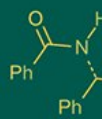


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Standardization of various food ingredients to develop protein enriched kiddi (*Parapeneopsis stylifera*) shrimp paratha

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Abstract

The present study evaluated the quality characteristics and formulation standardization of value-added Kiddi shrimp-based paratha product using Kiddi shrimp (*Parapeneopsis stylifera*). The proximate composition of fresh shrimp revealed moisture 73.14±0.01%, protein 18.06±0.03%, fat 4.21±0.02% and ash 2.37±0.01%. Biochemical parameters indicated freshness with pH 6.57±0.02, TVB-N 8.21±0.02 mg/100g, TMA-N 2.84±0.01 mg/100g, FFA 0.51±0.01% (oleic acid) and peroxide value 2.67±0.02 meq O₂/kg. Microbial load was in acceptable limit with total plate count 2.43±0.02 log cfu/g and absence of *Staphylococcus aureus*. Sensory score of raw shrimp was observed (9.0). Yield decreased from 100% (raw) shrimp to 56.20% (dressed) shrimp and 32.15% (minced). Standardization showed optimum incorporation of shrimp mince at 20%, salt at 1.5%, red chili powder at 2% and garam masala at 1.5%, showed highest overall acceptability scores (up to 8.8). Sensory attributes including appearance, colour, odour, texture and taste improved significantly at optimized levels.

Keywords: Kiddi shrimp (*parapeneopsis stylifera*), shrimp-enriched paratha, ingredient standardization, sensory evaluation

Introduction

Paratha is a stuffed flatbread commonly made from whole wheat flour (*Triticum aestivum*) in Indian subcontinent (Gudisa and Rai, 2023). Parathas are layered with ghee or oil and then cooked on a hot griddle, resulting in crispy, flaky texture. They are often stuffed with a variety of fillings such as spiced potatoes, paneer, lentils etc. enhancing both their nutritional profile and flavour. From nutritional point of view, parathas provide carbohydrates as a primary energy source, along with proteins and lipids, depending on the ingredient used. Parathas can also offer beneficial dietary fibre and micronutrients (Gopalan *et al.*, 2012) [10]. The use of the saturated fats during cooking can contribute to higher caloric intake, which may be of concern in diets with low physical activity levels (Misra *et al.*, 2011) [18]. During high-heat cooking the milliard reaction takes place, which contribute to the appealing flavour and browning of parathas, though it may also produce potentially harmful compounds like acrylamide under certain conditions (Zhang, 2007) [29]. According to Gedam *et al.*, (2024) [9] Demand for ready-to-cook or ready-to-eat food products is increasing day by day due to lifestyle changes and most people focus on healthy food and tasty food. Whilst, Majority of snacks available in the market are based on cereals, which are high in calories and low in protein content. Overall, parathas represent a staple of Indian cuisine that combines cultural heritage with complex nutritional and biochemical properties. Parathas made from whole wheat flour and stuffed with ingredients such as vegetables, lentils, or paneer offer a balanced mix of carbohydrates and micronutrients like magnesium and B-vitamins, which support metabolic functions (Slavin, 2003) [28]. Stuffed variants often incorporate vegetables like cauliflower or leafy greens, contributing to antioxidant intake and dietary fibre, which are linked to improved digestive health and reduced risk of chronic diseases (Liu, 2003) [16]. In the year 2024, the total world fisheries and aquaculture production was recorded 195 million tonnes. Out of this, 173.7 million tonnes were utilized for human consumption (FAO, 2026).

In 2023, India recorded 3.53 million tonnes of marine fish landings along with the mainland landing, which is a increased 1.2% compared to landings in 2022, in which Maharashtra contributes 2.11 million tonnes. The total landing of penaeid shrimps along Indian coast is 159201 tonnes (CMFRI, 2023) ^[7]. The landing of Penaeid shrimps along Maharashtra coast is 0.41 lakh tones & of India is 1.60 lakh tones. (Handbook on Fisheries Statistics, 2025). Kiddi shrimp is a low cost, easily and abundantly available crustacean along the Ratnagiri coast. It is rich in nutrition as it contains high percentage of crude protein (18.24%), crude lipid (6.51%), Carbohydrates (1.02%), Ash (1.20%), Energy (140.79 Kcal/100 gm.) and Moisture (73.03%) (Gopan *et al.*, 2020) ^[11]. The species is also rich in health-promoting polyunsaturated fatty acids (PUFAs), particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), while palmitic acid is the dominant saturated fatty acid (SFA). These nutritional attributes indicate that *P. stylifera* has substantial potential for utilization in the development of functional seafood based value-added products enriched with omega-3 fatty acids. Therefore the aim of the present study is to develop and standardize the protein-rich paratha through incorporation of Kiddi shrimp mince.

Material and methods

Freshly caught Kiddi shrimp, *Parapeneopsis stylifera* were procured from commercial catch from Mirkarwada Jetty, Ratnagiri, and Maharashtra. It was transported by using a polythene ice box with a 1:1 ratio of shrimp and ice and was brought to the laboratory of Fish Processing Technology, College of Fisheries, Shirgaon, and Ratnagiri. Later the shrimp were washed with potable water repeatedly to remove the blood and filth attached to it. Then the shrimp were beheaded and deveined. Further it was again washed properly to remove any unwanted matter adhered to the shrimp.

Preparation of shrimp mince

After cleaning the shrimp properly, the beheaded and deveined shrimp were boiled in the water at about 100°C for around 10 minutes. It was then removed by draining the water completely and was chopped into the small suitable size pieces according to the method given by (Shekhar and Prabhsankar, 2011) ^[26].

Standardization of ingredients

Standardization of shrimp mince for shrimp mince paratha

For the standardization of shrimp mince for shrimp mince paratha various concentrations of shrimp mince was taken and treatments were designated as Control (35%) T1 (10%), T2 (15%), T3 (20%), T4 (25%) (Table: 2). Sensory analysis of standardization of shrimp mince for shrimp mince paratha of various concentrations were carried out using 9 point hedonic scale for selecting the best concentration of shrimp mince.

