



# Sensory Attributes of *Channa striata* Through Dietary Supplementation of Selenium and Taurine in Inland Saline Aquaculture

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## ABSTRACT

**Background:** Stress management through a dietary approach is an emerging area in aquaculture which paves the way for sustainable aquaculture. Salinity-induced stress in aquaculture using inland saline groundwater (ISGW) can significantly impact the organoleptic characteristics of the fish.

**Methods:** This study investigates the influence of dietary selenium (Se) and taurine (Tau) enrichment on the organoleptic characteristics of *Channa striata* reared in ISGW at 12 and 14 ppt salinity. Juvenile *C. striata* were fed diets consisting different concentrations of Se (0, 0.1, 0.3 and 0.5 mg/kg) and Tau (0, 5, 10 and 15 g/kg) for 150 days at 12 and 14 ppt salinities. Fillet quality was assessed through colour analysis and sensory evaluation.

**Result:** Results indicated that at 12 ppt salinity, Se at 0.3 mg/kg positively enhanced fillet whiteness, texture and flavour intensity, while Tau at 10 g/kg improved muscle firmness and overall acceptability. Increased salinity negatively affected fillet colour and texture, but Se and Tau supplementation mitigated these adverse effects. Sensory evaluation revealed higher appearance, taste and texture scores in Se and Tau-supplemented groups, suggesting improved consumer appeal. These findings highlight the potential of Se and Tau as effective dietary interventions to enhance fillet quality in *C. striata* reared under saline conditions. The study provides valuable insights for aquaculture sustainability, demonstrating that strategic dietary modifications can optimize fish quality and consumer acceptance in challenging environments.

**Key words:** Consumer preference, Dietary intervention, Groundwater salinization, Organoleptic characteristics, Stress management.

## INTRODUCTION

The rise in the human population has led the globe to face various significant environmental crises. One such problem is groundwater and land salinization due to multiple anthropogenic activities (Sandeep *et al.*, 2013; Paswan *et al.*, 2025). It was estimated that 8.62 million hectares (mha) of India's land was heavily affected by soil salinity, which is ultimately unsuitable for agriculture (Iffat *et al.*, 2020) and it also projected that the area in India affected by salinity will increase by 20 mha by 2050 (Sharma *et al.*, 2014). So, developing a mitigation strategy to utilize these unusable resources for sustainable food production for the growing population is important (Anantharaja *et al.*, 2023). In this regard, aquaculture can be a viable option for effectively utilising these underutilized resources (Kumar *et al.*, 2016). However, due to the differing chemistry of inland saline groundwater (ISGW) from freshwater, it is challenging to develop inland saline aquaculture (ISA) (Murmu *et al.*, 2019; Patel *et al.*, 2022). Even though many countries have successfully employed fish farming in these saline-afflicted areas (Thirunavukkarasar *et al.*, 2022). Freshwater fish such as *Labeo rohita* (Patel *et al.*, 2022, 2023), *Cyprinus carpio haematopterus* (Singh *et al.*, 2020) and *Cyprinus carpio* (Iffat *et al.*, 2021) have been reared in the ISGW. However, further species diversification is needed for mankind's future food demand.

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*Channa striata* (Bloch, 1793) or striped snakehead, is a highly prized food fish species farmed extensively in Southeast Asia (Kumar *et al.*, 2022). Since it is an air-breathing species, it is highly resilient to environmental stressors. Due to this, the culture of *C. striata* can be a promising approach for using inland saline aquaculture. But fishes reared in an unfavourable environment will face biological stress, that leads to changes in carcass quality parameters, which leads to a change in consumer preference for aquaculture products (Dharani *et al.*, 2024). Similarly, higher salinities (12 and 14 ppt) of ISGW have

altered the organoleptic characters of *C. striata*, explored in our previous work (Unpublished).

Preventing stress in fish can ultimately lead to enhanced farm productivity (Li *et al.*, 2022). Studies have shown that adopting a dietary interventional approach can mitigate stress effectively. It can be attained through the nutritional and non-nutritional compounds/additives supplementation of feed (Ciji and Akhtar, 2021). However, recent research has shown that minerals and amino acids can improve various fishes' resistance to environmental stressors. Selenium (Se) is a mineral element with immense antioxidant capacity, it significantly decreases free radicals produced from lipid peroxidation (Zhou *et al.*, 2009). The growth of the fish can be improved by Se (Ahmad *et al.*, 2024). Impact on supplementation of Se in various fishes such as *Cyprinus carpio* (Saffari *et al.*, 2017), *Oreochromis niloticus* (Dawood *et al.*, 2020), *Carassius auratus gibelio* (Zhou *et al.*, 2009), *Labeo rohita* (Swain *et al.*, 2019) and *Megalobrama amblycephala* (Long *et al.*, 2017) has revealed the nutritional importance of Se. So, it also can be utilized to improve the sensory attributes of fish affected by stress.

Taurine (Tau) is an amino acid which has a vital role in the various physiological processes (Wu, 2020). Recent studies have revealed that Tau positively affects meat quality (Li *et al.*, 2022). Previous work on the rice field eel (*Monopterus albus*) has shown that Tau has upregulated the expression levels of muscle development genes, reduced myofiber loss and maintained muscle homeostasis (Zhang *et al.*, 2022). Another study on *O. niloticus* has found that Tau plays a vital role in improving skin colour and promoting organoleptic characteristics (Urbich *et al.*, 2022). However, studies on the effects of Se and Tau on the organoleptic characteristics of fish are limited. So, the current research has aimed to explore the benefit of Se and Tau on the organoleptic characteristics of *C. striata* reared in varying salinities (12 and 14 ppt) of ISGW.

