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All authors' names and
 affiliations are given below,
 after the references.

Development and standardization of functional bakery puffs incorporated with kiddi shrimp (*Parapenaeopsis styliifera*) and finger millet (*Eleusine coracana*) flour

AS Sharangdhar, JM Koli, AS Desai, SS Sawant, MT Sharangdhar, DI Pathan, Shalu, Panchkarla Sedyaw, SB Bhor, RS Apte, DR Murkute, Anupam Das and TM Sawant

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Abstract

The present study was undertaken to develop and standardize a value-added bakery puff prepared from Kiddi shrimp (*Parapenaeopsis styliifera*) and fortified with finger millet (*Eleusine coracana*) flour. The increasing demand for nutritious convenience foods has encouraged the incorporation of seafood and millet into bakery products to enhance their nutritional quality and consumer acceptability. The study aimed to optimize the formulation of puff pastry and shrimp stuffing through sensory evaluation. Finger millet flour was incorporated into puff pastry sheets at levels of 5%, 10%, and 15% by partially replacing all-purpose flour, while shrimp stuffing was standardized using different levels of minced shrimp meat (30-45%), salt (2-4%), red chilli powder (10-15%), and garam masala (10-14%). Sensory evaluation was conducted using a 9-point hedonic scale, and the data were analyzed using one-way ANOVA followed by Tukey's HSD test. Among the puff pastry formulations, the treatment containing 10% finger millet flour (F2) recorded the highest overall acceptability score of 8.60 ± 0.52 . For the stuffing formulation, incorporation of 40% minced shrimp meat (SM3) resulted in the highest overall acceptability score of 8.75 ± 0.47 . Similarly, stuffing standardized with 3% salt (SL2), 12% red chilli powder (RC2), and 12% garam masala (G2) achieved superior sensory scores, each recording an overall acceptability of 8.70 ± 0.48 . The optimized bakery puff exhibited desirable appearance, flavour, texture, colour, and overall sensory quality. The incorporation of finger millet improved the nutritional profile through increased dietary fibre and mineral content, while shrimp meat enhanced protein quality and flavour characteristics. The study demonstrated that *P. styliifera*, an underutilized marine resource, can be effectively utilized in the development of a nutritious and highly acceptable bakery product. The standardized shrimp-finger millet bakery puff has significant potential as a functional seafood-based snack and offers promising opportunities for commercial production and value addition in the seafood processing sector.

Keywords: *Parapenaeopsis styliifera*, kiddi shrimp, finger millet, bakery puff, value-added seafood product, sensory evaluation, product standardization

1. Introduction

1.1 Seafood as a Functional Food

Seafood is recognized as an excellent source of high-quality protein and contains lipids rich in unsaturated fatty acids. It is characterized by high digestibility, tenderness, and the presence of essential minerals required for human nutrition (Kadam & Prabhasankar, 2010)^[12]. Owing to its nutritional benefits, fish and fishery products contribute significantly to global food security and human health. According to the State of World Fisheries and Aquaculture (SOFIA, 2024) report, the global per capita fish consumption reached 20.7 kg in 2024.

1.2 Fisheries and Shrimp Production Scenario in India

India is one of the leading fish-producing countries in the world. During 2024-25, the total fish production of India was reported at 197.75 lakh tonnes, while Maharashtra contributed approximately 6.08 lakh tonnes to the national production. Among crustacean resources, penaeid prawns contributed about 4.83 lakh tonnes and non-penaeid prawns about 1.31 lakh tonnes during the same period (Handbook of Fisheries Statistics, 2025)^[6]. Maharashtra possesses a coastline of approximately 877.97 km

Corresponding Author:
 AS Sharangdhar
 Department of Fish Processing
 Technology and Microbiology,
 College of Fisheries, Shirgaon,
 Ratnagiri, Maharashtra, India

and contributes nearly 0.43 lakh tonnes of penaeid prawns, accounting for about 8.9% of the total penaeid shrimp production of India (Handbook of Fisheries Statistics, 2025) [6].

1.3 Nutritional Characteristics of *Parapenaeopsis styliifera*: Among the commercially important penaeid shrimp species, *Parapenaeopsis styliifera* (H. Milne Edwards, 1837), commonly known as kiddi shrimp, is widely distributed along the Indian coastline. The species is harvested predominantly from shallow coastal waters, with abundance particularly observed along the south-west coast of India from May to September, coinciding with the monsoon fishing season. Nutritionally, *P. styliifera* possesses a balanced amino acid profile containing all essential amino acids, with lysine being predominant in the edible meat and histidine in the shell. Among non-essential amino acids, glycine is reported to be dominant in both meat and shell fractions. Furthermore, sulfur-containing amino acids such as methionine and cystine occur at higher concentrations in the shell than in the meat (Gopan *et al.*, 2020) [4]. The proximate composition of *P. styliifera* consists of approximately 73.03% moisture, 18.24% protein, 1.30% fat, and 1.20% ash (Gopan *et al.*, 2020) [4]. 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. styliifera* has substantial potential for utilization in the development of functional seafood-based value-added products enriched with omega-3 fatty acids.