Table 1: Standardization of shrimp mince for shrimp mince paratha

Treatment	Control	T1%	T2%	T3%	T4%
Shrimp mince concentration (%)	Wheat flour concentration (35%)	10%	15%	20%	25%

Control (Wheat flour concentration of 35%) as per (Husain and Bhatnagar, 2018), T1: 10% Shrimp mince, T2: 15% Shrimp mince, T3: 20% Shrimp mince, T4: 25% Shrimp mince.

Standardization of salt for shrimp mince paratha

For the standardization of salt for shrimp mince paratha various concentrations of salt was taken and treatments were designated as Control (2%) T1 (1%), T2 (1.5%), T3 (2%), T4 (2.5%) (Table:1). Sensory analysis of standardization of salt for shrimp mince paratha of various concentrations were carried out using hedonic scale for selecting the best concentration of salt.

Table 2: Standardization of salt for shrimp mince paratha

Treatment	Control%	T1%	T2%	T3%	T4%
Salt concentration (%)	2%	1%	1.5%	2%	2.5%

Control 2% as per (Shikha *et al.*, 2023) ^[27], T1: 1% salt, T2: 1.5% salt, T3: 2% salt, T4: 2.5% salt

Standardization of red chili powder for shrimp mince paratha

For the standardization of red chili powder for shrimp mince paratha various concentrations of red chili powder was taken and treatments were designated as Control (2%) T1 (1%), T2 (1.5%), T3 (2%), T4 (2.5%) (Table: 2). Sensory analysis of standardization of red chili powder for shrimp mince paratha of various concentrations were carried out using hedonic scale for selecting the best concentration of red chili powder.

Table 3: Standardization of red chili powder for shrimp mince paratha

Treatment	Control%	T1%	T2%	T3%	T4%
Red chili powder concentration (%)	2.5%	1%	1.5%	2%	2.5%

Control 2.5% as per (Andhale, 2021) ^[1], T1: 1% red chili powder, T2: 1.5% red chili powder, T3: 2% red chilli powder, T4: 2.5% red chili powder

Standardization of garam masala powder for shrimp mince paratha

For the standardization of garam masala powder for shrimp mince paratha various concentrations of garam masala powder was taken and treatments were designated as Control (5%) T1 (1%), T2 (1.5%), T3 (2%), T4 (2.5%) (Table:3). Sensory analysis of standardization of garam masala powder for shrimp mince paratha of various concentrations were carried out using hedonic scale for selecting the best concentration of garam masala powder.

Table 4: Standardization of garam masala powder for shrimp mince paratha

Treatment	Control%	T1%	T2%	T3%	T4%
Red chili powder concentration (%)	5%	1%	1.5%	2%	2.5%

Control 5% as per (local recipe), T1: 1% garam masala powder, T2: 1.5% garam masala powder, T3: 2% garam masala powder, T4: 2.5% garam masala powder.

Proximate composition

Moisture

Moisture was estimated according to (AOAC, 2006). Sample (2 g) was taken in a glass dish which was previously

dried in an oven and weighed and kept in oven at $100 \pm 2^\circ\text{C}$ for 5 hours, cooled in desiccators and weighed. The process of cooling and weighing was repeated until the difference between two successive weights was less than 1 milligram. The lowest weight was recorded accurately. Moisture content of the samples was estimated using the formula,

$$\text{Moisture}(\%) = \frac{w_1 - w_2}{w_1 - w} \times 100$$

Where,

W_1 = Weight (g) of the dish with sample before drying

W_2 = Weight (g) of the dish with sample after drying

W = Weight (g) of empty dish

Protein

Protein in the samples was estimated according to the method given by (AOAC, 2006).

Digestion

Sample (1 g) was taken and transferred into Kjeldhal digestion flask. 0.5 g of digestion mixture (K_2SO_4 : CuSO_4 - 5:1) was added to it. Then 20 ml concentrated sulphuric acid was added and mixed. The solution was heated at 420°C until it become clear.

Distillation

The digested sample was put into a volumetric flask measuring 250 ml, and the volume was filled with distilled water. A volumetric pipette was used to measure 10 ml of the sample, which was then attached to the distillation unit along with 10 ml of a 40% NaOH solution. The top of the digesting tube was sealed and partially filled with distilled water. A 100 ml conical flask was filled with a 10 ml solution of boric acid (2%) and two drops of mixed indicator using a volumetric pipette. The water was heated, producing steam. Then the sample was distilled for around 15 minutes. Boric acid changes from a blue violet to a green colour when 30 to 40 ml of distillate have been collected. Distillate was titrated with 0.143 N H_2SO_4 until the blue violet color persists.

$$\text{Protein}(\%) = \frac{v \times 0.002 \times 6.25 \times 100}{w \times A}$$

V = Volume of 0.143 N of H_2SO_4

D = Volume of digested sample

W = Weight of sample

A = Aliquot taken for distillation

Fat

Fat was estimated as per the method given by (AOAC, 2006). The flask of Soxhlet apparatus was cleaned, dried and weighed accurately. The dried sample (2 g) was weighed into a thimble made of filter paper. The thimble was placed in extraction tube, which was then connected with the weighed flask containing sufficient ether and also with the condenser. The apparatus was used to heat the chemicals to $55-60^\circ\text{C}$. The heat vaporized the volatile solvent, which passed up through side arm and was condensed in the condenser. The condenser solvent felled drop by drop into the porous thimble. When sufficient solvent has been transferred to the extraction tube to fill the siphon arm, it siphons back over into the weighed flask. This process was continued until the extraction was

completed in 8-10 hours. The flask was removed and the volatile solvent was evaporated. The flask with the fatty material was dried in a hot air oven till the weight remained constant.

$$\text{Fat content}(\%) = \frac{w_1 - w_2}{w} \times 100$$

W = Weight of sample in gm

W_1 = Final weight of sample with flask (g)

W_2 = Weight of empty flask (g)

Ash

Ash in sample was estimated according to (AOAC, 2006) [2]. Ash content in Sample was carried out by weighing about 2 g sample in a porcelain crucible. Then, it was placed in muffle furnace for about 5 hour at 550°C . Then it was cooled in desiccator and weighed. The ash content of the samples was estimated by given formula.

$$\text{Ash content}(\%) = \frac{W_1 - W_2}{W_1 - W}$$

Where,

W = Weight (g) of empty crucible

W_1 = Weight (g) of crucible + dried sample

W_2 = Lowest weight (g) of crucible with sample

Biochemical parameters

Ph measurement

Estimation of pH was carried out by the protocol laid down by (AOAC, 2006) [2]. About 5 g sample was ground with 45 ml of distilled water and filtered using a filter paper. The pH of the filtrate was recorded using a digital pH meter.

