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The effect of Eucalyptus leaf meal on growth Common carp (*Cyprinus carpio* Linnaeus, 1758)

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Abstract:

This study investigated the impact of feeding common carp (*Cyprinus carpio*) with a diet incorporating eucalyptus leaf meal as a prebiotic. Common carp used in the experiment were sourced from Al-Bahaa fish farm at Alseeba, south of Basrah. The live fish were transported in nylon bags to the Fish Laboratory at the College of Agriculture, University of Basrah. A total of 12 aquariums, each containing five fish with an initial average weight of 17.84 ± 1.02 g, were utilised for the study. Each treatment was replicated three times. The fish were fed artificial feed for 56 days at a rate of 3% of their body weight, supplemented with varying levels of eucalyptus leaf meal – meal-0%, 0.5%, 1.0%, and 1.5% – designated as the control group, T1, T2, T3, and T4, respectively. The results of the experiment indicated improved growth rates and the best feed conversion ratio in the T4 group compared to the other treatments. In T4, the final average weight reached 52.22 g, with a weight gain of 34.29 g, a daily growth rate of 0.611 g/day, a specific growth rate of 1.906%/day, and a feed conversion ratio of 2.147. Statistical analysis revealed significant differences ($P \leq 0.05$) in growth rates between T4 and all other treatments, confirming its superior performance.

Keywords: *Eucalyptus*, *Common carp*, *Feed conversion rate* *Daily growth rate*

تأثير استعمال مسحوق اوراق اليوكالبتوز في نمو اسماك الكارب الشائع (*Cyprinus carpio* Linnaeus, 175).

صادق جواد محمد

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الخلاصة:

بحثت هذه الدراسة في تأثير النمو لاسماك الكارب الشائع (*Cyprinus carpio*) المغذاة بعلائق تحتوي على مسحوق أوراق اليوكالبتوز كسابق حيوي. جلبت اسماك التجربة من مزرعة أسماك البهاء في السببة، جنوب البصرة. ونقلت الأسماك الحية في أكياس بلاستيكية إلى مختبر الأسماك في كلية الزراعة، جامعة البصرة. استخدم ما مجموعه 12 حوض زجاجي يحتوي كل منها على خمس أسماك بمتوسط وزن أولي يبلغ 17.84 ± 1.02 غم وبواقع اربع معاملات وثلاث مكررات لكل معاملة،

غذيت الأسماك على عليقة صناعية لمدة 56 يومًا بمعدل 3% من وزن الجسم، مع إضافة مستويات متفاوتة من مسحوق أوراق اليوكالبتوز 0%، 0.5%، 1.0%، 1.5%، T1، T2، T3 و T4 على التوالي. أشارت نتائج التجربة إلى تحسن معدلات النمو وأفضل معامل تحويل غذائي في مجموعة T4 مقارنةً بالمعاملات الأخرى. بلغ متوسط الوزن النهائي 52.22 غ في T4، بزيادة وزنية قدرها 34.29 غ، ومعدل نمو يومي قدره 0.611 غ/يوم، ومعدل نمو نوعي قدره 1.906%/يوم، ومعامل تحويل غذائي قدره 2.147. بينت نتائج التحليل الإحصائي عن فروق معنوية ($P \leq 0.05$) في معدلات النمو بين T4 وجميع المعاملات الأخرى مما يؤكد تفوقها في الأداء.

الكلمات المفتاحية: نبات اليوكالبتوز، أسماك الكارب الشائع، معدل النمو اليومي، معدل التحويل الغذائي

Introduction:

Aquaculture is farming fish and other water-related organisms for food and other purposes. In relation to the topics at hand, it should be noted that the more rapid growth of the aquaculture sector in recent years, in addition to the intensification of production, raises issues of concern about possible environmental impacts (Ruzauskas, *et al.*, 2021). Common carp (*Cyprinus carpio*) is regarded as one of the most economically significant freshwater fishes globally, with its production level surpassing four million tons annually, with its aquaculture production level surpassing four million tons annually (Pathak *et al.*, 2014; Shalgimbayeva *et al.*, 2021). Common carp is native to certain regions in Asia; however, its range has expanded to include parts of Europe and North America, where it is plentiful in stagnant or slow-moving waters (Vajargah, and Vatandoust, 2022). In spite of the importance of common carp in the aquaculture industry, it is regarded as an invasive species in a large number of countries owing to the anthropogenic impacts on the biodiversity and ecological interactions of the region (McColl and Sunarto, 2020).

