6	Diet7
Fish meal (72% CP)	10	10	10	10	10	10	10
Yellow corn	22	22	22	22	22	22	22
Soybean meal (45% CP)	42	42	42	42	42	42	42
Wheat bran	20	20	20	20	20	20	20
Fish Oil	5	5	5	5	5	5	5
Vit&Min	1	1	1	1	1	1	1
Biomos	-	0.1	0.2	0.3	-	-	-
Agrimos	-	-	-	-	0.1	0.2	0.3

Table 1B: Chemical analysis of the experimental diets (% on DM basis).

Ingredients	Diet 1 control	Diet 2 (0.1% Biomos)	Diet 3 (0.2% Biomos)	Diet 4 (0.3% Biomos)	Diet 5 (0.1% Agrimos)	Diet 6 (0.2% Agrimos)	Diet 7 (0.3% Agrimos)
Dry matter	92.78	92.38	92.22	92.07	92.56	92.60	92.66
Crude protein	31.08	31.08	31.08	31.08	31.08	31.08	31.08
Ether extract	6.32	5.62	4.71	4.94	6.71	6.02	6.10
CF	1.10	2.21	1.92	1.93	2.13	2.09	2.21
Ash	6.73	6.65	6.45	9.37	6.49	6.61	6.14
NFE	54.77	54.44	55.84	52.68	53.59	54.2	54.47
Gross energy(GE) (Kcal/100g)[1]	458.265	445.622	448.879	437.775	459.625	453.861	454.254
Digestible energy(DE) (Kcal/100g) [2]	321.82	318.4	321.32	307.37	327.94	319.51	317.83
P/E ratio[3]	67.82	72.39	71.35	72.61	71.21	69.60	67.38

[1] Gross energy (Kcal/100g), based on 5.6Kcal/g protein, 9.44 Kcal/g lipid, 4.1 Kcal/g carbohydrate.

[2] Digestible energy (Kcak/100g), based on 5.0Kcal/g protein 9.0Kcal/g lipid, 2.0Kcal/g carbohydrate. According to (Wee & shu, 1989).

[3] P/E (protein to energy ratio)= mg crude protein/Kcal of gross energy.

Table 2A: Effect of Used prebiotics on growth parameters and survival rate of Nile tilapia

Treatment	I.W.	F.W.	T.W.G (g/fish)	A.D.G (g/fish/day)	S.G.R (%/day)	S.R.%
T1	7.02±.02	24.93±0.06^{b}	18.10±0.20^{d}	0.16±0.03^{c}	1.3±0.03^{b}	95.5±2.2^{c}
T2	6.97±.02	29.46±0.78^{a}	23.50±0.36^{a}	0.27±0.01^{a}	1.8±0.16^{a}	100±0.00^{a}
T3	7.00±.00	27.36±0.08^{ab}	20.86±0.84^{ab}	0.21±0.01^{ab}	1.5±0.03^{ab}	97.7±2.2^{b}
T4	7.00±.00	26.96±1.00^{ab}	20.13±0.98^{b}	0.18±0.04^{b}	1.43±0.03^{b}	95.5±4.4^{c}
T5	7.32±.32	27.00±1.01^{ab}	20.86±1.2^{ab}	0.21±0.01^{ab}	1.6±0.18^{ab}	100±0.00^{a}
T6	7.00±.00	28.86±0.57^{a}	21.86±0.59^{ab}	0.23±0.01^{ab}	1.7±0.15^{ab}	97.7±2.2^{b}
T7	7.01±.01	25.06±0.86^{b}	18.26±0.84^{cd}	0.16±0.03^{c}	1.40±0.05^{b}	95.5±2.2^{c}

T1=Diet 1 (control group), T2= Diet 2 (0.1% Biomos), T3= Diet 3 (0.2% Biomos), T4=Diet 4 (0.3% Biomos), T5= Diet 5 (0.1% Agrimos), T6= Diet 6 (0.2% Agrimos), T 7= Diet 7 (0.3% Agrimos), I.W. = Initial Weight, F.W. = Final Weight, T.W.G = Total weight gain, A.D.G = Average daily gain, S.G.R = Specific growth rate, S.R.% = Survival Rat