1.4 Finger Millet as a Nutritional Fortification

Millet is among the oldest cultivated cereal crops and belong to the *Poaceae* family. They are considered nutrient-dense, climate-resilient crops and serve as staple foods for a significant proportion of the global population (Hassan *et al.*, 2021) [8]. Finger millet (*Eleusine coracana*), commonly known as ragi, is believed to have originated in East Africa and has been cultivated in India since approximately 2300 BC. It is particularly valued for its exceptional nutritional composition, including high levels of calcium (approximately 0.38%), dietary fiber (18%), and phenolic compounds (0.3-3.0%), which contribute antioxidant and health-promoting properties (Hassan *et al.*, 2021) [8]. Owing to its nutritional richness and functional characteristics, finger millet has gained considerable attention as an ingredient for fortification of bakery and convenience foods.

1.5 Value Addition in Seafood Products

The growing popularity of fast-food products among consumers, particularly younger populations, has led to increased demand for convenient, ready-to-eat, and ready-to-serve foods. Factors such as accessibility, palatability, affordability, and changing lifestyles have accelerated the consumption of bakery-based snack products (Kaushik *et al.*, 2011) [13]. Simultaneously, rapid urbanization and the increasing participation of women in the workforce have

contributed to a rising demand for nutritionally enhanced convenience foods (Guran *et al.*, 2015) [15].

1.6 Need for Development of Shrimp-Finger Millet Bakery Puff:

Incorporation of seafood and millet ingredients into bakery products offers an effective approach to improve their nutritional quality while catering to consumer preferences for convenient food options.

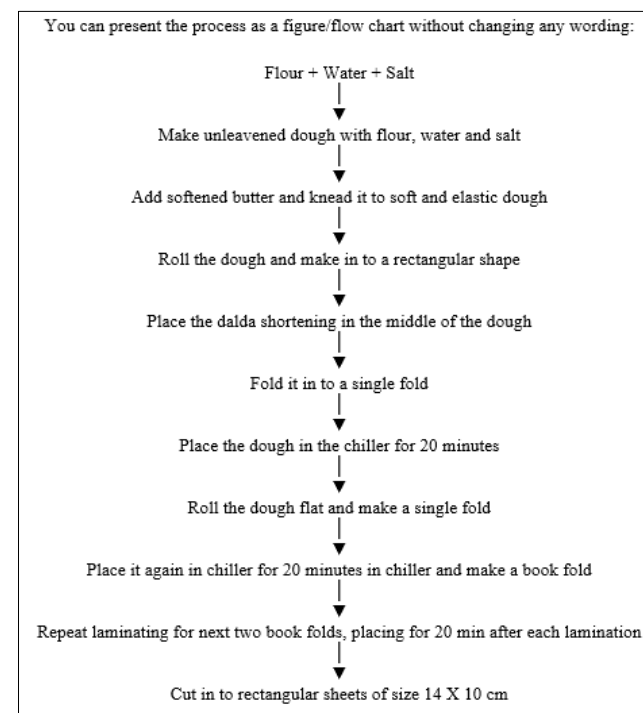
1.7 Objectives of the Study

Therefore, the present study was undertaken to develop and standardize a value-added bakery puff fortified with kiddi shrimp (*Parapenaeopsis styliifera*) and finger millet. The study aimed to optimize the formulation of shrimp-finger millet bakery puffs and evaluate their nutritional, physicochemical, microbiological, and sensory quality characteristics. Furthermore, the storage stability of the developed product was assessed under chilled storage conditions and compared with a control (non-fortified) bakery puff to determine the effect of shrimp and finger millet incorporation on product quality and shelf life.

2. Material and methods

2.1 Puff Patti /Sheet fortification with Finger Millet

The puff pastry sheet (puff patti) was initially prepared according to the standardized procedure reported by Kingslee (2006) [15]. The formulation and processing steps adopted are illustrated in (Flowchart 2.1.1). Following standardization, the formulation was further modified by partially replaced all pupose flour (maida) with finger millet (ragi) flour at different incorporation levels to obtain a nutritionally enriched puff pastry sheet (Tabel 2.1.1). The optimized formulation was selected based on its physicochemical, sensory, and processing attributes.