## MATERIALS AND METHODS

### Ethical statement

The study was done by employing the protocol of CPCSEA (Committee for the Purpose of Control and Supervision of Experiments on Animals), Ministry of Environment and Forests (Animal Welfare Division), Govt. of India on welfare and utilization of animals in scientific research. This study was approved by the ethical committee of ICAR-Central Institute of Fisheries Education, Mumbai, India.

### Experimental animals and design

The experiment was carried out from June to November, 2023. Juveniles of *C. striata* with a mean weight of  $4.74 \pm 0.09$  g were acquired from an aqua consultant in Andhra Pradesh, India. After being transported to the ICAR-Central Institute of Fisheries Education (CIFE) regional centre, Rohtak, Haryana, India, the fish were acclimated in tanks containing freshwater for 15 days. After acclimatization, the

juveniles with a mean weight of  $6.21 \pm 0.03$  g were progressively changed to salinities of 12 and 14 ppt, respectively, by adding 1 ppt every day within 15-day intervals. Throughout the acclimatization period, the fish were provided with a Growel commercial feed with 42% crude protein (CP), 3% crude fibre (CF), 8% crude lipid (CL) and 12% moisture content twice daily @ 5% biomass. The tanks were provided with proper aeration to maintain an appropriate DO level.

After 15 days, twenty-four *C. striata* juveniles with mean biomass of  $(8.31 \pm 0.05)$  g were randomly released in eight different experimental units for the Se experiment viz., (12 ppt) 0 mgSe (0 mg sodium selenite (inorganic form of Se) ( $\text{Na}_2\text{SeO}_3$ )/kg of diet), (12 ppt) 0.1 mgSe (0.1 mg  $\text{Na}_2\text{SeO}_3$ /kg of diet), (12 ppt) 0.3 mgSe (0.3 mg  $\text{Na}_2\text{SeO}_3$ /kg of diet), (12 ppt) 0.5 mgSe (0.5 mg  $\text{Na}_2\text{SeO}_3$ /kg of diet) were reared in 12 ppt salinity whereas, (14 ppt) 0 mgSe (0 mg  $\text{Na}_2\text{SeO}_3$ /kg of diet), (14 ppt) 0.1 mgSe (0.1 mg  $\text{Na}_2\text{SeO}_3$ /kg of diet), (14 ppt) 0.3 mgSe (0.3 mg  $\text{Na}_2\text{SeO}_3$ /kg of diet), (14 ppt) 0.5 mgSe (0.5 mg  $\text{Na}_2\text{SeO}_3$ /kg of diet) were reared in 14 ppt salinity in triplicates following a  $2 \times 3$  factorial design for 150 days. Similarly, the fish were randomly stocked in another eight experimental units for the Tau experiment viz., (12 ppt) 0 gTau (0 g Tau/kg of diet), (12 ppt) 5 gTau (5 g Tau/kg of diet), (12 ppt) 10 gTau (10 g Tau/kg of diet), (12 ppt) 15 gTau (15 g Tau/kg of diet) were reared in 12 ppt salinity whereas, (14 ppt) 0 gTau (0 g Tau/kg of diet), (14 ppt) 5 gTau (5 g Tau/kg of diet), (14 ppt) 10 gTau (10 g Tau/kg of diet), (14 ppt) 15 gTau (15 g Tau/kg of diet) were reared in 14 ppt salinity in triplicates employing a  $2 \times 3$  factorial design for an experimental period of 150 days. Circular fibre-reinforced plastic (FRP) tanks with a capacity of 400 L (1.0 m  $\times$  0.5 m) were used for experiments and 250 L water volume was maintained in every tank with proper aeration during the experiment trial. The *C. striata* were hand-fed two times daily (08:30 and 16:30 hrs.) @ 5% biomass to their satiation level. 30% water was exchanged regularly to eradicate the faecal matter and uneaten feed.

### Preparation of experimental diet

The feed employed in this study is a commercial diet from Growel, India, having a size of 1.2 mm with 42.0% CP, 8.0% CL, 3.0% CF and 12.0% moisture and with this, Se and Tau were separately added through the surface coating method using the Unispray equipment (S. B. Panchal and Company, Mumbai). The feed additive Se was purchased from Merck Schuchardt OHG, Germany and Tau was procured from Virion Enterprises, Mumbai. As per the experimental requirement, Se and Tau were weighed and diluted in the commercial coating gel (Turbogel, Guybro Chemical) (50-70 ml/kg feed) according to manufacturer instructions and stirred for homogeneous distribution. After the even coating, the feed was dried at room temperature for at least one day before feeding. The control diet was coated with the same coating gel to avoid an experimental error.

### Preparation of fillets

After being cultured for 150 days, *C. striata* were euthanized by cervical dislocation following hypo-thermal stunning and

placed in a cooler containing ice-cold water at 0-4°C. After being washed using freshwater, the grown *C. striata* were segregated into ten samples for every replicate and brought to the processing lab on crushed ice. To investigate fillet quality, a competent fish processor filleted the fish.