Estimation of Total Volatile Base Nitrogen (TVB-N)

The TVB-N content was analyzed as per the method given by (Beatty and Gibbons, 1937) [5].

Preparation of TCA (Trichloro-Acetic Acid)

About 10 g of sample was blended with 90 ml of distilled water for 2 min, then added 5 ml. of 10% TCA (w/v in distilled water). The mixture was ground well and filtered through Whatman's filter paper no.1.

Preparation of reagent: About 92 ml of 2% boric acid, 4 ml of 0.1% of alcoholic solution of bromocresol green and 4 ml of 0.1% of alcoholic methyl red were mixed to make 100 ml of reagent.

Procedure: The Conway unit was washed with distilled water. 1 ml of reagent was added in to the inner chamber of Conway unit. TCA extract (1 ml) and saturated potassium carbonate (0.5 ml) were taken in the unit's outer chamber, then grease was applied on the edges of the Conway unit. Conway unit was rotated clockwise and anticlock wise and incubated at ambient temperature for 3 hours. The reagent (inner chamber) was titrated with 0.02 N sulphuric acid (H_2SO_4) till the blue colour turned in to pink. TVB-N was calculated as mg/100 g of sample as follows:

$$\text{TVB-N mg}\% = \frac{T \cdot v \times 14 \times N \times 100 \times D \cdot F}{w}$$

Where T.V= Titre value

N= Normality

W=Weight of sample

D.F= Dilution factor

TMA values are expressed as mg%

Estimation of Trimethylamine Nitrogen (TMA-N)

Estimation of TMA content was carried out by using the same procedure as TVBN except that 1 ml of 10% formaldehyde was added to fix ammonia in the outer chamber with the following 1 ml TCA extract and 0.5 ml saturated potassium carbonate (K_2CO_4).

$$\text{TMA-N mg\%} = \frac{T \cdot v \times 0.02 \times 50 \times 100}{w}$$

Where T.V= Titre value

W=Weight of sample

TMA values are expressed as mg%

Peroxide Value (PV)

The peroxide value was calculated in milli-equivalents of oxygen per kilogram of fat. Sample was ground using a mortar and pestle. Fat was extracted by adding 50 ml of chloroform and filtering the mixture. This filtrate was then passed through filter paper containing anhydrous sodium sulphate and collected in a stoppered flask. For fat content estimation, 20 ml of the filtrate was transferred to a pre-weighed evaporating dish. The chloroform was evaporated using a water bath, and the dish was then dried in a hot air oven at 100°C for 3 hours. Once dried, the dish was cooled in a desiccator and weighed to determine the fat content. To measure the peroxide value, 10 ml of the same filtrate was taken in a conical flask, followed by the addition of 10 ml glacial acetic acid and 1 ml of 10% potassium iodide. The flask was sealed with a stopper and shaken gently, allowing the solution to stand for exactly one minute. Then, 50 ml of distilled water and 1 ml of 1% starch indicator were added. The solution was titrated with 0.01N sodium Thiosulphate, added gradually while shaking constantly. As the end point neared, vigorous shaking was done to ensure complete release of iodine from the chloroform layer. The titration was continued drop by drop until the blue color disappeared. A blank sample was also prepared using 10 ml of the chloroform extract, and its titre value was recorded (AOAC, 2006) [2].

$$\text{PV (Milli equivalent of } O_2/\text{kg of fat)} = \frac{T \cdot v \times N \times 1000}{w}$$

Where,

T.V. = Sample titer value PV (Milli equivalent of O_2 /kg fat)

N = Normality of sodium thiosulphate

W = Weight of fat (g)

Free Fatty Acid (FFA)

The FFA content of the sample was estimated following the (AOAC, 2006) [2] method. About 25 g of sample was placed in a mortar and a sufficient amount of anhydrous sodium sulphate was added to ensure complete dehydration. The mixture was ground thoroughly and transferred to a dry conical flask. Chloroform was then added, the contents were mixed well, and the solution was filtered. For FFA analysis, 20 ml of the chloroform extract was taken in a conical flask and evaporated to dryness using a water bath. After cooling, 10 ml of neutral alcohol was added, followed by a drop of phenolphthalein indicator. The solution was titrated with N/100 sodium hydroxide until a light pink color appeared

and remained stable for at least one minute. To determine the fat content in the 20 ml extract, the same volume of extract was taken in a pre- weighed Petri dish, evaporated to dryness, and the weight difference was recorded. Free fatty acid as oleic acid percentage in sample was expressed as:

$$\text{Free fatty acid (\% as oleic acid)} = \frac{v \times 0.001 \times 0.28 \times 100}{w}$$

Here,

W = Weight of fat present in 10 ml chloroform extract

V = Volume in ml of N/100 NaOH used for titration

Microbiological parameters

Enumeration of Total Plate Count (TPC)

Total plate count (TPC) was carried out by the method of (APHA, 1992) [3]. Physiological saline solution (0.85% NaCl) was used as a diluent for preparing the homogenate. About 25 gm sample was weighed and transferred to 225 ml of physiological saline in a homogenizer. Tryptone Glucose Beef Extract Agar (TGBE) was used as a media for plating. Inoculum dilutions of 0.1ml of 10^{-1} , 10^{-2} , 10^{-3} and 10^{-4} were taken in the petri dishes. The sample-containing petri dishes were incubated at 37 °C for 24-48 hours. The colonies developed on agar were counted. Plates giving colonies between 30-300 ranges were selected. Plates with crowded or spread colonies, which could not be counted, were discarded. The TPC was counted with the below formula.

Total plate count (CFU/ml) = Average counts of colonies × Dilution factor

Sensory analysis

Sensory analysis of fish was evaluated using '1 to 9' point hedonic). In that characteristic such as appearance, colour, odour, texture, and overall acceptability was evaluated by group of semi- trained panellist during organoleptic evaluation (Hough, 2010) [13].