The species is famous for its lower tillering trait, resistance to waterlogging, quick rooting ability, wide range of pH, omnivorous feeding habit, and gregarious or social behavior in warm temperate regions of the world with specific water acid and hardness ranges. The species is famous for its lower tillering trait, resistance to waterlogging, quick rooting ability, wide range of pH, omnivorous feeding habit, and gregarious or social behavior in warm temperate regions of the world with specific water acid and hardness ranges. The studies conducted have also examined the molecular genetic variations of common carp fish populations that underscored the divisions at the average level as well as older evolutive connections of these variants. (Basha, *et al.*, 2012). Eucalyptus, belonging to the Myrtaceae family, contains a vast number of species, making it one of the largest plant genera globally (Vecchio *et al.*, 2016). Prior to more than a century and a half ago, the genus had already been successfully introduced to over 90 countries, according to Brooker and Kleinig (2006), and it has since become one of the most widespread and extensively distributed plants across the world. Native to Australia, eucalyptus is a medicinal shrub that originated from that continent but has now spread far and wide internationally, predominantly locating to tropical and subtropical regions, as described by Salari *et al.* (2006). But according to Brooker and Kleinig (2006), it had been successfully introduced in over 90 countries.

Dating from over 150 years ago and becoming one of the most commonly used and most widely dispersed plants at various locations. Eucalyptus is a medicinal plant that has been widely used in modern practice. They are also found across the globe with a predominant presence in tropical and subtropical regions (Salari *et al.*, 2006). According to Sadlon and Lamson (2010), eucalyptus leaves are used as a cure for people who are suffering from cold-weather-induced nasal congestion. The antibacterial activity of the compound was illustrated in order to demonstrate this. Effect of eucalyptus globulus Essential Oil on Seven Pathogenic Bacterial Strains Infecting the Crops Cultivated in Korea Flatfish, Park, and colleagues (2016). Materi because chemical components have hazardous side effects on humans and animals, many nations

have curtailed or even prohibited their use. As a result, it's vital to engage natural promoters like plants (Mashayekhi *et al.*, 2018). According to Vecchio *et al.* (2016), eucalyptus species can grow fast. It acts as a source of oil that has multiple uses as well as timber (Surbhi *et al.*, 2021). Eucalyptus is widely used in modern food and pharmaceutical industries. In addition to contemporary scientific investigations concerning the plant, its applications in culinary and medicinal contexts, based on historical records of its applications in culinary and medicinal contexts, were considered. The plant's phytochemical composition. According to a study by Hutkins *et al.* (2016), prebiotics are complex, indigestible saccharides that are added to animal feed to support health and speed up growth. While Hanley *et al.* (1995) carried out the first study on prebiotics for aquatic animals in aquaculture, Yazawa *et al.* (1978) provided substantial amounts of carbohydrates to mammals. Several laboratory studies carried out in Iraq concentrate on the effects of different Al-Atabi (2012) states that numerous laboratory research studies in Iraq examine the impact of various prebiotics on the growth and health of the well-known farmed fish, common carp, as well as their development and well-being. Al-Atabi, 2012; Ahmed, 2014; Al-Faiz *et al.*, 2014; Al-Faragi, 2014; Mustafa *et al.*, 2014; Ahmed and Abdulrahman, 2015; Abdulrahman *et al.*, 2016; Al-Muslimawi and Al-Shawi, 2016; Mohammad, 2016; Taher *et al.*, 2018). The goal of this experiment was to examine the impacts of whether common carp growth performance is improved by adding eucalyptus leaf meal as a prebiotic to their meals.

Materials and Methods:

The impact of adding eucalyptus leaf powder to a common carp's diet can have a major impact on the fish's growth and health, according to a lab experiment. As feed additives in the diet's formulation on common carp growth performance. The feed, which is made in the lab with locally sourced basic materials (Table 1), is designed to supply 27% crude protein. Common carp, weighing $17.84 \pm 1.02\text{g}$ on average, were acquired from Al-Bahaa fish farm at Alseeba, south of Basrah. Following seven days of acclimatization, the fish were placed in twelve glass aquariums measuring 60 cm 40×30 cm and equipped with pumping aeration. For the current experiment, five fish in three duplicates for each treatment were employed at the Laboratory of Agriculture College's Aquaculture Unit. The experimental diets employed in the feeding trial of the current experiment included a control T1 (no additives), T2 (0.5%), T3 (1%) and T4 (1.5%). Fish were fed at a feeding ratio of 3% of their weight seven days a week for the duration of the 57-day experiment. To adapt the food to the new mean body weight, the weight of every fish in each replicate was measured every two weeks.

