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Bergapur® prebiotic dietary incorporation modulates growth performance in Nile tilapia.

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ABSTRACT

The present experiment examined the effect of the prebiotic BergaPur® (de-oiled phospholipid complex) dietary incorporation on the growth parameters of Nile tilapia *Oreochromis niloticus.* Three fish groups (Average weight 10.0 ± 0.5 g) were supplemented with prebiotic, BergaPur® at a rate of 1.0, 1.5 and 2.0 g/kg diet and the fourth group served as control without any dietary supplementation. The experiment lasted for 9-weeks; and fish were weighted each 3 weeks. Results showed that BergaPur® prebiotic incorporation significantly improved growth performance parameters including final weight, body mass gain, specific growth rate, and length gain rate over the control group, with most significant elevation for 2.0 BergaPur® g/kg group. Also, 2.0g prebiotic BergaPur® group showed the most obvious reduced feed conversion ratio. Conclusively, our data proved the useful effect of incorporating *O. niloticus* diets with different concentrations of BergaPur® prebiotic on growth profiles, with a suspected enhancement of palatability and digestibility.

1. INTRODUCTION

The aquaculture faces many challenges including, infections (bacterial, viral and parasitic) (Martinez Cruz *et al.*, 2012). The antibiotics usage caused the development of resistant strains and harmful effects to aquaculture (Jahangiri and Esteban, 2018). Consequently, the necessary need and command to figure an eco-safe alternative therapies like prebiotics to maintain fish overall health and bio-viability without detrimental drawbacks (Dawood and Koshio, 2016; Dawood *et al.*, 2020; Song *et al.*, 2014). Moreover, aquaculture intensification is mostly associated with raised stress levels and a consequent stress response which conveys damaging effects on fish, with subsequent immune suppression as the stressors prolonged (Bittencourt *et al.*, 2003).

Recently, research focused on modulating the fish immune response as a control strategy against fish infections (Elkamel and Mosaad, 2012). Prebiotics are a group of non-digestible diet components that promote the growth of beneficial gastro-intestinal microbiota. BergaPur® contains essential nutrients as phospholipids, phosphorus and choline; in addition, it is a functional feed additive that improves crude protein and amino acid digestibility and absorption of other water/fat soluble nutrients (vitamins, minerals). BergaPur® is a pure, de-oiled phospholipid complex includes concentrated active components of crude soya phospholipids in powder and granular form. Main constituents of BergaPur® include Phosphatidylcholine (PC), phosphatidylinositol (PI), phosphatidylethanolamine (PE). Its dietary incorporation is suspected to improve growth rate and overall performance (Majdolhosseini *et al.*, 2019). Therefore, our experimental work was elucidated to study the possible useful effects of BergaPur® (de-oiled phospholipid complex) on the Nile tilapia *Oreochromis niloticus* growth and overall performance.

2. MATERIAL AND METHODS

2.1. Fish and rearing conditions:

Three hundred sixty fish (Average weight 10.0 ± 0.5 g) were obtained from the Egyptian military veterinary administration aquaculture farm, Kafr Elsheikh governorate, Egypt and conveyed in polyethylene bags to (100 cm base, 140 cm top face, 120 to 140 cm side walls) tanks at the Military aquaculture unite number (1) and left for 14 days acclimatization. De-chlorinated tap-water was provided, temperature was 25.0 ± 0.5°C and dissolved oxygen (DO) was 6.1±0.4 mg/L. Entire procedures of the experiment were carried out following the institutional guidelines of Benha University BUFVTM 02-06-22.

2.2 BergaPur® and experimental diets:

BergaPur® was obtained as commercial product from Berg +Schmidt, Singapore (deoiled soy plant derived lecithin, phospholipid of high concentration 96.9 %, mostly more than two times the content in the traditional lecithin powders). Basal diet obtained from Feed manufacturing and packaging complex (Fipco), related to Egyptian armed forces' logistic consultant and it composed from dry matter 66.13,crude fiber 8.20, crude protein 31.09 and

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lipid 5.92 as presented in table 1, and experimental diets were prepared by adding BergaPur® at a rate of 0,1.0, 1.5 and 2.0 g/kg feed to the basal diet and mixed for 15 minutes, then pressed, cooled, and finally received the final product.

Table 1 Proximate composition of the basal diet.

Composition	Proximate analysis (%)
Crude protein (CP)	31.09
Ether extract (EE)	6.36
Crude fiber (CF)	8.20
lipid	5.92
Digestible energy (Kcal/kg)	3302

2.3. Experimental feeding:

After acclimatization, fish were divided into four random groups (ninety fish per group, in triplicates). The first group served as control without any supplementation, the second, third and fourth groups were supplemented with 1.0, 1.5 and 2.0 BergaPur® g/kg diet, respectively for nine-weeks feeding trial. Fish were fed twice daily at rate of 3% of total fish weight (9 am and 4 pm).