Statistical analysis

All experiments were performed in triplicate and a completely randomized design were used. Analysis of variance (ANOVA) was performed and mean comparisons were done by Tukey test. Analysis was performed using a SPSS package (SPSS 16.0 for windows, SPSS Inc, Chicago, II, USA). P values less than 0.05 were considered statistically significant.

Result

Proximate composition of fresh Kiddi shrimp

The proximate composition of fresh Kiddi shrimp (*Parapenaeopsis styliifera*) was observed to be 73.14±0.01%, 18.06±0.03%, 4.21±0.02% and 2.37±0.01% of moisture, protein, fat, and ash, respectively (Table 5 and Fig. 1).

Quality of fresh Kiddi shrimp

The quality parameters of the fresh kiddi shrimp, like proximate composition, sensory, biochemical, and microbial quality characteristics, are shown in Table 6. The sensory quality evaluation of fresh Kiddi shrimp showed the highest (9.0) overall acceptance. The biochemical analysis indicated lower initial TMA-N (2.84±0.01 mg/100g), TVB-N (8.21±0.02 mg/100 g), pH (6.57±0.01), FFA (0.51±0.01% of oleic acid) and peroxide value (2.67±0.02 meq of O_2 /kg). The microbial result for total plate count showed (2.43 ± 0.02 log cfu/g) during the analysis; however, *Staphylococcus aureus* was not detected.

Yield (%) of Kiddi shrimp

The yield of the Kiddi shrimp after peeling was around 56.20% and after boiling and chopping obtained yield was 32.15% (Table 7 and Fig. 2).

Table 5: Proximate composition of fresh Kiddi shrimp (*Parapenaeopsis styliifera*)

Sr. No.	Attributes	Compositions (%)
1.	Moisture	73.14±0.01
2.	Protein	18.06±0.03
3.	Fat	4.21±0.02
4.	Ash	2.37±0.01

Results in the table represent the mean ± SD for each attribute represents the percentage composition of three determinations (n=3)

Standardisation of ingredients for Shrimp mince paratha

Standardisation of Shrimp mince concentration in Shrimp mince paratha

Paratha was prepared with various combinations of Shrimp mince such as Control (0g), T1 (10g), T2 (15g), T3 (20g) and T4 (25g). According to the results of sensory analysis, Shrimp mince with 20g (T3) concentration had highest sensory scores (Mean±S.D). The ANOVA result showed that T3 was significantly different ($p<0.05$) from remaining concentrations Control, T1, T2 and T4 in terms of Appearance, Colour, Odour, Texture, Taste and Overall Acceptability (Table:8 and Fig.3).

Standardisation of salt concentration in Shrimp mince paratha:

Paratha was prepared with various combinations

of Salt such as Control (2g), T1 (1g), T2 (1.5g), T3 (2g), T4 (2.5g). According to the results of sensory analysis, salt concentration with 1.5g (T2) concentration had highest sensory scores (Mean±S.D). The ANOVA result showed that T2 was significantly different ($P<0.05$) from remaining concentrations Control, T1, T3, and T4 in terms of Appearance, Colour, Odour, Texture, Taste and Overall Acceptability (Table:9 and Fig.4).

Standardisation of red chili powder concentration in Shrimp mince paratha

Paratha was prepared with various concentrations of Red chili powder such as Control (2.5g), T1 (1g), T2 (1.5g), T3 (2g), T4 (2.5g). According to the results of sensory analysis, red chili powder concentration with 2g (T3) concentration had highest sensory scores (Mean±S.D). The ANOVA result showed that T3 was significantly different ($p<0.05$) from remaining concentrations Control, T1, T2, and T4 in terms of Appearance, Colour, Odour, Texture, Taste and Overall Acceptability (Table:10 and Fig.5).

Standardisation of garam masala powder concentration in Shrimp mince paratha

Paratha was prepared with various concentrations of Garam masala powder such as Control (5g), T1 (1g), T2 (1.5g), T3 (2g), T4 (2.5g). According to the results of sensory analysis, garam masala powder concentration with 1.5g (T2) concentration had highest sensory scores (Mean±S.D). The ANOVA result showed that T2 was significantly different ($p<0.05$) from remaining concentrations Control, T1, T3 and T4 in terms of Appearance, Colour, Odour, Texture, Taste and Overall Acceptability (Table: 11 and Fig.6).

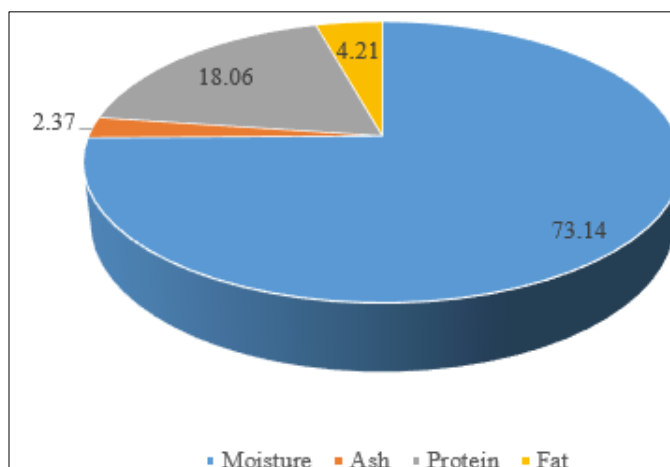


Fig 1: Proximate composition of fresh Kiddi shrimp (*Parapenaeopsis styliifera*)

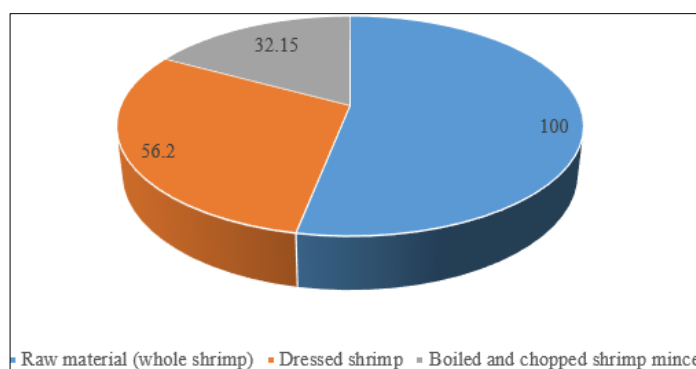


Fig 2: Yield (%) of dried kiddy shrimp

Table 6: Quality of fresh kiddi shrimp (*Parapenaeopsis stylifera*)