Growth performance

The experiment began on March 1, 2023, and ended on April 25, 2023. The common carp's growth performance was described using the following growth parameters:

Weight gain: $WI = W2 (g) - W1 (g)$

Daily growth rate (DGR): $(FW - IW) / \text{days}$

Relative Growth Rate:

$RGR = [(W2 (g) - W1 (g)) / W1] \times 100$ Specific Growth Rate: $SGR = (\ln W2 (g) - \ln W1 (g)) / (t2 - t1) \times 100$ The natural logarithms of the beginning weight at time T1 and the final weight at time T2 are denoted by $\ln W1$ and $\ln W2$, respectively, and the interval between the two weights is $T2 - T1$. $GR = (\ln W2 (g) - \ln W1 (g)) / (t2 - t1) \times 100$

Feed utilization Feed Conversion Ratio

$FCR = R (g) / WG (g)$ Where R is the dry feed intake weight. WG: wet weight growth (fish's live weight). The feeding trial was carried out using a perfectly randomized design, and the SPSS software version 22 was used to test for significant differences using the LSD test at a 0.05 probability level and analyses mean differences using analysis of variance (ANOVA).

Results:

The average fish weights of 12 aquariums during the trial, together with standard deviations, were displayed in Table (1). Fish in aquarium 12 of T4 had the highest ultimate average weight (53.56 g), whereas fish in aquarium 1 of T1 had the lowest (28.64 g). A few growth criteria for various treatments with feed conversion rates were displayed in Table (2). For T1, T2, T3, and T4, the ultimate average weights were 32.06, 38.82, 40.81, and 52.22 g, respectively (Figure 1). The final weights of T1 and the other treatments, as well as between T2 and T4, showed significant differences ($P \leq 0.05$), according to statistical analysis of the data. The ultimate weights of T2 and T3 are not significantly different ($P > 0.05$). Fish in T4 had the largest weight rise (34.27 g), while fish in T1 had the smallest (10.84 g). Analysis of the data using statistics

Weight increases demonstrated that T1 and T3 and T4 differed significantly ($P \leq 0.05$). The weight increments for T1 and T2 did not change significantly ($P > 0.05$). According to Figure 2, the daily growth rate varied from 0.187 g/day in T1 to 0.611 in T4.

Table (1) shows the average weight of the fish during the trial.

Treatment..	Aquarium.	Average fish weight different dates (g)..				
		1/3/2023	15/3/2023	28/3/2023	11/4/2023	25/3/2023
T1 (0%).	1.	18.16 ±0.93	21.62 ±1.04	23.38 ± 1.01	25.78 ±1.39	28.64 ±1.25
	2.	18.48 ±0.96	22.17 ±1.09	25.94 ±1.02	30.06 ±1.22	34.21± 1.19
	3.	18.28 ±0.74	22.17 ±0.82	25.91 ±1.05	29.20 ±0.82	33.34 ± 0.82
T2 (0.5).	4.	18.36 ±0.88	23.53 ±0.99	29.04 ±1.63	32.89 ±0.99	39.48 ± 1.42
	5.	17.93±1. 02	22.88 ±0.83	28.42 ±0.86	33.65 ±1.14	38.94 ± 1.46
	6.	18.18 ±1.61	23.34 ±1.80	28.27 ±1.34	33.69±1.8 1	38.05±1. 11
T3 (1%).	7.	18.28 ±1.42	23.84 ±1.58	29.60±1.5 6	35.80 ±1.10	40.99 ± 1.62
	8.	18.25±0. 65	23.77 ±0.72	29.34 ±0.60	34.918 ±0.77	40.72 ±0.72
	9.	18.26 ±1.36	23.59 ±1.44	29.28 ±1.36	34.93 ±1.52	40.74 ± 1.81
T4 (1.5%).	10.	18.15 ±0.74	26.57 ±1.17	34.37 ±0.82	42.95 ±0.90	51.30 ± 0.89
	11.	17.86 ±1.18	26.22 ±1.32	34.37 ±0.72	42.98 ±1.33	51.80 ± 1.34
	12.	17.84 ±0.76	26.88 ±1.27	35.99 ±1.22	44.62±1.1 2	53.56 ± 1.03

