Effectiveness of adding monosodium glutamate to an artificial feed on the growth and survival of Asian Redtail Catfish (*Hemibagrus nemurus*)

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Abstract. The problems in Asian Redtail Catfish farming are low growth and survival rate. Therefore, it is necessary to provide adequate feed to increase the production. One of these important nutrients is glutamine which can be obtained in the form of monosodium glutamate (MSG). This study aimed to evaluate the effectiveness of adding MSG to feed on the growth and survival rate of Asian Redtail Catfish. Five experimental diets with graded levels of MSG were used, i.e. P0 as the control (0.0 g kg^{-1} feed), P1 (0.5 g kg^{-1} feed), P2 (1.0 g kg^{-1} feed), P3 (1.5 g kg^{-1} feed), and P4 (2.0 g kg^{-1} feed) with three replications. Twenty Asian Redtail Catfish juveniles were randomly distributed into aquarium (10 L in capacity) and kept in conditions without changing water. The fish were fed three times a day to apparent satiation at 08.00 AM, 01.00 PM, and 06.00 PM. The fish on MSG supplemented diets had higher final body weight, specific growth rate, and feed conversion ratio. Furthermore, MSG treatment groups had increased feed intake and feed efficiency, but there were no significant differences in final mean body weight. In conclusion, the current study showed that adding MSG to the diet could enhance growth and survival of Asian Redtail Catfish.

1 Introduction

One of the most popular fishery commodities is Asian Redtail Catfish (*Hemibagrus nemurus*), especially in the Riau region [1]. The region's need for this fish is still high, but its fulfillment is still dominant from natural catches. One of the obstacles to Asian Redtail Catfish farming activities is still low seed production, which greatly affects the availability of superior seeds [2]. One way to get superior seeds is by providing quality feed. Quality feed must have nutrient content that is to the needs of the fish kept. One of the nutrients in the feed that supports optimal growth of fish is protein [3]. Protein serves to aid in growth, body maintenance, and tissue formation [4,5,6]. Proteins are grouped into two types, namely essential and non-essential amino acids [7]. The body can produce non-essential amino acids, but essential amino acids are those that it is unable to produce on its own.

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One of the non-essential amino acids needed by fish is glutamine [8]. This amino acid can be produced in the body to meet its needs, but under certain conditions, such as high growth phases in larval and seed stadia, the need for glutamine by the body increases, so glutamine must be obtained from feed [9]. Glutamine has an important role in protein synthesis and regulates various energy metabolism processes [10]. The results of Rifa'i's research [11] showed that tilapia fed with the addition of glutamine by 3% resulted in 1.5 times higher growth than the control treatment. Glutamine consumption can also increase the body's antioxidant activity so that it can increase survival value [12].

In the body of fish, glutamine is synthesized from glutamate and NH_4^+ with the help of glutamine synthetase enzyme [13]. Thus, glutamate in feed has the same effect as glutamine on improving growth performance and survival in Asian Redtail Catfish. The disadvantage of using glutamine is its high price, while on the other hand glutamine in feed can be obtained in the form of glutamic acid and monosodium glutamate (MSG) [14]. The addition of 0.87% MSG to feed cultivated in stagnant water can increase the value of feed efficiency due to lighter liver workload in *Clarias gariepinus* [22]. Another study on Catfish showed that MSG supplementation as much as 0.8% in feed in stagnant water cultivation conditions can reduce liver workload, thereby increasing growth [8]. For this reason, it is necessary to research to determine the effectiveness of adding MSG to feed on the growth performance and survival of Asian Redtail Catfish.

2 Method

This study was conducted at the Fish Nutrition Laboratory, Faculty of Fisheries and Marine, University of Riau, Pekanbaru, for five months from March 2023 to August 2023.

The test feed used in this study was commercial feed and MSG was added at the dose according to the treatment. The addition of MSG to the feed was carried out by the coating method. For every 1 kg of feed, MSG was added according to the desired treatment, egg white and 100 mL of water, and combined with hand mixer for 15 minutes until completely homogenous. The feed was then dried in an oven at 40 ^{0}C for ± 5 hours. Once dry, the feed is stored in an airtight container until it is given to the fish. Furthermore, the feed was tested for proximate analyses following the procedures of AOAC (Table 1).