2.4. Sampling:

Three sampling points were perused at the third, sixth, and ninth weeks from the beginning of the experimental feeding period. All experimental fish were weighted at the start point (Zero-day); and at the end of the third, sixth, and ninth week of the feeding trial. 30 fish from each group (10 samples /replicate) were used for the following measurements:

Body Mass Gain % = 100 × (final weight - initial weight) / (initial weight)

SGR% = (ln final mass- ln initial mass) / (days) ×100)

LGR% =100 × (final length–initial length) / (initial length) × 100]

FCR = Feed / (final weight – initial weight).

2.5. Statistical analysis:

All recorded results were analyzed using ANOVA and Duncan's range test through SPSS statistical program # 22.0. Means were considered significant when p value < 0.05.

3. RESULTS

Growth performance:

BergaPur® supplementation revealed significant improvement (P<0.05) in all the tested growth parameters including (final weight, body mass gain, specific growth rate and length gain rate) at all the sampling points (3, 6 and 9 weeks) with the greatest value for 2.0 g/kg BergaPur® group, that also revealed the most obvious ($P<0.05$) diminution in FCR over the control group (Tables 2, 3 and 4).

Table 2 Effect of 1, 1.5 and 2g/kg diet Bergapur® on growth performance of (*O. niloticus*) at 3 weeks.

Bergapur® g/kg feed	Initial Wt (g)	Final Wt (g)	BMG (%)	SGR (%)	LGR (%)	FCR
Control	10±0.5	24.1±0.2^{c}	244±0.2^{c}	2±0.01^{c}	38.8±0.3^{c}	2±0.00^{c}
1.0	10±0.5	24.8±0.5^{b}	254±0.3^{b}	1.9±0.02^{b}	42±0.2^{ab}	1.9±0.03^{b}
1.5	10±0.5	25.1±0.2^{b}	259±0.2^{b}	1.9±0.00^{b}	45.8±0.2^{b}	1.9±0.00^{b}
2.0	10±0.5	26.5±0.4^{a}	279±0.1^{a}	2.1±0.01^{a}	53.1±0.3^{a}	1.7±0.03^{a}

Table 3 Effect of 1, 1.5 and 2g/kg diet BERGAPUR® on growth performance in (*O. niloticus*) at 6 weeks.

Bergapur® g/kg feed	Initial Wt (g)	Final Wt (g)	BMG (%)	SGR (%)	LGR (%)	FCR
Control	10±0.5	28.2±0.05^{c}	303±0.2^{c}	1.1±0.004^{c}	62.2±0.2^{b}	1.5±0.00^{c}
1.0	10±0.5	29.8±0.3^{b}	327±0.2^{b}	1.2±0.02^{b}	64.6±0.2^{b}	1.4±0.00^{b}
1.5	10±0.5	30.1±0.4^{b}	331±0.3^{b}	1.2±0.03^{b}	70.8±0.3^{b}	1.4±0.03^{b}
2.0	10±0.5	32.5±0.3^{a}	367±0.1^{a}	1.3±0.02^{a}	74.4±0.1^{b}	1.2±0.03^{a}

Table 4 Effect of 1, 1.5 and 2g/kg diet BERGAPUR® on growth performance in (*O. niloticus*) at 9 weeks.

BergapuR® g/kg feed	Initial Wt (g)	Final Wt (g)	BMG (%)	SGR (%)	LGR (%)	FCR
Control	10±0.5	32.5±0.2^{c}	427±0.2^{c}	0.94±0.01^{c}	74.4±0. 1^{c}	1.0±0.00^{c}
1.0	10±0.5	35.8±0.3^{b}	446±0.2^{b}	0.97±0.02^{b}	93.2±0.2^{b}	1.0±0.00^{b}
1.5	10±0.5	36.4±0.1^{b}	464±0.1^{b}	0.99±0.04^{b}	95.4±0.1^{ab}	1.0±0.00^{b}
2.0	10±0.5	39.2±0.2^{a}	481±0.01^{a}	1.0±0.00^{a}	99.0±0.1^{a}	0.9±0.00^{a}

Values are mean (n = 30) ± SE. Different superscript letters indicate significant difference

BMG = Body Mass Gain, SGR = Specific growth rate, LGR=Length Gain Rate, FCR = Feed Conversion Ratio

4. DISCUSSION

Inclusion of feed additives including prebiotics have been known for their growth-stimulating properties into Nile tilapia (*Oreochromis niloticus*) diets, which is an important cultured species worldwide (FAO, 2018). The current experiment targeted the study of the possible roles of BergaPur® at a rate of 1.0, 1.5 and 2.0 g/kg diet on growth performance in Nile tilapia (*Oreochromis niloticus*).