Table 2B: Feed intake, feed conversion rate and protein efficiency ratio of Nile tilapia in response to prebiotics supplementation

Treatment	FI	FCR	PER
T1	42.16±.16^{c}	2.33±.03^{a}	1.26±.08^{b}
T2	48.90±1.50^{a}	1.97±.08^{b}	1.53±.03^{a}
T3	47.43±.51^{a}	2.10±.17^{ab}	1.43±.06^{ab}
T4	46.33±.83^{ab}	2.22±.13^{a}	1.30±.15^{b}
T5	45.33±1.51^{abc}	2.13±.08^{ab}	1.46±.03^{ab}
T6	46.16±1.63^{ab}	1.99±.04^{b}	1.53±.03^{a}
T7	42.70±1.40^{bc}	2.20±.26^{a}	1.33±.08^{b}

T1=Diet 1 (control group), T2= Diet 2 (0.1% Biomos), T3= Diet 3 (0.2% Biomos), T4=Diet 4 (0.3% Biomos), T5= Diet 5 (0.1% Agrimos), T6= Diet 6 (0.2% Agrimos), T 7= Diet 7 (0.3% Agrimos), FI: Feed Intake, FCR: Feed conversion rate, PER: Protein efficiency ratio

Table 3: Composition Analysis of fish body fed graded levels of Biomos and Agrimos

Treatment	DM	CP	EE	ASH	GE Kcal/100g
T1	24.52±0.01^{c}	58.92±0.01^{c}	17.54±0.01^{a}	17.84±0.02^{b}	518.89
T2	24.34±0.02^{d}	64.32±0.01^{a}	13.33±0.01^{b}	18.42±0.01^{a}	502.140
T3	25.16±0.01^{a}	61.52±0.01^{b}	13.57±0.01^{c}	19.16±0.01^{a}	496.187
T4	24.52±0.01^{c}	57.52±0.01^{c}	13.33±0.02^{c}	18.42±0.01^{a}	491.940
T5	24.55±0.01^{c}	64.32±0.01^{a}	15.07±0.01^{b}	18.71±0.00^{a}	510.242
T6	24.65±0.00^{b}	58.66±0.01^{c}	17.17±0.01^{a}	18.17±0.00^{a}	515.180
T7	24.10±0.00^{e}	59.72±0.01^{b}	15.33±0.01^{b}	17.74±0.00^{b}	508.708

T1= Diet 1 (control group), T2= Diet 2 (0.1% Biomos), T3 = Diet 3 (0.2% Biomos), T4= Diet 4 (0.3% Biomos), T5= Diet 5 (0.1% Agrimos), T6= Diet 6 (0.2% Agrimos), T 7= Diet 7 (0.3% Agrimos). DM= Averege dry matter, CP= crude protein, EE= ether extract, GE= gross energy

Table 4: Effect of Biomos and Agrimos on haematological parameters and serum biochemical analysis in *Oreochromis niloticus*