Table 1. Proximate analysis of the test fish feed

Treatments	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Crude Fiber (%)
P0	8,36	7,58	35,01	6,57	8,01
P1	7,84	7,47	34,95	6,48	7,76
P2	7,51	7,31	35,24	6,25	7,54
P3	6,96	6,87	35,32	6,17	6,83
P4	6,78	6,61	35,22	5,92	6,52

Note: P0 = 0.0 g MSG kg^{-1}feed, P1 = 0.5 g MSG kg^{-1}feed, P2= 1.0 g MSG kg^{-1}feed, P3 = 1.5 g MSG kg^{-1}feed, and P4 = 2.0 g MSG kg^{-1}feed

The fish is obtained from fish cultivators in Pekanbaru. The fish were fed commercial feed containing 35% protein three times a day at satiation after 15 days of adaptation. The study started on the 17th day after the test fish were fasted for 24 hours. After that, the fish were weighed to determine their initial weight, then the fish were put in the experimental container as much as 3 fish L^{-1}. Fish rearing was carried out for 50 days and fed at satiation with a frequency of feeding three times a day, namely at 08.00 AM, 01.00 PM, and 06.00 PM (GMT+7). The amount of feed given is recorded to determine the level of feed consumption and efficiency. Measurement of water quality including dissolved oxygen was

carried out using a DO meter, pH using a pH meter, temperature using a thermometer, and phenate was used to quantify TAN concentration. Table 2 displays the water quality metrics during the study. Over time, the study showed that TAN values continued to increase in all treatments. All three parameters (temperature, pH, and DO content) were equivalent between the treatments.

Table 2. Water quality data for Asian Redtail Catfish rearing media for 50 days

Parameters	Treatments				
	P0	**P1**	**P2**	**P3**	**P4**
pH	6-6.5	6-6.7	6.4-6.6	6.3-6.5	6.4-6.7
Thermometer (□C)	28.3-28.5	28.3-28.5	28.4-28.5	28.4-28.5	28.4
DO (mg L^{-1})	1.45-2.15	1.47-1.97	1.53-1.98	1.52-1.99	1.55-2.00
TAN (mg L^{-1})	0.59-0.91	0.60-0.92	0.57-0.95	0.59-0.93	0.58-0.90

Note: P0 = 0.0 g MSG kg^{-1}feed, P1 = 0.5 g MSG kg^{-1}, P2= 1.0 g MSG kg^{-1}, P3 = 1.5 g MSG kg^{-1}, and P4 = 2.0 g MSG kg^{-1}

For calculating fish growth performance and survival rates, the following equations were used:

1) Feed intake (g) = total quantity of feed consumed daily for 50 days (g)
2) The specific growth rate (SGR, % day^{-1}) = [(ln Wt − ln W0) / t] × 100 %
3) Feed conversion ratio (FCR) = total of feed consumed divided by the starting total fish biomass
4) Survival rate (%) = (final fish count / beginning fish count) × 100

This study was conducted using a Complete Randomized Design (CRD) with three treatments and three replications. The arrangement and placement of maintenance aquariums are done randomly using random numbers (Steel & Torrie, 1993). The obtained data is tabulated with the Excel program MS Office 2013. Growth performance data were analyzed using ANOVA at a 95% confidence interval and if the difference was marked, Duncan further tested with the help of SPSS Version 22.

3 Result and Discussion

MSG suplementation was also increased the fish's final biomass, specific growth rate (SGR), feed intake, feed conversion ratio (FCR), feed efficiency (FE) and survival rate ($P < 0.05$), but had no appreciable impact on their final mean body weight ($P > 0.05$) (Table 3).

