# SYNERGETIC RESPONSE OF DIETARY ESSENTIAL AMINO ACIDS (LYSINE & METHIONINE) ON THE GROWTH AND FEED UTILIZATION PERFORMANCE OF GENETICALLY MALE TILAPIA (GMT) FED A LOW THRESHOLD PROTEIN DIET

*Aquaculture Nutrition Research | Essential Amino Acid Supplementation Study*

**Ayesha Tanveer[1], Hira Waris[2], Noor Khan[2], Simon John Davies[3]**

[1]Institute of Zoology, University of the Punjab, Lahore, Pakistan

[2]Department of Fisheries and aquaculture, University of Veterinary and Animal Sciences, Lahore, Pakistan

[3]Aquaculture and Nutrition Research Unit (ANRU), Carna Research Station, Ryan Institute and School of Natural Sciences, University of Galway, H91 V8Y1, Ireland.

## ABSTRACT

This study assessed the effects of methionine and lysine supplementation on growth, feed utilization, body composition, body amino acid composition, and digestive enzyme activity of genetically male tilapia (GMT) fed a low-protein (20% CP) diet. Four iso-nitrogenous and iso-caloric diets were formulated: Control (0% M and 0% L), T1 (0.3% M and 2% L), T2 (0.6% M and 4% L) and T3 (0.9% M and 6% L). After 90 days, T1 shows significantly higher weight gain (267.55%), SGR (1.89% per day) and best FCR (2.15). Crude protein was highest in T3 (8.80%). Digestive enzymes activities increased with EAA supplementation. Overall essential amino acid supplementation improved growth performance and body composition of GMT fed 20% protein diet.

## INTRODUCTION

- Tilapia farming contributes ~10% of global aquaculture
- Rising fishmeal prices demand low-protein, sustainable diets.
- Plant proteins have amino acid imbalances; lysine and methionine are most limiting.
- GMT strain prevents mixed sex breeding.
- Dietary essential amino acids (EAA) can enhance growth and feed utilization while reducing feed cost

## OBJECTIVE

To examine the synergetic effects of dietary lysine and methionine supplementation on growth performance, feed utilization, body composition, digestive enzyme activities and amino acid profile of genetically male tilapia fed a 20% protein diet.

## MATERIALS & METHODS

**Experimental Design:** 12 glass aquariums (35 L), completely randomized design with 4 dietary treatments, 3 replicates each, 15 fish/ replicate.

**Dietary Treatments**

- Control (0% M and 0% L)
- T1 (0.3% M and 2% L),
- T2 (0.6% M and 4% L)
- T3 (0.9% M and 6% L).

Base diet: 20% CP commercial feed

**Fish & Breeding**: Initial weight 16.56 ± 0.42 g.

Fed twice daily at 3% body weight.

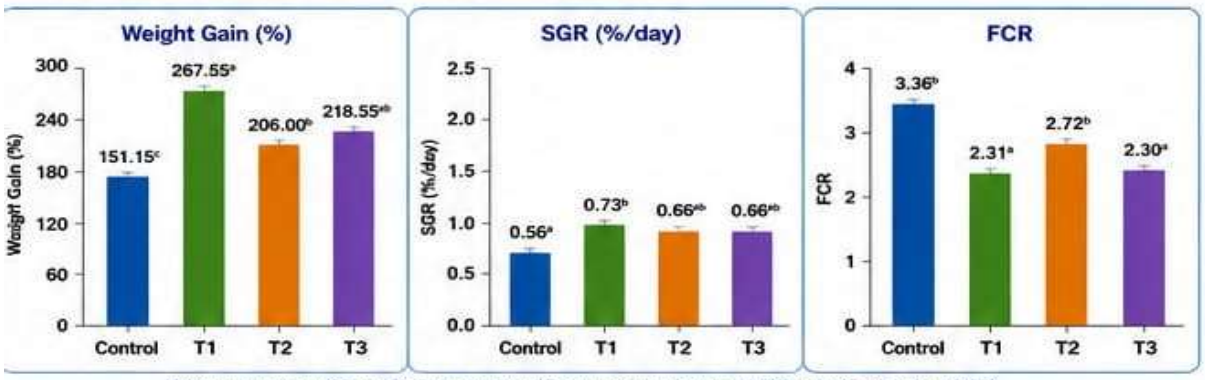
**Water quality (mean)**

pH (8.11), DO (4.99mg/l), Temperature (27.79 ℃)

**Sample collection:** Fish morphometric data measured fortnightly. After 90 days fish were analyzed for growth, proximate composition (AOAC, 2006), amino acid profile and digestive enzyme activities.

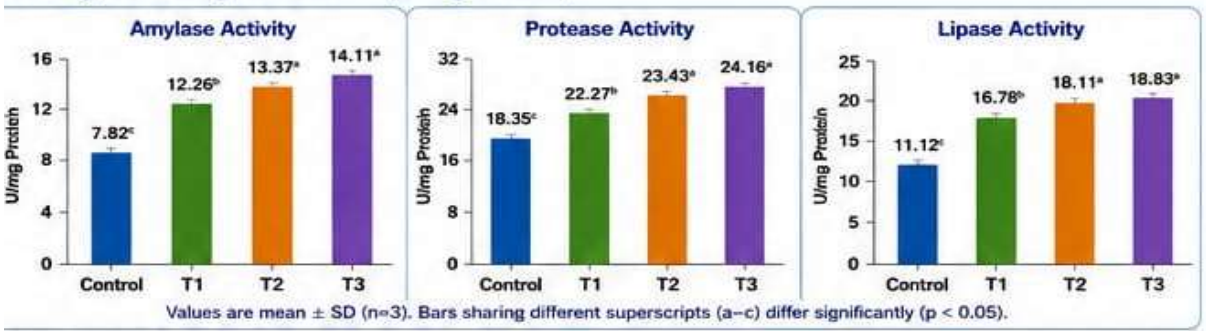
## RESULTS

### 1. Growth Performance of GMT Fed Different EAA Levels




Values are mean ± SD (n=3). Bars sharing different superscripts (a–c) differ significantly ($p < 0.05$).