### Colour analysis

Using a CR-300 chromometer (Minolta, Osaka, Japan), the colour of the *C. striata* fillet was assessed in both raw and cooked forms. The apparatus measures the CIE-L\* brightness of the *C. striata* raw and cooked fillet ( $L^* = 0$  for black,  $L^* = 100$  for white),  $a^*$  redness ( $a^* > 0$ ) and  $b^*$  yellowness ( $b^* > 0$ ), with the chroma  $((a^*)^2 + (b^*)^2)^{1/2}$  being the position in the colour space. The colour was recorded above the lateral line at three points on the *C. striata* fillet: close to the head, middle of the fillet and close to the tail. For every body component, the average of two measurements was taken. The L\*C\*H colour model was then used to translate measurements taken using the L\*a\*b\* colour model, where L\* stands for brightness and C\* for chroma, which is equal to  $[(a^*)^2 + (b^*)^2]^{1/2}$  (Choubert *et al.*, 1997). The same procedure was also followed to analyze the colour of the whole *C. striata* fish before making it into a fillet. The colour was recorded above the lateral line at three points for the entire *C. striata* fish: close to the head, in the middle and close to the tail. The illumination system was rotated 90 degrees between duplicate measurements for each position of the whole fish. For every body component, an average of two measurements was taken to measure the whiteness of the entire fish. The whiteness value of *C. striata* external colour of fish, raw fillets and cooked fillets was obtained using the formula,

$$\text{Whiteness} = 100 - [(100 - L^*)^2 + a^{*2} + b^{*2}]^{1/2}$$

### Sensory analysis of cooked fillets

... (1)  
A 9-point hedonic scale was used to assess the sensory aspects of cooked *C. striata* fillets, including appearance, colour, taste, texture, strength of flavour and odour and overall acceptability of cooked fillets (Peryam and Pilgrim, 1957). The assessments were carried out by a sensory panel of 30 people, both male and female, ages 20 to 40. The cooked fillets were randomly arranged on white porcelain plates at room temperature in the presence of natural light. The panellists scored the fillets on a 9-point scale, with 9 denoting "extremely like" and 1 denoting "extremely dislike."

### Statistical analysis

All the statistical analysis were carried out in SPSS (version. 25). Two-way analysis of variance (ANOVA) was carried at a significance level of 5%. All the data were presented in the mean  $\pm$  standard error.

## RESULTS AND DISCUSSION

Consumers prefer meat products for their nutritional value and appearance in terms of colour and other organoleptic

characteristics. The present evaluation shows the effect of Se and Tau in the ISGW-reared *C. striata* on the organoleptic parameters.

### Colour analysis

#### Effect of selenium

In the current work, the whiteness value of the external colour of the whole *C. striata*, is enhanced in raw fillet and cooked fillet, were noted in the (12 ppt) 0.3 mg Se group (Table 1). Similarly, Liu *et al.* (2017) recorded that muscle colour of the *Megalobrama amblycephala* was enhanced by the diets supplemented with nano-selenium (Nano-Se) (0.2 mg Se/kg) and Se-yeast (0.2 mg Se/kg). This is due to the antioxidant capacity of Se, which protects against detrimental reactions caused by lipid peroxidation (Zhan *et al.*, 2007).

#### Effect of taurine

In this research, an increased whiteness value of the external colour of the whole *C. striata*, raw fillet and the cooked fillet were observed in (12 ppt) 10 g Tau treatment and significantly ( $p < 0.05$ ) decreased in (14 ppt) 0 g Tau treatment (Table 2). As the salinity increases, the whiteness score of the external colour, raw fillet and cooked fillet of *C. striata* decreased significantly. This is due to declined growth in the presence of an environmental stressor (Portz *et al.*, 2006).

### Sensory attributes

#### Effect of selenium

In this assessment, Se supplementation significantly ( $p < 0.05$ ) affected the cooked fillet of *C. striata* sensory attributes. Cooked fillets of (12 ppt) 0.3 mg Se treatment had greater appearance, texture, colour, odour intensity, taste, flavour intensity and overall acceptability of sensory scores, respectively, whereas it was decreased in (14 ppt) 0 g Tau treatment (Fig 1). Likewise in a previous study carried out by Liu *et al.* (2017) in *Megalobrama amblycephala* fed with diet supplemented with Se in the form of Nano-Se,  $\text{Na}_2\text{SeO}_3$  and Se-yeast in varying concentrations. The results revealed that the 0.4 and 0.8 mg/kg of Se-yeast-fed fish group revealed better texture, which is similar to our study. Another study by Lin *et al.* (2014) in juvenile *Epinephelus malabaricus* fed with a diet supplemented with Se at varying concentrations (0, 0.3, 0.7, 1.0 and 1.5 mg Se/kg diet). The findings showed that the water-holding capacity of the muscle was higher and had high texture quality in fish fed with a diet less than 0.7 mg Se/kg-diets, which is in line with our current work.

#### Effect of taurine

In this work, addition of taurine significantly ( $p < 0.05$ ) affected the cooked fillets of *C. striata* sensory attributes. Cooked fillets of (12 ppt) 10 g Tau treatment had greater sensory attributes and overall acceptability, respectively, whereas it decreased in (14 ppt) 0 g Tau treatment (Fig 2).

**Table 1:** Effect of selenium supplementation on *Channa striata* external fish, raw filelets and cooked filelets colour.