Sr. No.	Quality parameters	Observed values
A. Sensory quality		
1	Sensory quality (9-point hedonic scale)	9
B. Biochemical quality		
2	pH	6.57±0.02
3	TVB-N (mg/100g)	8.21±0.02
4	TMA-N (mg/100g)	2.84±0.01
5	FFA (% of oleic acid)	0.51±0.01
6	PV (meq of O ₂ /kg)	2.67±0.02
C. Microbiological quality		
8	Total Plate Count (log cfu/g)	2.43±0.02
9	<i>Staphylococcus aureus</i> (log cfu/g)	Not detected

Table 7: Yield (%) of Kiddi shrimp from fresh Kiddi shrimp (*Parapenaeopsis stylifera*)

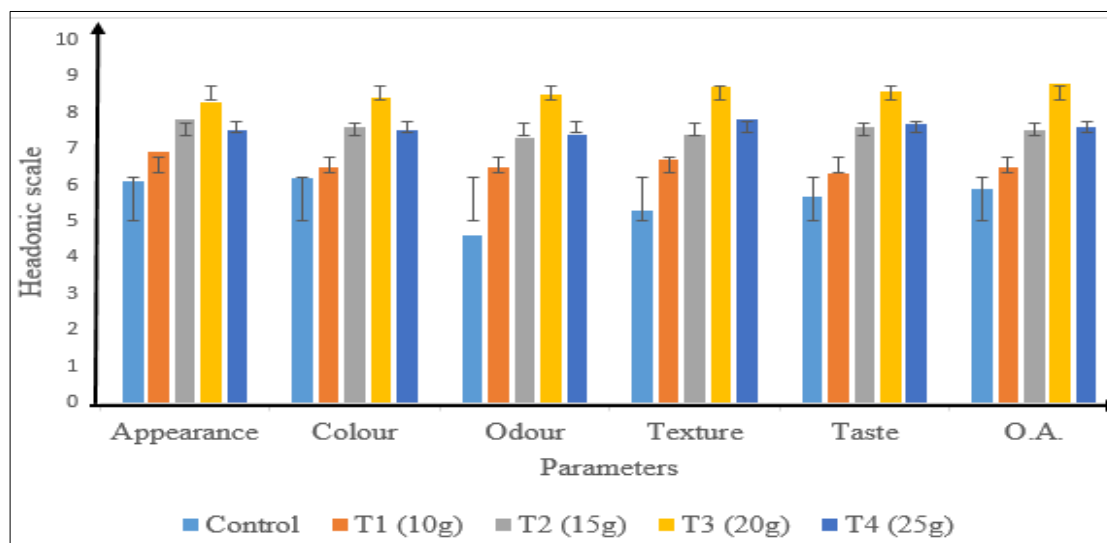
Sr. No.	Particulars	Yield (%)
1	Raw material (whole shrimp)	100
2	Dressed shrimp	56.20
3	Boiled and chopped shrimp mince	32.15

Results in the table represent percentage yield of Kiddi shrimp

Table 8: Mean results of sensory characteristics for standardizing the percentage of Shrimp mince in Paratha

Sensory characteristics	Control	T1 (10g)	T2 (15g)	T3 (20g)	T4 (25g)
Appearance	6.1±1.10 ^a	6.9±1.10 ^b	7.8±0.78 ^{bc}	8.3±0.67 ^c	7.5±0.52 ^{bc}
Colour	6.2±0.63 ^a	6.5±1.35 ^a	7.6±0.84 ^b	8.4±0.69 ^b	7.5±0.70 ^b
Odour	4.6±1.95 ^a	6.5±0.84 ^b	7.3±1.05 ^{bc}	8.5±0.52 ^c	7.4±0.51 ^{bc}
Texture	5.3±0.94 ^a	6.7±1.33 ^b	7.4±1.17 ^{bc}	8.7±0.48 ^d	7.8±0.63 ^c
Taste	5.7±0.67 ^a	6.3±1.05 ^a	7.6±0.69 ^b	8.6±0.69 ^c	7.7±0.48 ^b
O.A.	5.9±0.99 ^a	6.5±1.17 ^a	7.5±0.84 ^b	8.8±0.42 ^c	7.6±0.51 ^b

Values are presented as mean ± standard deviation (n = 10). Statistical analysis was performed using one-way ANOVA followed by Tukey's HSD post hoc test to determine significant differences among treatments. Means with different superscript letters within the same row indicate significant differences ($p < 0.05$), while means sharing common superscripts are not significantly different. Sensory evaluation was conducted using a 9-point hedonic scale (9 = like extremely; 1 = dislike extremely).

**Fig 3:** Mean results of sensory characteristics for standardizing the percentage of Shrimp mince in Paratha**Table 9:** Mean results of sensory characteristics for standardizing the percentage of salt in Shrimp mince Paratha

Sensory characteristics	Control	T1 (1g)	T2 (1.5g)	T3 (2g)	T4 (2.5g)
Appearance	6.6±0.51 ^a	6.9±0.73 ^{ab}	8.2±0.63 ^c	8.0±0.47 ^c	7.6±0.51 ^{bc}
Colour	6.7±0.48 ^a	7.3±0.67 ^{ab}	8.3±0.67 ^c	8.1±0.56 ^c	7.6±0.51 ^{bc}
Odour	6.6±0.69 ^a	7.6±0.51 ^b	8.5±0.52 ^c	8.1±0.56 ^{bc}	8.0±0.47 ^{bc}
Texture	6.6±0.51 ^a	7.4±0.84 ^b	8.3±0.67 ^c	8.1±0.31 ^{bc}	7.8±0.63 ^{bc}
Taste	6.5±0.52 ^a	7.6±0.69 ^b	8.5±0.52 ^c	7.7±0.82 ^{bc}	7.6±0.51 ^b
O.A.	6.2±0.63 ^a	7.9±0.56 ^b	8.6±0.51 ^c	8.0±0.47 ^{bc}	7.7±0.48 ^b

Values are presented as mean ± standard deviation (n = 10). Statistical analysis was performed using one-way ANOVA followed by Tukey's HSD post hoc test to determine significant differences among treatments. Means with different superscript letters within the same row indicate significant differences ($p < 0.05$), while means sharing common superscripts are not significantly different. Sensory evaluation was conducted using a 9-point hedonic scale (9 = like extremely; 1 = dislike extremely).