	T1	T2	T3	T4	T5	T6	T7
RBCs (x10/mm^3)	2.8±.02^{c}	2.9±.02^{bc}	3.9±.05^{a}	3.2±.12^{abc}	3.3±.07^{abc}	3.8±.09^{a}	3.5±.53^{ab}
Hb (g/100ml)	8.1±.11^{a}	9.2±.70^{a}	10.57±.67^{a}	10.51±1.04^{a}	9.5±.26^{a}	8.3±.21^{a}	10.9±1.6^{a}
PCV (%)	24±0.00^{b}	26±2.0^{ab}	30.5±2.5^{a}	30±1.00^{ab}	27.5±.50^{ab}	26.5±.50^{ab}	32±3.00^{a}
WBCs (x10^3/mm^3)	31.9±5.01^{a}	37.7±7.9^{a}	41.3±10.1^{a}	38.7±.7^{a}	44.4±4.4^{a}	32.2±1.5^{a}	36.3±7.3^{a}
Total protein (g/dl)	4.8±.10^{b}	5.2±.20^{ab}	5.1±.24^{ab}	5.9±.11^{a}	5.6±.24^{ab}	5.7±.39^{ab}	5.8±.38^{ab}
Albumin (g/dl)	2.9±.08^{a}	3.06±.06^{a}	3.02±.21^{a}	3.4±.08^{a}	3.3±.05^{a}	3.4±.22^{a}	3.2±.19^{a}
Globulin (g/dl)	1.9±.02^{b}	2.14±.14^{ab}	2.11±.03^{ab}	2.49±.03^{a}	2.3±.18^{ab}	2.41±.17^{ab}	2.41±.19^{ab}
ALT (U/I)	5.10±.28^{a}	5.11±.02^{a}	5.11±.30^{a}	4.5±.32^{a}	5.3±.10^{a}	4.8±.04^{a}	5.11±.19^{a}
AST (U/I)	77±.93^{a}	76.6±.4^{a}	75.1±4.01^{ab}	69.8±.04^{b}	78±.90^{a}	72.8±.57^{ab}	62.8±.40^{c}

T1=Diet 1 (control group), T2= Diet 2 (0.1% Biomos), T3= Diet 3 (0.2% Biomos), T4=Diet 4 (0.3% Biomos), T5= Diet 5 (0.1% Agrimos), T6= Diet 6 (0.2% Agrimos), T 7= Diet 7 (0.3% Agrimos). RBCs = Red Blood Cells, HB = Haemoglobin, PCV = Packed Cell Volume, WBCs = White Blood Cells, ALT = Alanine aminotransferase, AST = Aspartate amninotransferase

Table (5): Effect of prebiotics supplementation on immunity and biochemical parameters

Treatment	Phagocytic activity	phagocytic index	Respiratory burst activity	lysozyme activity	Total antioxidant activity	Catalase activity
T1	16.47±1.02^{c}	4.27±0.08^{a}	2.41±0.03^{Da}	0.04±0.001^{Da}	0.38±0.002^{Fa}	2.05±0.15^{Ea}
T2	42.55±1.66^{ab}	19.33±0.41^{ab}	8.72±0.022^{Aa}	0.83±0.002^{Aa}	1.95±0.006^{Aa}	7.78±0.08^{Aa}
T3	31.35±1.73^{a}	13.26±0.27^{ab}	5.37±0.021^{Ba}	0.34±0.003^{Ba}	1.21±0.02^{3Ca}	3.56±0.05^{Ca}
T4	29.63±3.11^{bb}	11.47±0.74^{a}	4.68±0.044^{Cb}	0.39±0.003^{Cb}	1.54±0.002^{Ab}	5.31±0.08^{Ab}
T5	28.27±1.64^{abc}	11.37±0.44^{a}	4.23±0.032^{Ba}	0.025±0.005^{Ba}	1.11±0.002^{Da}	2.14±0.17^{Db}
T6	39.93±1.27^{ab}	16.25±0.36^{b}	7.29±0.027^{Aa}	0.76±0.003^{Aa}	1.52±0.002^{Ba}	5.13±0.13^{Ba}
T7	25.87±3.47^{bc}	9.62±0.89^{a}	3.85±0.052^{Cb}	0.31±0.004^{Cb}	1.12±0.002^{Bb}	4.33±0.02^{Bb}

T1=Diet 1 (control group), T2= Diet 2 (0.1% Biomos), T3= Diet 3 (0.2% Biomos), T4=Diet 4 (0.3% Biomos), T5= Diet 5 (0.1% Agrimos), T6= Diet 6 (0.2% Agrimos), T 7= Diet 7 (0.3% Agrimos)

Aqua feeds industry are focusing mainly on getting double advantages of both upgraded development and resistant reaction of vast majority of farmed fish species, as well as preventive medicinal services by means of numerous healthful procedures to guarantee its manageability in the aquaculture system (41). The nutritional status is the main key that affects the immune status of cultured fish species so as to finally get a superior assurance (42).