Colour analysis	Components	Treatment							P value	
		(12 ppt) 0 mgSe	(12 ppt) 0.1mgSe	(12 ppt) 0.3 mg Tau	(12 ppt) 0.5 mg Se	(14 ppt) 0 mg Se	(14 ppt) 0.1mgSe	(14 ppt) 0.3 mgTau		(14 ppt) 0.5 mgSe
External colour	L*	25.81±0.05 <sup>ab</sup>	26.78±0.04 <sup>ab</sup>	27.13±0.24 <sup>ab</sup>	26.65±0.06 <sup>ab</sup>	23.88±0.04 <sup>ab</sup>	24.64±0.19 <sup>ab</sup>	25.37±0.08 <sup>ab</sup>	24.49±0.12 <sup>ab</sup>	<0.001
	a*	0.55±0.01 <sup>bcA</sup>	0.20±0.02 <sup>ab</sup>	0.23±0.06 <sup>ab</sup>	0.37±0.02 <sup>ab</sup>	0.77±0.05 <sup>ab</sup>	0.54±0.04 <sup>ab</sup>	0.57±0.04 <sup>ab</sup>	0.67±0.03 <sup>ab</sup>	<0.001
	b*	4.84±0.14 <sup>bcA</sup>	4.35±0.45 <sup>ab</sup>	3.29±0.04 <sup>ab</sup>	4.49±0.07 <sup>ab</sup>	5.63±0.07 <sup>ab</sup>	4.17±0.07 <sup>ab</sup>	4.78±0.20 <sup>ab</sup>	4.33±0.08 <sup>ab</sup>	<0.001
Raw fillet colour	Whiteness	25.56±0.04 <sup>ab</sup>	26.38±0.15 <sup>ab</sup>	26.92±0.27 <sup>ab</sup>	26.34±0.03 <sup>ab</sup>	23.56±0.03 <sup>ab</sup>	24.41±0.19 <sup>ab</sup>	25.11±0.12 <sup>ab</sup>	23.99±0.19 <sup>ab</sup>	<0.001
	L*	43.66±0.06 <sup>ab</sup>	44.77±0.50 <sup>ab</sup>	45.98±0.19 <sup>ab</sup>	43.33±0.03 <sup>ab</sup>	38.67±0.23 <sup>ab</sup>	39.62±0.14 <sup>ab</sup>	41.68±0.19 <sup>ab</sup>	39.89±0.18 <sup>ab</sup>	<0.001
	a*	9.40±0.53 <sup>cdA</sup>	2.39±0.69 <sup>ab</sup>	3.69±0.15 <sup>ab</sup>	4.51±0.43 <sup>ab</sup>	12.56±1.84 <sup>ab</sup>	11.90±0.88 <sup>ab</sup>	7.49±1.09 <sup>ab</sup>	7.97±0.50 <sup>ab</sup>	<0.001
Cooked fillet colour	Whiteness	7.59±0.44 <sup>abca</sup>	5.54±0.39 <sup>ab</sup>	6.34±0.45 <sup>ab</sup>	5.92±0.11 <sup>ab</sup>	10.69±1.26 <sup>ab</sup>	8.68±0.59 <sup>ab</sup>	10.47±0.68 <sup>ab</sup>	7.39±0.08 <sup>ab</sup>	<0.001
	L*	42.24±0.14 <sup>ab</sup>	44.35±0.42 <sup>ab</sup>	45.33±0.22 <sup>ab</sup>	42.73±0.03 <sup>ab</sup>	36.06±0.30 <sup>ab</sup>	37.70±0.09 <sup>ab</sup>	40.12±0.23 <sup>ab</sup>	38.79±0.22 <sup>ab</sup>	<0.001
	a*	59.33±0.11 <sup>ab</sup>	60.69±0.16 <sup>ab</sup>	61.91±0.04 <sup>ab</sup>	59.30±0.19 <sup>ab</sup>	52.52±0.69 <sup>ab</sup>	54.24±0.24 <sup>ab</sup>	55.57±0.23 <sup>ab</sup>	54.20±0.29 <sup>ab</sup>	<0.001
Whiteness	L*	2.61±0.25 <sup>ab</sup>	3.76±0.56 <sup>ab</sup>	3.09±0.31 <sup>ab</sup>	4.41±0.93 <sup>ab</sup>	6.40±0.80 <sup>ab</sup>	5.17±0.23 <sup>ab</sup>	4.63±0.21 <sup>ab</sup>	5.10±0.27 <sup>ab</sup>	0.002
	a*	18.55±0.96 <sup>ab</sup>	19.10±0.28 <sup>ab</sup>	20.95±0.29 <sup>ab</sup>	17.93±0.62 <sup>ab</sup>	18.72±0.59 <sup>ab</sup>	18.32±0.04 <sup>ab</sup>	19.08±0.12 <sup>ab</sup>	18.74±0.26 <sup>ab</sup>	0.020
	b*	55.16±0.42 <sup>ab</sup>	56.17±0.08 <sup>ab</sup>	56.42±0.14 <sup>ab</sup>	55.32±0.46 <sup>ab</sup>	48.58±0.42 <sup>ab</sup>	50.48±0.23 <sup>ab</sup>	51.50±0.14 <sup>ab</sup>	50.29±0.39 <sup>ab</sup>	<0.001

Note: Values are average of three readings, presented as mean ± standard error (one-way ANOVA) and different lowercase letters (doses of Se) and uppercase letters (salinity variations) indicate statistically significant differences (DMRT at the 5% probability level) (Two-way ANOVA). Values in the same column with different superscripts are significantly different (p<0.05).  
L\*: Lightness; a\*: Redness/Greenness, b\*: Yellowness/Blueness.

**Table 2:** Effect of taurine supplementation on *Channa striata* external fish, raw filelets and cooked filelets colour.