Flowchart 2.1.1: Procedure for the preparation of puff sheets (Kingslee, 2006) [15]

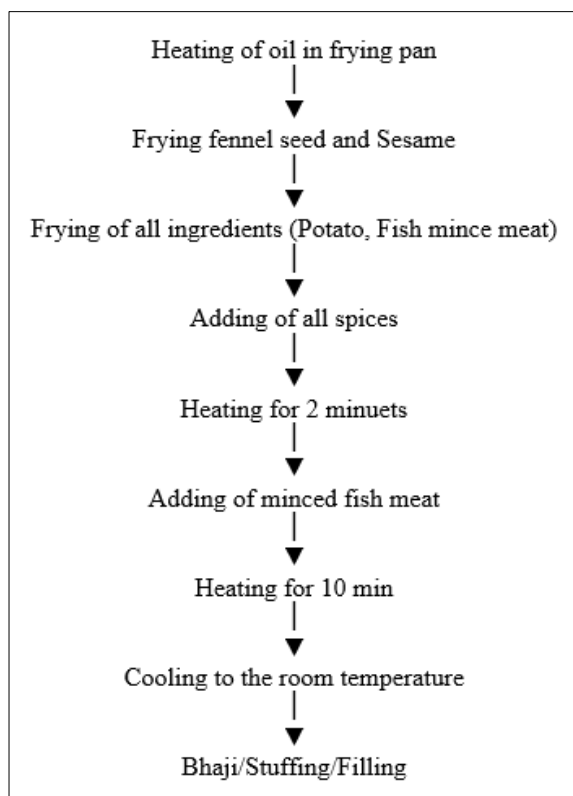
Table 2.1.1: Different Concentration Finger Millet (ragi) replaced with All-purpose flour (Maida)

	% of Maida (All-purpose Flour)	% of Finger Millet (Ragi)
Control	100	0
F1	95	5
F2	90	10
F3	85	15

2.2 Stuffing for puff pastry with incorporation shrimp meat and other ingredients

Inside of the unstuffed puff sheets filling/stuffing/bhaji prepared as per (Jain *et al.* 2014; Local recipe) ^[20] were

referred and slightly changes will be done and standardization was done for percentage of chopped meat of shrimp, salt, red chilli powder and garam masala these key ingredients of filling recipe were standardized.

**Flowchart 2:** Standardize recipe for fish puff stuffing, (Jain *et al.* 2014) ^[20]**Table 2.2.1:** Fish Meat Percentage used in stuffing of fish puff (Jain *et al.* 2014) ^[20]

Sr. No.	Recipes	R1	R2	R3	R4
	Ingredients	Quantity (%)	Quantity (%)	Quantity (%)	Quantity (%)
1.	Minced fish meat	30.5	31.4	34.9	36.5

The percentage of shrimp meat used in the stuffing formulation was selected with reference to the baseline formulation reported by Jain *et al.* (2014) ^[20]. Based on this formulation (Table 2.2.1), different treatment levels were

designed by varying the proportion of shrimp meat to standardize the stuffing for the development of shrimp bakery puff.

Table 2.2.2: Various treatment to obtain appropriate percentage of shrimp meat in stuffing

	% of Potato and Other Ingredients	% of Minced shrimp meat
Control	100	0
SM1	70	30
SM2	65	35
SM3	60	40
SM4	55	45

The stuffing formulation was prepared according to the ingredient composition shown in Table 2.2.3. For the standardization of other key ingredients, a locally popular vegetable puff recipe was used as the reference formulation.

The ingredient levels were subsequently optimized to obtain desirable sensory and technological characteristics in the developed shrimp bakery puff

Table 2.2.3: Local Veg Puff Reference Recipe for other ingredients.

Sr.no	Ingredients	Quantity (g)
1.	Potatoes cooked and peeled	850
2.	Chopped Vegetable	100
3.	Garam Masala	5
4.	Turmeric powder	3
5.	Red chili powder	10
6.	Mustard Seed	5
7.	Cummin seeds	5
8.	Salt	2
9.	Oil	10
10.	Citric Acid	5
Total		1000

Table 2.2.4: Modified Tentative Recipe with Jain *et al.* and Local Veg Puff Recipes.