In the current study, the increased growth parameters among prebiotic treated groups may be attributed to improved feed utilization in fish. The results are similar to those reported by some authors (43-47); but in contrast to those reported by Genc et al., (48).

The improvement of food conversion rate, the best was recorded in T2 and T6 groups, may be due to the effect of used prebiotics in the current study which led to decreased amount of feed necessary for producing one unit of fish leading consequently to production cost reduction. The results are in agreement with some authors (45, 46, 49). The dietary MOS could altogether build the intestinal microvilli length or potentially thickness prompting expanded nutrient absorptive capacity (43, 46, 49).

The results of chemical composition of the experimental fish body, average dry matter, crude protein, ether extract, ash and nitrogen free extract, are in a partial consent to Orban et al., (50), where they recorded that body composition was strongly affected by their feed composition. In the current study, there were no critical contrasts recorded in body composition among groups; however, an expansion was noticed in protein level of carcass prawn with expanding the Agrimos® incorporation level in the diet. These outcomes are like those announced by numerous authors (45, 48, 51, 52).

The elevated number of WBCs may be attributed to the improved defense response as a result of Biomos and/or Agrimos feed supplementation. The obtained result is similar to those reported by some authors (53-55). However, it is in contrast to other authors (56, 57). The variety in the results of haematological parameters might be due to the probiotic type and dose, fish physiological status, species, size, age, ecological conditions and dietary routine (58). The increased level of total proteins in all prebiotic treated groups may be attributed to improved body defense and stronger innate response of fish as a result of prebiotic supplementation (53, 59, 60). The results were in agreement to some authors (57, 61); however, in contrast to Andrews *et al.* (53). Fluctuations in hematological and serum biochemical factors may be species-related and rely upon the

incorporation rates of MOS, diet ingredients and/or the raising time frame period (62).

This study demonstrated that the immune response of *O. niloticus* fingerlings was fundamentally influenced and expanded in all groups with the maximum level in group 2 and 6. Lysozyme is a standout amongst the most fundamental safe reactions of fish. It is originating from neutrophils and macrophages emitted into blood and mucus to apply bacteriolytic impacts (63) helping organisms to oppose bacterial, viral and parasitic diseases (64). The present outcomes demonstrated that the dimensions of lysozyme action were fundamentally modified due to Biomos and Agrimos supplementation. The highest serum lysozyme activity was observed in fish encouraged eating diet with 0.1% Biomos diet and 0.2% Agrimos, respectively. The expanded lysozymal action might be due to the immune-stimulatory effects of dietary Biomos and Agrimos (42).

Respiratory burst activity, a key for innate immunity, could be estimated utilizing nitroblue tetrazolium (NBT) (65, 66). It shows the oxidative capability of reactive oxygen species (ROS) like; hydrogen peroxide, superoxide anions, and hydroxyl radicals (67), delivered by initiated phagocytic cells and in charge of killing or degrading engulfed materials, including microbes (67). In the present study, group 2 (0.1% Biomos) and group 6 (0.2% Agrimos) demonstrated a huge upgrade of NBT toward the finish of the investigation. It implies that both Biomos and Agrimos assumes a critical job in activating antioxidant defense systems including superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx) (68). The expanded bactericidal, lysozyme, and antioxidant activities in the present investigation might be attributed to the resistant stimulatory impacts of dietary Biomos and Agrimos.

Conclusion

It could be concluded that prebiotics supplementation of Biomos® and Agrimos® are highly beneficial in *O. niloticus* fingerlings diets resulting in an increased nutrient utilization and improving growth rate, hematological, biochemical parameters, immunological responses and survival rate. From the obtained results, it is preferable to use Biomos® and Agrimos® as feed additives at levels of 0.1% and 0.2%, respectively, with commercial feeds to improve tilapia fingerlings immune response.

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