Colour analysis	Components	Treatment							P value	
		(12 ppt) 0g Tau	(12 ppt) 5g Tau	(12 ppt) 10g Tau	(12 ppt) 15g Tau	(14 ppt) 0g Tau	(14 ppt) 5g Tau	(14 ppt) 10g Tau		(14 ppt) 15g Tau
External colour	L*	25.71±0.05 <sup>ab</sup>	26.51±0.15 <sup>ab</sup>	27.00±0.28 <sup>ab</sup>	26.48±0.03 <sup>ab</sup>	23.78±0.04 <sup>ab</sup>	24.54±0.19 <sup>ab</sup>	25.27±0.09 <sup>ab</sup>	24.16±0.19 <sup>ab</sup>	<0.001
	a*	0.65±0.02 <sup>bcA</sup>	0.30±0.02 <sup>ab</sup>	0.33±0.07 <sup>ab</sup>	0.47±0.03 <sup>ab</sup>	0.87±0.05 <sup>ab</sup>	0.64±0.04 <sup>ab</sup>	0.60±0.09 <sup>ab</sup>	0.77±0.03 <sup>ab</sup>	<0.001
	b*	4.63±0.46 <sup>abA</sup>	4.41±0.45 <sup>abA</sup>	3.35±0.07 <sup>ab</sup>	4.59±0.07 <sup>ab</sup>	5.67±0.12 <sup>ab</sup>	4.27±0.08 <sup>ab</sup>	4.74±0.63 <sup>ab</sup>	4.99±0.37 <sup>ab</sup>	0.018
Raw fillet colour	Whiteness	25.56±0.05 <sup>ab</sup>	26.38±0.15 <sup>ab</sup>	26.92±0.23 <sup>ab</sup>	26.34±0.04 <sup>ab</sup>	23.56±0.04 <sup>ab</sup>	24.41±0.19 <sup>ab</sup>	25.11±0.13 <sup>ab</sup>	23.99±0.19 <sup>ab</sup>	<0.001
	L*	43.56±0.07 <sup>ab</sup>	44.70±0.47 <sup>ab</sup>	45.84±0.17 <sup>ab</sup>	43.23±0.03 <sup>ab</sup>	38.34±0.31 <sup>ab</sup>	39.52±0.15 <sup>ab</sup>	41.58±0.19 <sup>ab</sup>	39.79±0.19 <sup>ab</sup>	<0.001
	a*	9.50±0.53 <sup>ab</sup>	2.49±0.69 <sup>ab</sup>	3.79±0.16 <sup>ab</sup>	4.61±0.43 <sup>ab</sup>	12.66±1.84 <sup>ab</sup>	12.00±0.88 <sup>ab</sup>	7.59±1.09 <sup>ab</sup>	8.07±0.50 <sup>ab</sup>	<0.001
Cooked fillet colour	Whiteness	7.68±0.43 <sup>abca</sup>	5.64±0.39 <sup>ab</sup>	6.43±0.45 <sup>ab</sup>	6.02±0.12 <sup>ab</sup>	10.77±1.29 <sup>ab</sup>	8.78±0.59 <sup>ab</sup>	10.57±0.68 <sup>ab</sup>	7.49±0.09 <sup>ab</sup>	<0.001
	L*	42.24±0.14 <sup>ab</sup>	44.35±0.43 <sup>ab</sup>	45.33±0.23 <sup>ab</sup>	42.73±0.03 <sup>ab</sup>	36.06±0.31 <sup>ab</sup>	37.69±0.09 <sup>ab</sup>	40.12±0.24 <sup>ab</sup>	38.79±0.22 <sup>ab</sup>	<0.001
	a*	59.43±0.12 <sup>ab</sup>	60.79±0.16 <sup>ab</sup>	61.97±0.02 <sup>ab</sup>	59.40±0.19 <sup>ab</sup>	52.62±0.69 <sup>ab</sup>	54.34±0.25 <sup>ab</sup>	55.71±0.23 <sup>ab</sup>	54.30±0.29 <sup>ab</sup>	<0.001
Whiteness	L*	3.67±1.25 <sup>abA</sup>	3.86±0.57 <sup>abA</sup>	3.12±0.35 <sup>ab</sup>	4.51±0.93 <sup>ab</sup>	6.49±0.80 <sup>ab</sup>	5.27±0.24 <sup>ab</sup>	4.73±0.21 <sup>ab</sup>	5.20±0.27 <sup>ab</sup>	0.062
	a*	18.63±0.95 <sup>ab</sup>	19.19±0.28 <sup>ab</sup>	21.05±0.29 <sup>ab</sup>	18.03±0.62 <sup>ab</sup>	18.82±0.59 <sup>ab</sup>	18.42±0.04 <sup>ab</sup>	19.18±0.13 <sup>ab</sup>	18.84±0.26 <sup>ab</sup>	0.018
	b*	55.16±0.42 <sup>ab</sup>	56.17±0.09 <sup>ab</sup>	56.42±0.15 <sup>ab</sup>	55.32±0.47 <sup>ab</sup>	48.58±0.42 <sup>ab</sup>	50.48±0.23 <sup>ab</sup>	51.49±0.14 <sup>ab</sup>	50.29±0.39 <sup>ab</sup>	<0.001

Note: Values are average of three readings, presented as mean ± standard error (one-way ANOVA) and different lowercase letters (doses of Tau) and uppercase letters (salinity variations) indicate statistically significant differences (DMRT at the 5% probability level) (Two-way ANOVA). Values in the same column with different superscripts are significantly different (p<0.05).  
L\*: Lightness; a\*: Redness/Greenness, b\*: Yellowness/Blueness.