Significant differences ($P \leq 0.05$) were found between T1 and all other three treatments, as well as between T2 and T3, and T4, according to statistical analysis of the daily growth rate results. The daily growth rate did not differ significantly ($P > 0.05$) between T2 and T3. The highest specific growth rate of 1.9% per day was recorded in T4, whereas a lowest rate of 0.81% per day was observed in T1 (Figure 3). Significant differences ($P \leq 0.05$) were found between T1 and all other three treatments, as well as between T4 and T1, T2, and T3, according to statistical analysis of the particular growth rate results. Specific growth did not change significantly ($P >$

0.05). Rate in the range of T2 and T3. The feed conversion rate results show that the fish in T4 had the best feed conversion rate (2.14), while the fish in T1 had the worst feed conversion rate (4.71), as shown in Figure 4. The feed conversion rate between T1 and T2, T3, and T4 varied significantly ($P \leq 0.05$), according to statistical analysis. The feed conversion rate did not differ significantly ($P > 0.05$) between T2 and T3.

Table (2): Growth requirements of the experiment's various treatments

Treatment	.Growth criteria				
	FW (g)	WI (g)	DGR (g/day)	SGR (%/day)	FCR
T1.A1.	28.64	10.48	0.187	0.814	4.712
T1.A2.	34.21	15.73	0.281	1.1	3.494
T1A3	33.34	15.06	0.269	1.073	3.595
Average.	32.06333 a	13.75667 a	0.245655 a	0.995454 a	3.933678 a
T2.A4.	39.48	21.12	0.377	1.367	2.85
T2.A5.	38.94	21.01	0.375	1.385	2.835
T2.A6.	38.05	19.87	0.355	1.319	2.992
Average.	38.82333.b	20.66667.a	0.369048b	1.356991.b	2.892114.b
T3.A7.	40.99	22.71	0.406	1.442	2.747
T3.A8	40.72	22.47	0.401	1.433	2.747
T3.A9.	40.74	22.48	0.401	1.433	2.743
Average.	40.81667.b	22.55333.b	0.402738b	1.436055.b	2.745578.b
T4.A10.	51.3	33.15	0.592	1.855	2.196
T4.A11.	51.8	33.94	0.606	1.901	2.144
T4.A12.	51.3	33.15	0.592	1.855	2.196
Average.	52.22 c	34.27 c	0.611964 c	1.90667 c	2.147752 c

Different letters in one column is significantly different ($P \leq 0.05$).

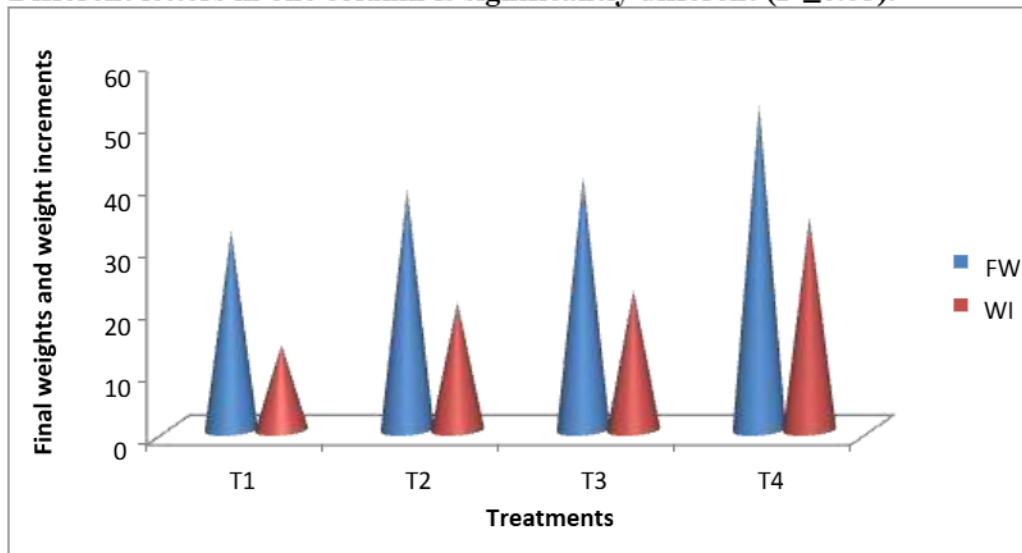


Figure (1) Final weights and weight increments of Common carp at different treatments.