Table 3. Growth performance of Asian Redtail Catfish for 50 days

Parameters	Treatments				
	P0	**P1**	**P2**	**P3**	**P4**
Wt (g)	8.82±0.38[a]	8.83±0.73[a]	9.49±0.35[a]	9.82±0.68[a]	10.02±1.15[a]
Bt (g)	117.33±7.84[a]	139.33±9.84[ab]	152.33±1.20[bc]	165.67±3.18[c]	176.67±12.20[c]
SGR (%)	8.97±1.09[a]	9.62±0.35[ab]	11.55±0.54[ab]	10.98±1.58[ab]	14.79±3.15[b]
Feed intake (kg)	138.66±1.19[a]	137.97±1.46[a]	142.81±1.68[ab]	150.73±4.18[b]	147.62±2.38[b]
FCR	2.96±0.75[b]	2.72±0.52[ab]	1.91±0.02[ab]	1.57±0.13[ab]	1.47±0.11[a]
FE (%)	28.01±4.43[a]	40.17±12.76[ab]	61.67±4.18[bc]	52.42±0.59[bc]	64.61±5.06[c]
SR (%)	66.67±1.67[a]	78.33±4.41[b]	90.00±5.00[c]	88.33±1.67[c]	90.00±0.00[c]

Note: P0 = 0.0 g MSG kg^{-1}feed, P1 = 0.5 g MSG kg^{-1}, P2= 1.0 g MSG kg^{-1}, P3 = 1.5 g MSG kg^{-1}, and P4 = 2.0 g MSG kg^{-1}

The maintenance of Asian Redtail Catfish with a system without water change causes a high concentration of TAN at the end of the rearing. High TAN in maintenance media can be harmful to fish because it can cause oxidative stress [15] and reduce fish growth rate [16]. In addition, there is also inhibition of the process of excretion of ammonia from the body of fish so that there is an increase in ammonia levels in the body of fish [17]. In this condition, there is an increase in the activity of glutamate dehydrogenase (GDH), glutamine synthetase (GS), alanine aminotransaminase (ALT), and aspartate aminotransaminase (AST) enzymes, as well as an increase in the concentration of various non-essential free amino acids, especially aspartate, alanine, glutamate, glutamine, and taurine [18]. Increased activity of various enzymes, as well as an increase in the amount of such non-essential free amino acids, leads to ammonia detoxification that occurs through the pathways of formation of glutamine and free amino acids. On the other hand, the increased activity of GDH to produce glutamate (Glu) indicates increased catabolism of amino acids and proteins in various body tissues [19, 20] to meet the high demand for Glu in converting ammonia into glutamine with the help of GS [18, 21]. The increase in catabolism is thought to cause the role of various amino acids as bodybuilders to be reduced. Thus, the suplementation of Glu in the feed is thought to increase the availability of Glu in the body of fish, so that the conversion of ammonia into Gln, does not require Glu catabolism from other amino acids in the body of fish. However, the addition of Glu in the feed has a relatively expensive cost, so other alternatives are needed to replace the Glu. One source of Glu substitutes that can be used is monosodium glutamate (MSG).

Table 3 showed that fish size at the end of the study did not differ markedly in all treatments (P>0.5). While giving MSG of 2.0 g kg^{-1} feed can increase the final biomass value of fish, specific growth rate (SGR), amount of feed intake, feed conversion ratio, feed efficiency and survival rate of Asian Redtail Catfish. This dose is thought to be the optimal dose because the addition of MSG to feed can increase the intake of Glu in the blood to react with blood ammonia to form glutamine [18]. By the research of Ngaddi et al., [22] adding MSG by 0.87 and 1.74% can reduce the ammonia content of fish blood. According to Wang & Wals [23], the increase in Gln in fish organs is the result of detoxification reactions. The presence of Glu intake causes more efficient feed utilization, so that the amount of feed consumption and feed efficiency results in a better value in the treatment of adding MSG.

FCR values and feed efficiency in this study obtained significantly different results in all treatments. Following Zhao et al., [24] giving Glu to Grass carp can reduce the value of the feed conversion ratio. The addition of MSG as much as 4% in feed for 21 days was also able to increase feed efficiency in piglets [25]. Economically, a single-decimal FCR change will have an impact on changes in production costs, especially feed costs. Therefore, it is

necessary to conduct a financial evaluation of feed costs due to changes in FCR and the addition of MSG. Besides being able to improve fish growth performance, the addition of MSG in feed can also increase the value of feed efficiency. High feed efficiency value is obtained in the treatment of adding MSG of 2.0 g kg^{-1} feed. A high feed efficiency value indicates that the dose is the right dose.

4 Conclusion

The addition of MSG in feed can improve the growth performance and survival rate of Asian Redtail Catfish that are kept in conditions without changing water. The optimal recommended dose for optimum growth is 2.0 g kg^{-1} feed.

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