### 2. Digestive Enzyme Activities (U/mg Protein)




Values are mean ± SD (n=3). Bars sharing different superscripts (a–c) differ significantly ($p < 0.05$).

### 3. Proximate Composition (% Dry Matter)

| Nutrient | Treatments | | | | P Value |
|---|---|---|---|---|---|
| | Control | T1 | T2 | T3 | |
| Dry Matter (%) | 26.23 ± 0.26$^{b}$ | 31.88 ± 0.28$^{a}$ | 31.57 ± 0.36$^{a}$ | 32.76 ± 0.45$^{a}$ | <0.001 |
| Crude Protein (%) | 12.00 ± 0.41$^{c}$ | 17.50 ± 0.15$^{b}$ | 18.26 ± 0.20$^{b}$ | 19.36 ± 0.31$^{a}$ | <0.001 |
| Crude Fat (%) | 6.86 ± 0.17$^{a}$ | 7.36 ± 0.21$^{a}$ | 6.56 ± 0.38$^{a}$ | 4.60 ± 0.34$^{b}$ | 0.001 |
| Crude Ash (%) | 3.30 ± 0.15$^{b}$ | 2.68 ± 0.02$^{a}$ | 2.82 ± 0.05$^{a}$ | 2.32 ± 0.59$^{a}$ | 0.008 |
| Nitrogen Free Extract (%) | 4.06 ± 0.24$^{b}$ | 4.32 ± 0.33$^{ab}$ | 3.92 ± 0.80$^{b}$ | 4.32 ± 0.59$^{a}$ | <0.001 |

Values are mean ± SD (n=3). Values sharing different superscripts (a–c) differ significantly ($p < 0.05$).

### 4. Amino Acid Profile (% of Dry Matter)

| Essential Amino Acids | | | | | | Non-Essential Amino Acids | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Amino Acid | Control | T1 | T2 | T3 | P Value | Amino Acid | Control | T1 | T2 | T3 | P Value |
| Methionine | 0.99 | 1.18 | 0.93 | 0.97 | 0.537 | Aspartic Acid + Asparagine | 3.84 | 4.04 | 3.65 | 4.08 | 0.436 |
| Threonine | 1.73 | 1.89 | 1.69 | 1.72 | 0.525 | Cystic acid | 0.28 | 0.60 | 0.27 | 0.31 | 0.517 |
| Valine | 1.56 | 1.83 | 1.68 | 1.68 | 0.176 | Serine | 1.76 | 1.86 | 1.65 | 1.77 | 0.058 |
| Isoleucine | 1.87 | 1.66 | 1.57 | 1.46 | 0.193 | Glutamic Acid + Glutamine | 5.91 | 6.36 | 5.66 | 6.23 | 0.181 |
| Leucine | 2.54 | 3.26 | 2.51 | 3.10 | 0.550 | Glycine | 3.02 | 3.31 | 3.11 | 3.75 | 0.004 |
| Phenylalanine | 1.33 | 1.72 | 2.00 | 1.76 | 0.369 | Alanine | 2.32 | 2.76 | 2.51 | 2.84 | 0.220 |
| Histidine | 1.54 | 0.94 | 1.08 | 0.88 | 0.688 | Tyrosine | 1.56 | 1.22 | 1.70 | 1.24 | 0.681 |
| Lysine | 2.26 | 3.34 | 2.33 | 2.83 | 0.130 | Arginine | 2.21 | 2.61 | 1.97 | 2.57 | 0.488 |
| | | | | | | Proline | 1.37 | 2.32 | 2.00 | 2.28 | 0.282 |

Values are mean ± SD (n=3). Values sharing different superscripts (a–c) differ significantly ($p < 0.05$).

## DISCUSSION

- Methionine at 0.3% (T1) significantly enhanced growth and feed efficiency, which declined at the higher levels.
- The combination of methionine and lysine showed greater growth improvement than individual supplementation.
- Highest digestive enzyme activities in T2 and T3 correlate with improved nutrient digestion and utilization.
- Results support the importance of balanced EAA supplementation in low protein tilapia diets.

## CONCLUSION

- EAA supplementation offers significant production efficiency advantage and can make feeds cost-effective with protein content.
- A 20% protein diet is achievable for GMT with methionine and lysine supplementation.
- Digestive enzyme activities and amino acid composition improved with EAA addition.
- This strategy reduce dependence on costly fishmeal supports sustainable aquaculture.
- Further exploration of lower protein diets with EAA supplementation warranted.

## KEY HIGHLIGHTS

- Best growth at T1 (0.3% M + 2% L)
- Lowest FCR at T1 (2.31)
- Highest digestive enzyme activity at T2 & T3



- Improved body composition: High protein, Low fat
- EAA supplementation supports low-protein, cost-effective and sustainable feeds

**KEYWORDS**

Growth performance, feed utilization, genetically male tilapia (GMT), digestive enzyme activities, essential amino acids, amino acid profile, body composition, low protein diet, aquaculture nutrition.

**ACKNOWLEDGEMENTS**

The authors are thankful to US-Pakistan Centers for Advanced Studies in Agriculture and Food Security (US-PCAS), University of Agriculture Faisalabad and University of California, Davis for financial support.