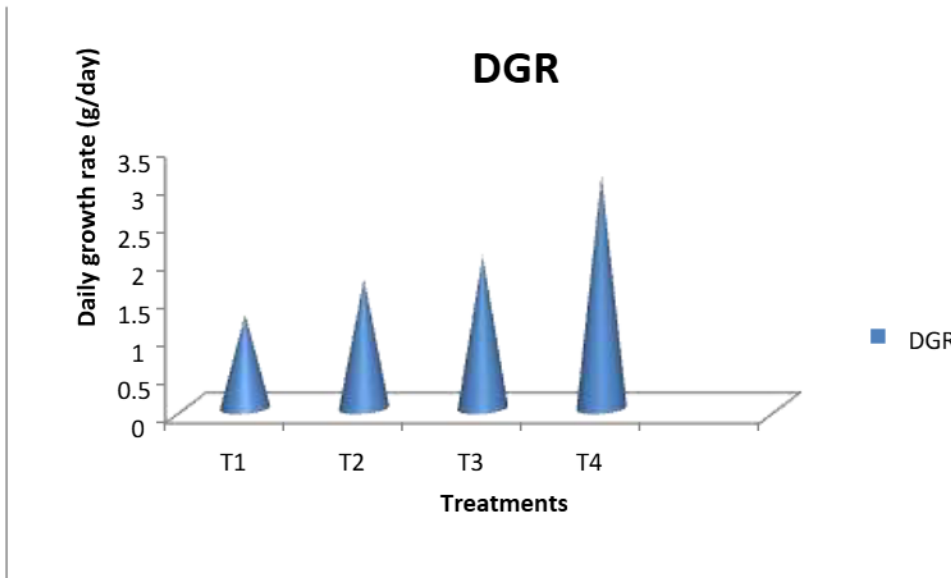


Figure (2) Daily growth rate of Common carp at different treatments

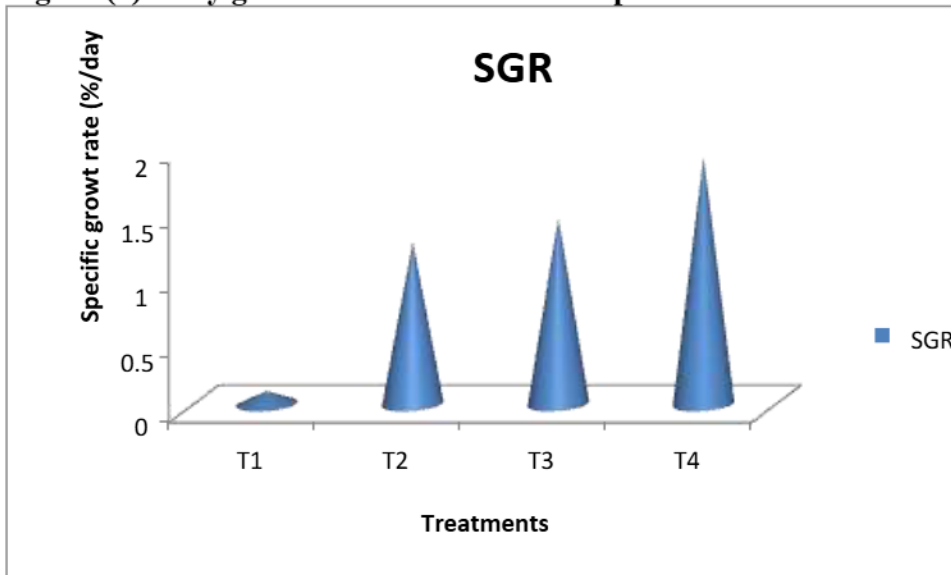


Figure (3) Specific growth rate of Common carp at different treatments.