Growth performance data indicated that BergaPur® dietary incorporation showed marked (P<0.05) enhanced growth performance (final weight, body mass gain, specific growth rate and length gain rate) at all the sampling points. On the same instance, commercial soy lecithin-containing bioemulsifier Lysomax® markedly improved growth performance, feed utilization, digestion of Nile tilapia (El-Sayed *et al.*, 2021). Likewise, improved growth, body gain, specific growth rate, protein efficiency, feed efficiency and feed conversion ratio were noticed for *O. niloticus* larvae that received 8% lipid (Eid *et al.*, 2019). Also, (Seiedzadeh *et al.*, 2016) suggested that inclusion of 4-6% of chicken egg lecithin in diets of *Mesopotamichthys sharpeyi* juvenile have promising roles on promoting health status and growth. Fermos® prebiotic incorporation also showed significant (P<0.05) enhancement in growth performance parameters (BW, BMG, SGR and LGR) of Nile tilapia all over the experiment (Abdel Gayed *et al.*, 2021). Moreover, (Abu-Elala *et al.* 2018) reported that the prebiotic Immunowall® which is composed mostly of yeast β-glucan and mannan oligosaccharide (MOS) significantly (P<0.05)

improved performance of Nile tilapia *O. niloticus*. Similarly, Torrecillas *et al.* (2014 and 2015) confirmed that dietary supplementation with of MOS significantly ($P<0.05$) increased growth performance of European Sea Bass (*Dicentrarchus labrax*). Dietary soybean lecithin (SBL) supplementation at the rate of 0% (control), 3%, 6%, 9% and 12% for Caspian brown trout, *Salmo trutta caspius* in the pre-spawning stage resulted in a significant enhanced ($p<0.05$) performance including specific growth rate (SGR), weight gain (WG) and feed conversion ratio (FCR); white blood cell counts (WBC), lysozyme activity, total immunoglobulin (IgM), and complement activity. In addition, antioxidants, catalase (CAT) and glutathione S-transferase (GST) revealed significant improvements. Also, digestive enzymes activity (amylase alkaline protease, and lipase were regulated ($p<0.05$) in supplemented groups. This enhancement could be attributed to the enhanced feed intake and utilization efficiency and improved dietary absorption and intestinal transportation (Jenabi Haghparast *et al.*, 2019; El-Sayed *et al.*, 2021).

Those effects might be mostly related to enhanced nutrients availability and digestibility through modulating the digestive enzymes gastric morphology. Caspian roach (*Rutilus rutilus*), allogynogenetic crucian carp (*Carassius auratus gibelio*), and blunt snout bream (*Megalobrama amblycephala*) supplemented with prebiotics (fructo-oligosaccharide (FOS), and xylooligosaccharides) showed significantly ($p<0.05$) higher growth, increased digestive enzymes activity (Xu *et al*. 2009; Soleimani *et al*. 2012; Wu *et al*. 2013). Anguiano *et al*. (2013) also investigated the effect of feeding fructooligosaccharides (FOS), mannan-oligosaccharides (MOS), transgalactooligosaccharides (TOS) and GroBiotic®-A prebiotics on the digestive enzymes and gut histomorphology of red drum (*Sciaenops ocellatus*), and hybrid striped bass (*Morone chrysops* × *M. saxatilis*) and reported an enhancement in the nutrient availability which could be attributed to the enhancement of the gut structure and the digestive enzyme activity. In addition, gilthead sea bream fed Bio-Mos® led to higher growth, feed conversion ratio, and feed digestibility (protein, carbohydrate, and energy. Authors recommended the inclusion of 0.2% Bio-Mos® in gilthead sea bream feed (Gültepe *et al*. 2011).

On contrary, Oxidized fish oil at rate of 0 g/kg, 30 g/kg, 60 g/kg, and 90 g/kg increased the moisture, crude protein, and ash content in whole body. The antioxidant enzyme content and vitamin E activity in serum including superoxide dismutase (SOD) and were significantly augmented as the oxidized fish oil in the diet increased, however malondialdehyde (MDA) level significantly regulated ($p<0.05$) decreased. The oxidized fish oil also decreased alpha diversity of intestinal bacteria and changed the intestinal flora (Cui *et al.*, 2022).

5. CONCLUSION

In assumption, the present experiment showed the promising role of BergaPur® prebiotic inclusion in diets of *Oreochromis niloticus* through improving growth profiles of supplemented fish and elucidates its role as a functional supplement though possessing a physiological action plus its nutritional properties according to (Roberfroid, 2000).

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