Previous work has shown that the inclusion of Tau can enhance the texture and taste of the fish fillet (Li *et al.*, 2009). The current evaluation proved that the fillet quality was improved in the fish from the (12 ppt) 10 g Tau group. Similarly, Kotzamanis *et al.* (2020) showed that the Tau supplementation significantly reduced the drip loss in the fillets and improved the cooked fillet quality of *Dicentrachus*

*labrax* reared in natural seawater (35 ppt) fed with 10 and 20 g/kg of Tau in diets, respectively. In our study, the sensory scores of the cooked fillet were higher in the fish from the (12 ppt) 10 g Tau group. Similarly, the sensory quality of fillets was higher in fish fed with a diet supplemented with 20 g/kg of Tau (Kotzamanis *et al.*, 2020). So, it has been revealed that optimum dietary Tau inclusion levels can act

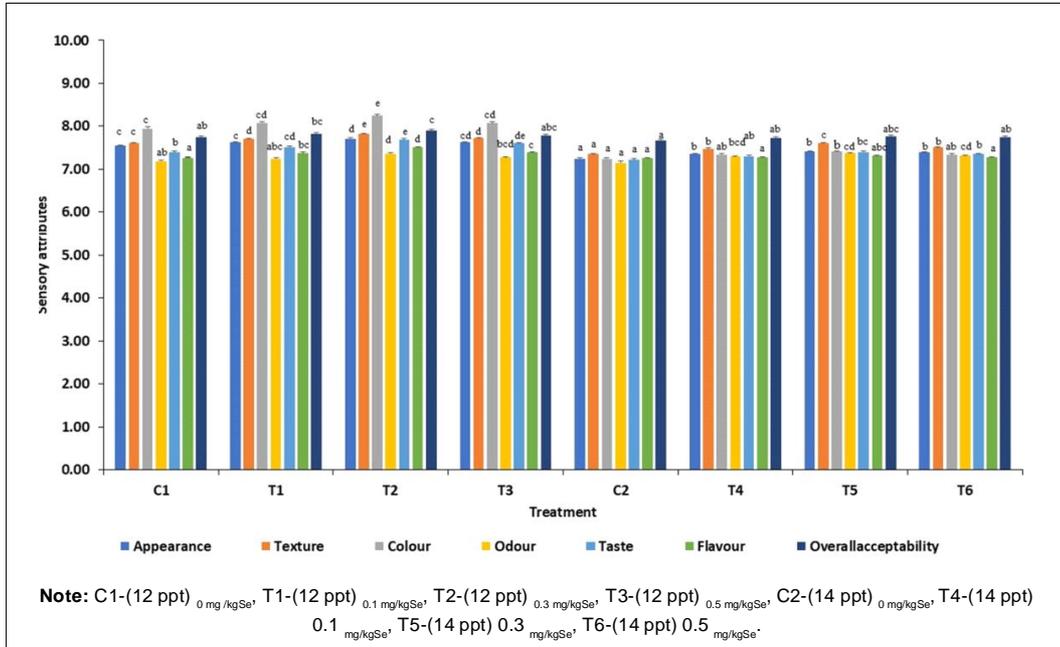


Fig 1: Effect of Se on the sensory attributes of *Channa striata*.

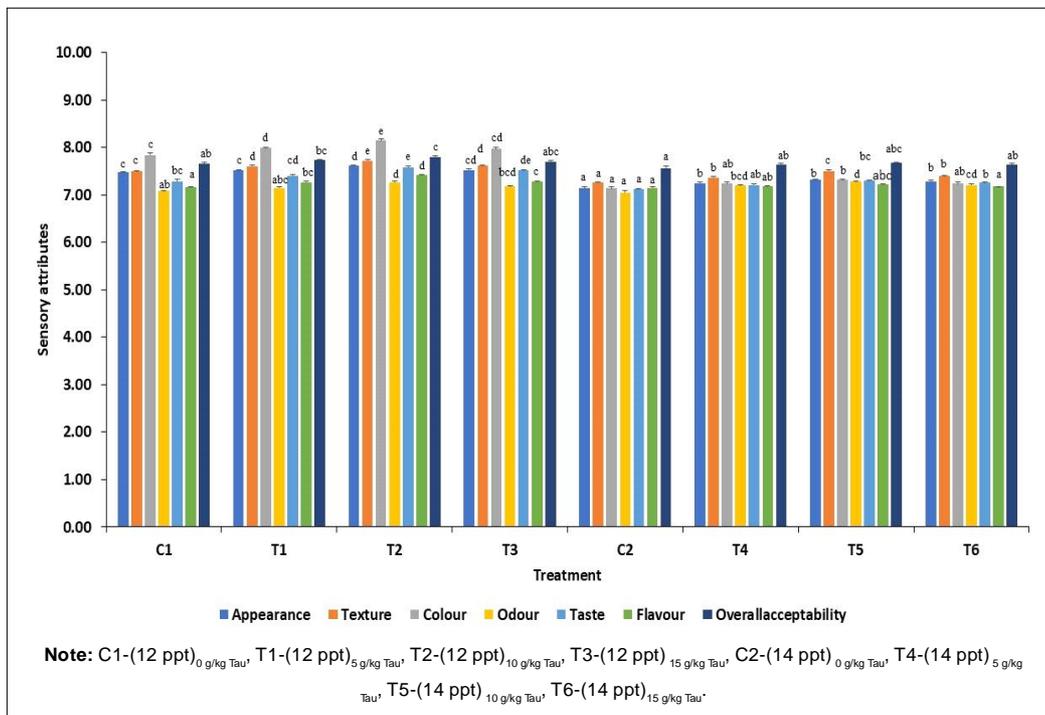


Fig 2: Effect of Tau on the sensory attributes of *Channa striata*.

as a growth promoter and result in the improved sensory attributes of filets.

## CONCLUSION

The results of the present evaluation can be concluded that the organoleptic characteristics of ISGW-reared *C. striata* were effectively improved by the Se and Tau at an inclusion level of (12 ppt) 0.3 mg Se and (12 ppt) 10 g Tau at 12 ppt salinity. This suggests the efficiency of dietary intervention and the importance of using minerals and amino acids in the stress management of finfish aquaculture, which promotes sustainability.