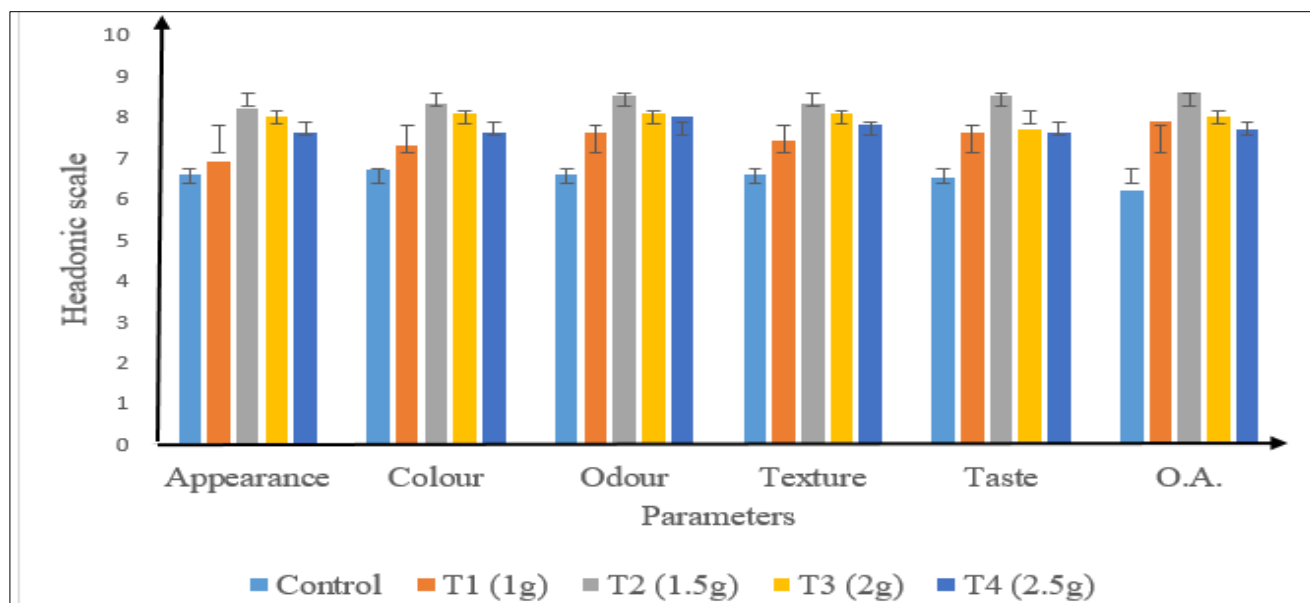


Fig 4: Mean results of sensory characteristics for standardizing the percentage of salt in Paratha

Table 10: Mean results of sensory characteristics for standardizing the percentage of red chili powder in Shrimp mince Paratha

Sensory characteristics	Control	T1 (1g)	T2 (1.5g)	T3 (2g)	T4 (2.5g)
Appearance	6.7±0.48 ^a	7.4±0.69 ^b	7.8±0.42 ^b	8.6±0.51 ^c	8.0±0.47 ^{bc}
Colour	6.6±0.51 ^a	7.4±0.69 ^b	7.8±0.42 ^{bc}	8.5±0.52 ^d	8.2±0.42 ^{cd}
Odour	6.9±0.56 ^a	7.5±0.70 ^{ab}	7.9±0.31 ^{bc}	8.5±0.52 ^c	8.0±0.47 ^{bc}
Texture	6.8±0.63 ^a	7.7±0.67 ^b	8.1±0.73 ^b	8.5±0.70 ^b	7.8±0.63 ^b
Taste	7.0±0.66 ^a	7.5±0.52 ^{ab}	8.0±0.47 ^{bc}	8.6±0.51 ^c	8.0±0.47 ^{bc}
O.A.	6.8±0.42 ^a	7.3±0.48 ^{ab}	7.6±0.51 ^{bc}	8.6±0.51 ^d	8.2±0.42 ^{cd}

Values are presented as mean ± standard deviation (n = 10). Statistical analysis was performed using one-way ANOVA followed by Tukey's HSD post hoc test to determine significant differences among treatments. Means with different superscript letters within the same row indicate significant differences ($p < 0.05$), while means sharing common superscripts are not significantly different. Sensory evaluation was conducted using a 9-point hedonic scale (9 = like extremely; 1 = dislike extremely).

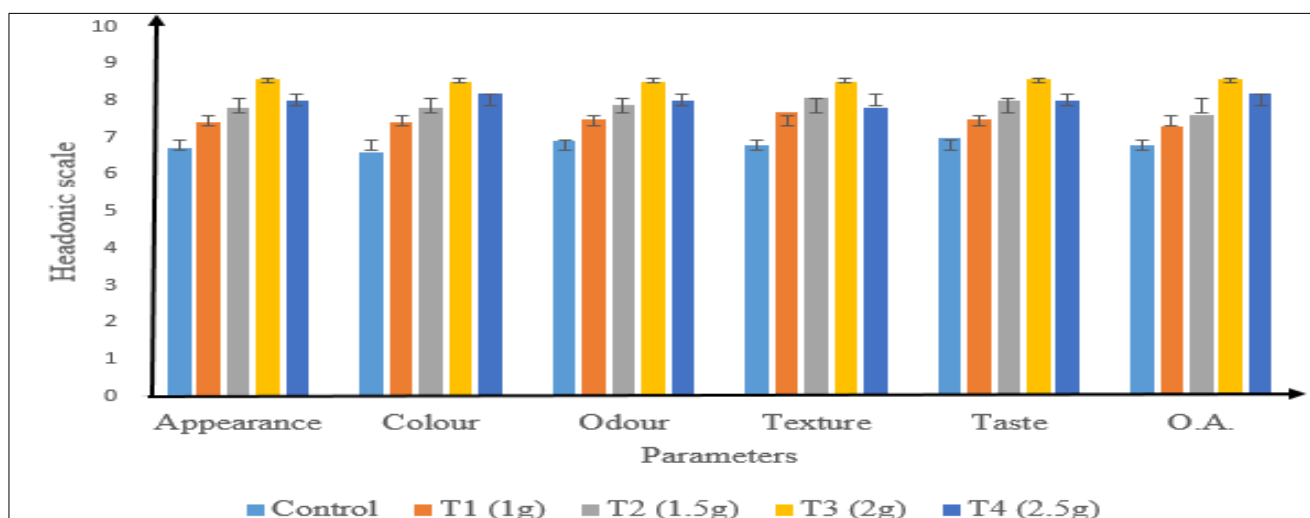


Fig 5: Mean results of sensory characteristics for standardizing the percentage of red chili powder in Paratha