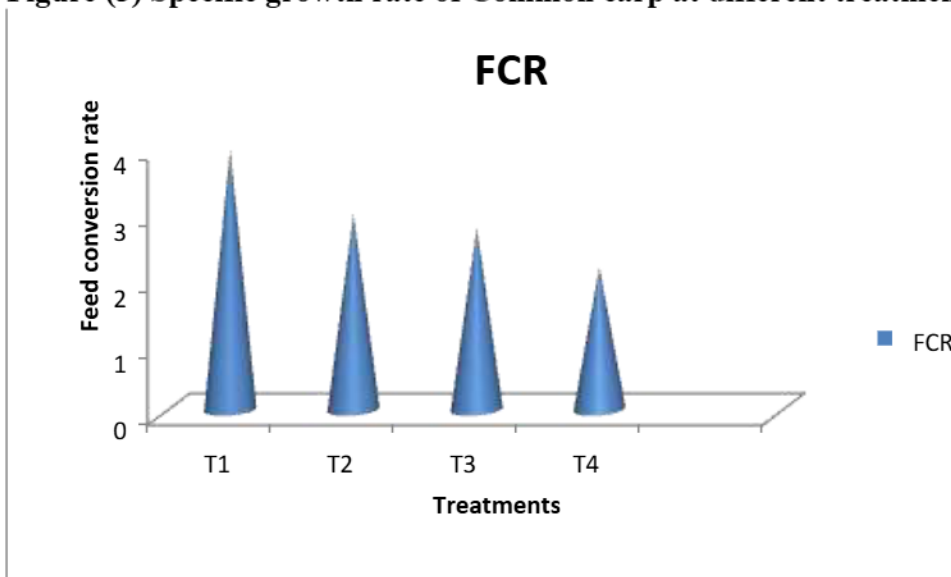


Figure (4) Feed conversion rate of Common carp at different treatments

Discussion

Probiotic and prebiotic supplements are incorporated into fish diets with the aim of stimulating fish appetite, enhancing feed quality through the production of enzymes and vitamins, aiding in the breakdown of complex compounds, and consequently bolstering fish immunity and growth (Merrifield *et al.*, 2010). The results of this study showed that fish fed a diet containing 1.5% eucalyptus leaf meal as prebiotics produced the best results; however, growth metrics and feed conversion efficiency were negatively impacted by raising the inclusion level to 1.5% and (0.5–1%). On the other hand, the fish did not grow more quickly at lower inclusion levels (0.52 %). Did not cause the fish's growth rates to increase. Venter (2007) pointed out that long-term prebiotic supplementation may result in problems like some pathogenic microorganisms adapting to use the carbohydrates in prebiotics for their own purposes, and Olsen *et al.* (2001) noted that the benefits or drawbacks of adding prebiotics depend on the microorganisms' ability to ferment more prebiotics. While Al-Asha'ab *et al.* (2014) observed that the addition of 5 g FOS per kg of feed did not provide any growth-promoting effects in juvenile common carp, Al-Saphar (2012) found that feeding common carp with *Saccharomyces cerevisiae* increased their growth. According to Ahmed (2014) and Abdulrahman and Ahmed (2015), common carp showed enhanced growth characteristics when fed diets supplemented with the prebiotic FOS.

According to Muhsan and Al-Shawi (2016), feeding a meal fortified with certain organic acids improved the growth metrics of young common carp. Common carp fingerlings fed a meal supplemented with 2% bay laurel (*Laurus nobilis*) leaf extract showed the greatest weight gain (7.63 g), whereas the control group showed the lowest gain (5.42 g), according to Taher *et al.* (2018). Additionally, the feed conversion rate was higher at 4.56 than in the control group (compared to 6.59), and the daily growth rate was higher at 0.099 g/day than in the control group (compared to 0.070 g/day); nonetheless, the use of 3% bay laurel extract had unfavourable effects. The mixed diet produced the best results, followed by the oyster and tubificid diets, while the formulated feed produced the worst results. After being fed the various diets for 75 days in salt water with a salinity of 25 PSU, these juveniles showed weight increases ranging from 0.649 to 0.786 g, specific growth rates between 3.62% and 3.86% per day, and feed conversion ratios of 2.91 to 4.69 (Kumaraguru Vasagam *et al.*, 2007).

Conclusions

Based on the current study's results, it can be concluded that common carp given a diet containing 1.5% eucalyptus leaves meal as a prebiotic achieved higher growth and feed conversion rates than those given control and alternative regimens involving eucalyptus leaves meal quantities equal to or greater than 1.5%.

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