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## Conflict of interest

The authors declare that they have no conflict of interest to disclose.

## REFERENCES

- Ahmad, N., Hussain, S.M., Ali, S., Sarker, P.K., Al-Ghanim, K.A. and Mahmood, M. (2024). Dietary nano-Selenium supplementation improves growth performance, nutrient digestibility and hematology in *Cirrhinus mrigala* fingerlings. *Journal of Trace Elements in Medicine and Biology*. 84: 127443. <https://doi.org/10.1016/j.jtemb.2024.127443>.
- Anantharaja, K., Barlaya, G., Raghavendra, C.H., Kumar, B.S., Siddaiah, G.M., Chadha, N.K., Krishna, G., Routray, P. and Hemaprasanth, K.P. (2023). Growth performance of critically endangered *Hypselobarbus pulchellus* in biofloc systems with various C/N ratios. *Indian Journal of Animal Research*. 57(12): 1725-1732. <https://doi.org/10.18805/IJAR.B-5202>.
- Choubert, G., Blanc, J.M. and Vallée, F. (1997). Colour measurement, using the CIELCH colour space, of muscle of rainbow trout, *Oncorhynchus mykiss* (Walbaum), fed astaxanthin: Effects of family, ploidy, sex and location of rearing. *Aquaculture Research*. 28(1): 15-22.
- Ciji, A. and Akhtar, M.S. (2021). Stress management in aquaculture: A review of dietary interventions. *Reviews in Aquaculture*. 13: 2190-2247.
- Dawood, M.A.O., Zommara, M., Eweedah, N.M. and Helal, A.I. (2020). Synergistic effects of selenium nanoparticles and vitamin E on growth, immune-related gene expression and regulation of antioxidant status of Nile tilapia (*Oreochromis niloticus*). *Biological Trace Element Research*. 195(2): 624-635. <https://doi.org/10.1007/s12011-019-01857-6>.
- Dharani, M., Nayak, B.B., Xavier, K.M., Layana, P. and Balange, A.K. (2024). Meat quality assessment of common carp (*Cyprinus carpio*) reared in inland saline water. *Indian Journal of Fisheries*. 71(4): 109-114.
- Iffat, J., Tiwari, V.K., Pavan Kumar, A., Verma, A.K., Harikrishna, V., Babitha Rani, A.M. and Anand, G. (2021). The effect of inland saline groundwater on growth, maturation and osmoregulation of common carp. *North American Journal of Aquaculture*. 83(1): 15-25.
- Iffat, J., Tiwari, V.K., Verma, A.K. and Pavan-Kumar, A. (2020). Effect of different salinities on breeding and larval development of common carp, *Cyprinus carpio* (Linnaeus, 1758) in inland saline groundwater. *Aquaculture*. 518: 734658. <https://doi.org/10.1016/j.aquaculture.2019.734658>.
- Kotzamanis, Y., Tsironi, T., Brezas, A., Grigorakis, K., Iliia, V., Vatsos, I., Romano, N., van Eys, J. and Kumar, V. (2020). High taurine supplementation in plant protein-based diets improves growth and organoleptic characteristics of European seabass (*Dicentrarchus labrax*). *Scientific Reports*. 10(1): 12294.
- Kumar, A., Krishna, V.H., Reddy, A.K., Chadha, N.K. and Rani, A.B. (2016). Effect of salinity on proximate composition of *Pangasianodon hypophthalmus* reared in inland saline water. *International Journal of Zoology Studies*. 3: 19-21.
- Kumar, R., Gokulakrishnan, M., Debbarma, J. and Damle, D.K. (2022). Advances in captive breeding and seed rearing of striped murrel *Channa striata*, a high value food fish of Asia. *Animal Reproduction Science*. 238: 106957. <https://doi.org/10.1016/j.anireprosci.2022.106957>.
- Li, L., Liu, H. Y., Xie, S. Q., Zhang, P. Y. and Yang, Z. C. (2022). Effects of taurine supplementation on growth performance and feed utilization in aquatic animals: A meta-analysis. *Aquaculture*. 551: 737896.
- Li, P., Mai, K., Trushenski, J. and Wu, G. (2009). New developments in fish amino acid nutrition: Towards functional and environmentally oriented aquafeeds. *Amino acids*, 37: 43-53.
- Lin, Y.H. (2014). Effects of dietary organic and inorganic selenium on the growth, selenium concentration and meat quality of juvenile grouper *Epinephelus malabaricus*. *Aquaculture*. 430: 114-119.
- Liu, G.X., Jiang, G.Z., Lu, K.L., Li, X.F., Zhou, M., Zhang, D.D. and Liu, W.B. (2017). Effects of dietary selenium on the growth, selenium status, antioxidant activities, muscle composition and meat quality of blunt snout bream, *Megalobrama amblycephala*. *Aquaculture Nutrition*. 23(4): 777-787.
- Long, M., Lin, W., Hou, J., Guo, H., Li, L., Li, D. and Yang, F. (2017). Dietary supplementation with selenium yeast and tea polyphenols improve growth performance and nitrite tolerance of Wuchang bream (*Megalobrama amblycephala*). *Fish and Shellfish Immunology*. 68: 74-83. <https://doi.org/10.1016/j.fsi.2017.07.017>.
- Murmu, K., Rasal, K.D., Rasal, A., Sahoo, L., Nandanpawar, P.C., Udit, U.K., Patnaik, M., Mahapatra, K.D. and Sundaray, J.K. (2019). Effect of salinity on survival, hematological and histological changes in genetically improved rohu (Jayanti), *Labeo rohita* (Hamilton, 1822). *Indian Journal of Animal Research*. 54(6): 673-678. <https://doi.org/10.18805/ijar.B-3801>.
- Paswan, V.K., Sudhagar, A., Lingam, R.S.S., Sangavi, S., Singh, D., Kumar, R. and Katira, N.N. (2025). Effects of salinity and Ca<sup>2+</sup>: Mg<sup>2+</sup> ratio on growth performance and survival of *Penaeus vannamei* (Boone, 1931) reared in inland saline ground water. *Indian Journal of Animal Research*. 59(1): 163-167. <https://doi.org/10.18805/IJAR.B-5304>.