Table 11: Mean results of sensory characteristics for standardizing the percentage of garam masala powder in Shrimp mince Paratha

Sensory characteristics	Control	T1 (1g)	T2 (1.5g)	T3 (2g)	T4 (2.5g)
Appearance	6.7±0.67 ^a	8.0±0.47 ^{bc}	8.7±0.48 ^c	8.1±0.56 ^{bc}	7.8±0.63 ^b
Colour	6.6±0.69 ^a	7.7±0.48 ^b	8.4±0.69 ^c	8.2±0.42 ^{bc}	8.0±0.47 ^{bc}
Odour	6.7±0.48 ^a	7.9±0.56 ^{bc}	8.5±0.70 ^c	7.9±0.56 ^{bc}	7.5±0.52 ^b
Texture	6.8±0.63 ^a	8.0±0.66 ^{bc}	8.7±0.48 ^c	8.0±0.47 ^{bc}	7.8±0.63 ^b
Taste	6.7±0.48 ^a	7.8±0.63 ^b	8.3±0.82 ^b	8.0±0.66 ^b	7.9±0.56 ^b
O.A.	6.8±0.63 ^a	8.0±0.47 ^{bc}	8.7±0.48 ^c	7.8±0.63 ^b	8.0±0.66 ^{bc}

Values are presented as mean ± standard deviation (n = 10). Statistical analysis was performed using one-way ANOVA followed by Tukey's HSD post hoc test to determine significant differences among treatments. Means with different superscript letters within the same row indicate significant differences ($p < 0.05$), while means sharing common superscripts are not significantly different. Sensory evaluation was conducted using a 9-point hedonic scale (9 = like extremely; 1 = dislike extremely).

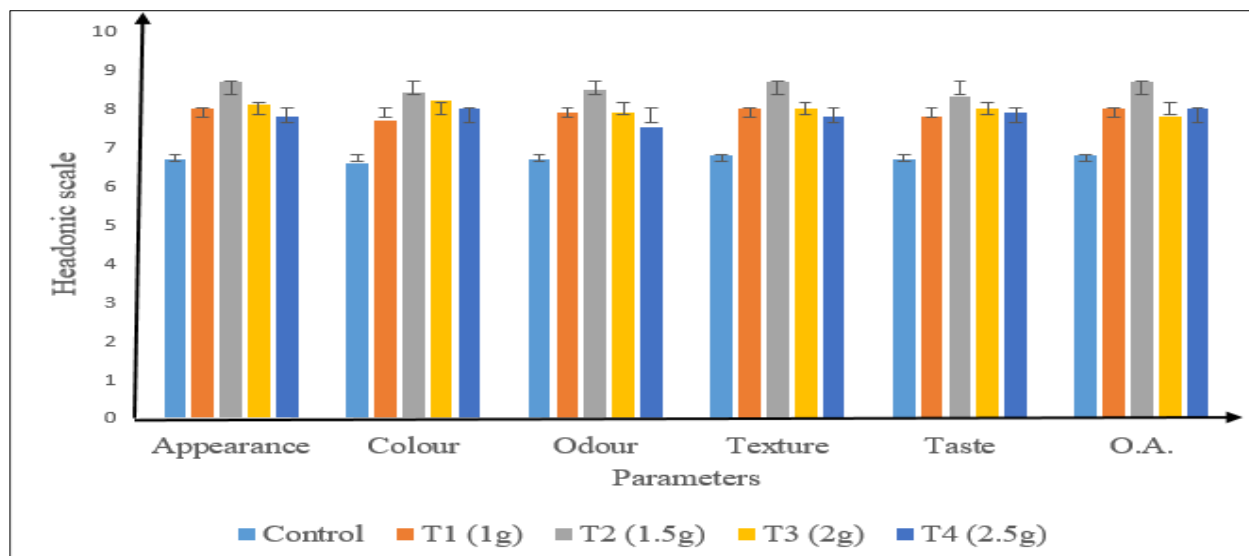


Fig 6: Mean results of sensory characteristics for standardizing the percentage of garam masala powder in Paratha

Discussion

Standardization of shrimp mince to paratha

The present study showed that addition of 20% shrimp meat gave the highest overall acceptability. The increase in sensory scores up to this level can be explained by the contribution of shrimp proteins, natural flavour compounds and juiciness, which improve taste and texture. Shrimp muscle contains free amino acids and nucleotides that enhance umami flavour, leading to better acceptability (Pawar *et al.*, 2012) [21]. At higher level (25%), a slight decrease in acceptability was observed. This may be due to excess shrimp content affecting the binding of ingredients and giving a slightly strong flavour. Similar trends have been observed in fish-based products where optimum meat level improves sensory quality but higher levels affect texture balance. Recent studies on value-added seafood products also reported that proper ratio of fish or shrimp meat is important to maintain desirable sensory properties and structural stability (Rathod *et al.*, 2014) [23].

Standardization of salt level

Salt plays an important role in improving taste and overall palatability of the product. In the present study, the 1.5% salt level showed the highest overall acceptability. The increase in sensory score at this level may be due to proper enhancement of flavour without masking the natural taste of shrimp (Rathod *et al.*, 2014) [23]. At lower level, the product was found to be less flavourful, while higher salt level reduced acceptability due to excessive saltiness. Similar observations were reported in fish-based products, where optimum salt level improved sensory quality, while higher levels negatively affected taste (Pawar *et al.*, 2012) [21].

Standardization of red chilli powder

Red chilli powder contributes to colour, taste and pungency of the product. In the present study, the 2% level showed the highest overall acceptability. This may be due to balanced pungency and improved visual appeal. Lower levels resulted in less flavour intensity, while higher levels caused excessive spiciness, which reduced acceptability (Rathod *et al.*, 2014) [23]. Similar results were reported in value-added fish products where optimum spice level improved sensory quality (Rathod *et al.*, 2014) [23].

Standardization of garam masala powder

Garam masala plays an important role in enhancing flavour and aroma of the product. The results showed that optimum level 1.5% gave highest acceptability. This may be due to proper balance of spice components which enhanced overall flavour (Rathod *et al.*, 2014) [23]. At lower levels, flavour was less intense, while higher levels resulted in strong and overpowering taste. Similar observations were reported in fish-based products, where balanced spice level improved sensory characteristics (Chandra *et al.*, 2020).

Proximate composition of fresh kiddi shrimp

The present study revealed that the fresh kiddi shrimp contained approximately 73.14±0.01% moisture, 18.06±0.03% protein, 4.21±0.02 fat, and 2.37±0.01% ash. Similar results of moisture were reported by Ramtane *et al.* (2025), Mangle *et al.* (2024), Gopan *et al.* (2020) [11] and Baug [4], 2008 as 72.80%, 73.03%, 73.03% and 73.90% respectively. Similar values of protein were documented by Ramtane *et al.* (2025), Mangle *et al.* (2023) and Gopan *et al.* (2020) [11] such as 18.24%, 18.22 and 18.24% in Kiddi shrimp. But slight higher value of protein was recorded by Baug *et al.* (2008) [4] as 22.53% crude protein in *P. stylifera*. Fat content in *P. stylifera* was recorded as 4.28±0.03% in the current study but slight higher values in fat content of *P. stylifera* such as 6.40%, 6.51 and 6.51% were recorded by Ramtane *et al.* (2025), Mangle *et al.* (2023) and Gopan *et al.* (2020) [11]. Contradictorily lower value of fat in *P. stylifera* as 1.52% was observed by Baug *et al.* (2008) [4]. Ash content in the present research was recorded as 2.35±0.02% for *P. stylifera*. Similar results of ash content in *P. stylifera* was observed by Baug *et al.* (2008) [4] as 2.20%. But lower values of ash in *P. stylifera* was recorded by Ramtane *et al.* (2025), Mangle *et al.* (2024) and Gopan *et al.* (2020) [11] as 1.20%, 0.90% and 1.2%. The nutrient content, sensory characteristics and shelf life of shrimp can vary with the proximate composition of individual species, which is decided by different factors such as growth stage, feed and season (Karakoltsidis *et al.*, 1995) [14]. The difference in the proximate composition values could be due to the difference in size, season of catch, sex, food, feeding habitat and composition of the shrimp waste.

Yield of Kiddi shrimp

The yield of the Kiddi shrimp after peeling was around 56.20% and after boiling and chopping obtained yield was 32.15%. Similar yield of 30% was documented by Mangle *et al.*, (2023).

Biochemical parameters of Kiddi shrimp

In the present study biochemical parameter such as TMA-N, TVBN, pH, FFA and PV were analysed to assess the quality of *P. stylifera*. Typically TMA-N and TVB-N serve as quality indicators and are widely utilized to estimate the freshness of fishery products. These parameters may indicate how bacterial spoilage occurs independently of the ageing process since the autolytic aspects of deterioration are not taken into account (Biede *et al.*, 1982; Kirk and Sawyer, 1991; Ocano-Higuera *et al.*, 2009) [6, 15, 20]. The PV determines the presence of fatty acids in the shrimp muscles that undergo oxidation, which results in the formation of either hydroperoxide or peroxide (Nirmal and Benjakul, 2009) [19]. TMA-N, TVBN, pH, FFA and PV were observed as 2.84 ± 0.01 (mg/100g), 8.21 ± 0.02 (mg/100g), 6.57 ± 0.02 , 0.51 ± 0.01 (% of oleic acid) and 2.67 ± 0.02 (meq of O_2 /kg) respectively. The obtained results are in complete agreement with the results documented by Ramtake *et al.* (2025) as TMA-N, TVBN, pH, FFA and PV 1.7 ± 0.05 (mg/100g), 8.42 ± 0.03 (mg/100g), 6.50 ± 0.01 , 0.72 ± 0.04 (% of oleic acid) and 3.3 ± 0.04 (meq of O_2 /kg).

Microbiological parameters of Kiddi shrimp

In the present study microbiological parameters of Kiddi shrimp such as were TPC and *Staphylococcus aureus* analysed to assess the quality of *P. stylifera* and were recorded as 2.43 ± 0.02 (log cfu/g), whereas *Staphylococcus aureus* was not detected. Similar results were documented by Ramtake *et al.* (2025) of TPC as 2.56×10^2 (log cfu/g) and *Staphylococcus aureus* was not detected.

Organoleptic evaluation of Kiddi shrimp

In the present study organoleptic evaluation of kiddi shrimp was carried out to assess the freshness of the Kiddi shrimp in which the overall acceptability was documented as 9.00. Similar overall acceptability of Kiddi shrimp was recorded by Ramtake *et al.* (2025) as 9.00.

Conclusion:

The present investigation highlights the significant potential of Kiddi shrimp as a valuable ingredient for the development of nutritionally enriched paratha. Incorporation of shrimp mince improved the quality of the product by enhancing its protein content and flavour profile. The natural presence of flavour-enhancing compounds in shrimp contributed to better palatability and consumer acceptance, establishing it as an effective functional ingredient in cereal-based foods. The study also emphasizes the importance of optimizing ingredient levels (20%) to achieve a balanced and acceptable product. Proper standardization of shrimp mince, salt, red chili powder and garam masala played a crucial role in improving sensory attributes such as appearance, colour, aroma, taste and texture. Controlled incorporation ensured that the characteristic shrimp flavour was retained without overpowering the product, while spices contributed to desirable pungency and aroma. Furthermore, the findings confirm that the use of acceptable raw shrimp with good biochemical and microbiological status is

essential for producing safe and acceptable food products. Overall, this research shows that Kiddi shrimp can be effectively utilized in traditional foods like paratha to enhance nutritional value, diversify seafood utilization and promote the development of innovative value-added products.

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Conflict of interest

The authors declare that there are no conflict of interest.

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