- Patel, R.K., Verma, A.K., Krishnani, K.K., Krishnan, S., Hittinahalli, C.M., Singh, A.L. and Haque, R. (2023). Effect of temporal increment in salinity of inland saline groundwater on growth performance, survival, metabolic and osmoregulatory responses of juveniles of *Labeo rohita* (Hamilton, 1822). *Aquaculture*. 571: 739473.
- Patel, R.K., Verma, A.K., Krishnani, K.K., Sreedharan, K. and Chandrakant, M.H. (2022). Growth performance, physio-metabolic and haemato-biochemical status of *Labeo rohita* (Hamilton, 1822) juveniles reared at varying salinity levels using inland saline groundwater. *Aquaculture*. 559: 738408. <https://doi.org/10.1016/j.aquaculture.2022.738408>.
- Peryam, D.R. and Pilgrim, F.J. (1957). Hedonic scale method of measuring food preferences. *Food Technology*. 11: 9-14.
- Portz, D.E., Woodley, C.M. and Cech, J.J. (2006). Stress-associated impacts of short-term holding on fishes. *Reviews in Fish Biology and Fisheries*. 16: 125-170.
- Saffari, S., Keyvanshokoh, S., Zakeri, M., Johari, S.A. and Pasha Zanoosi, H.J.A.N. (2017). Effects of different dietary selenium sources (sodium selenite, selenomethionine and nanoselenium) on growth performance, muscle composition, blood enzymes and antioxidant status of common carp (*Cyprinus carpio*). *Aquaculture Nutrition*. 23(3): 611-617. <https://doi.org/10.1111/anu.12428>.
- Sandeep, K.P., Shukla, S.P., Harikrishna, V., Muralidhar, A.P., Vennila, A., Purushothaman, C.S. and Ratheesh K.R. (2013). Utilization of inland saline water for Spirulina cultivation. *Journal of Water Reuse Desalination*. 3(4): 346-356. <https://doi.org/10.2166/wrd.2013.102>.
- Sharma, D.K., Dey, P., Gupta, S.K. and Sharma, P.C. (2014). CSSRI Vision 2050. Central Soil Salinity Research Institute. Karnal. 34p.
- Singh, S., Reddy, A.K., Harikrishna, V., Srivastava, P.P. and Lakra, W.S. (2020). Growth and osmoregulatory response of *Cyprinus carpio haematopterus* (Amur carp) reared in inland saline water. *The Indian Journal of Animal Sciences*. 90(1): 120-124. <https://www.researchgate.net/publication/339363213>.
- Swain, P., Das, R., Das, A., Padhi, S.K., Das, K.C. and Mishra, S.S. (2019). Effects of dietary zinc oxide and selenium nanoparticles on growth performance, immune responses and enzyme activity in rohu, *Labeo rohita* (Hamilton). *Aquaculture Nutrition*. 25(2): 486-494. <https://doi.org/10.1111/anu.12874>.
- Thirunavukkarasar, R., Kumar, P., Sardar, P., Sahu, N.P., Harikrishna, V., Singha, K.P. and Krishna, G. (2022). Protein-sparing effect of dietary lipid: Changes in growth, nutrient utilization, digestion and IGF-I and IGFBP-I expression of genetically improved farmed tilapia (GIFT), reared in inland ground saline water. *Animal Feed Science and Technology*. 284: 115150. <https://doi.org/10.1016/j.anifeedsci.2021.115150>.
- Urbich, A.V., Furuya, W.M., Michelato, M., Panaczevicz, P.A.P., da Cruz, T.P., Furuya, L.B. and Furuya, V.R.B. (2022). Synergistic effects of dietary methionine and taurine on growth performance, blood parameters, expression in hepatic sulfur-metabolism genes and flesh quality of large Nile tilapia. *Animal Feed Science and Technology*. 288: 115291.
- Wu, G. (2020). Important roles of dietary taurine, creatine, carnosine, anserine and 4-hydroxyproline in human nutrition and health. *Amino Acids*. 52(3): 329-360.
- Zhan, X., Wang, M., Zhao, R., Li, W. and Xu, Z. (2007). Effects of different selenium source on selenium distribution, loin quality and antioxidant status in finishing pigs. *Animal Feed Science and Technology*. 132(3-4): 202-211.
- Zhang, J., Che, C., Cai, M. and Hu, Y. (2022). Taurine improves health of juvenile rice field eel (*Monopterus albus*) fed with oxidized fish oil: Involvement of lipid metabolism, antioxidant capacity, inflammatory response. *Aquaculture Reports*. 27: 101388.
- Zhou, X., Wang, Y., Gu, Q. and Li, W. (2009). Effects of different dietary selenium sources (selenium nanoparticle and selenomethionine) on growth performance, muscle composition and glutathione peroxidase enzyme activity of crucian carp (*Carassius auratus gibelio*). *Aquaculture*. 291(1-2): 78-81. <https://doi.org/10.1016/j.aquaculture.2009.03.007>.