Sr.no	Ingredients	Quantity
1	Shrimp Chopped Meat	350
2	Boiled Potato	500
3	Chopped Vegetable (Onion, Coriander, Green Chili Paste)	100
4	Garam Masala	10
5	Turmeric powder	3
6	Red chili powder	10
7	Mustard Seed	5
8	Cumin seeds	5
9	Salt	2
10	Oil	10
11	Citric Acid	5
Total		1000

Table 2.2.5: Different level of key ingredients percentage for standardization

Sr. No	Ingredients	Treatments		
1	Salt	SL1 (2 g)	SL2 (3 g)	SL3 (4 g)
		2	3	4
2	Red Chilli Powder	RC1 (10 g)	RC2 (12 g)	RC3 (15 g)
		10	12	15
3	Garam Masala	G1 (10 g)	G2 (12 g)	G3 (15 g)
		10	12	15

As presented in Table 2.2.5, the stuffing formulation was standardized by varying the levels of salt, red chilli powder, and garam masala to optimize the sensory quality of the shrimp bakery puff. Salt was incorporated at three levels, namely SL1 (2 g), SL2 (3 g), and SL3 (4 g). Similarly, red chilli powder was added at RC1 (10 g), RC2 (12 g), and RC3 (15 g), while garam masala was incorporated at GM1 (10 g), GM2 (12 g), and GM3 (15 g). During the standardization process, all other ingredients were maintained at constant levels. The prepared samples were subjected to sensory evaluation to assess the effect of varying ingredient concentrations on appearance, flavour, taste, texture, and overall acceptability. Based on the sensory scores obtained, the treatment showing the highest overall acceptability was selected as the optimized formulation and used for further product development and analysis.

3. Result

3.1 Standardisation of a suitable % of finger millet (Ragi) for dough preparation of puff Patti

The experimental samples were formulated by partially replacing Maida (all-purpose flour) with finger millet (ragi) flour at varying incorporation levels. The control formulation (C) comprised 100% Maida without finger millet flour, whereas treatments F1, F2, and F3 were prepared by incorporating 5%, 10%, and 15% finger millet flour, respectively, with a corresponding reduction in Maida content. The developed formulations were utilized for the preparation and sensory evaluation of puff Patti samples (Table 3.1.1 and Fig. 3.1.1). Among the different treatments, the puff Patti incorporated with 10% finger millet flour (F2) achieved the highest overall acceptability score (8.60 ± 0.52), indicating greater consumer preference compared to the other formulations.

Table 3.1.1: Mean sensory scores of finger millet (Ragi) for dough preparation of puff Patti

Characteristics	C	F1 (5%)	F2 (10%)	F3 (15%)
Appearance	6.50 ± 0.53^a	7.20 ± 0.63^b	8.40 ± 0.52^c	6.20 ± 0.63^a
Taste	6.50 ± 0.53^a	7.30 ± 0.48^b	8.60 ± 0.52^c	6.10 ± 0.57^a
Texture	6.30 ± 0.48^b	7.30 ± 0.48^c	8.50 ± 0.53^d	5.60 ± 0.52^a
Odour	6.50 ± 0.53^a	7.40 ± 0.52^b	8.40 ± 0.52^c	6.30 ± 0.48^a
Colour	6.50 ± 0.53^a	7.30 ± 0.48^b	8.50 ± 0.53^c	6.00 ± 0.47^a
Overall acceptability	6.50 ± 0.53^a	7.30 ± 0.48^b	8.60 ± 0.52^c	6.00 ± 0.47^a

Values are presented as mean $\pm$ 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). F = Finger Millet

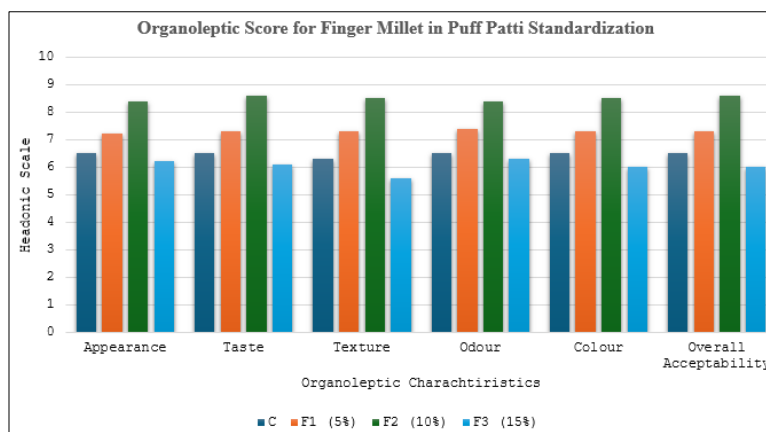


Fig 3.1.1: Finger Millet Effect on Acceptability

3.2 Standardisation of a suitable% of minced shrimp meat for preparation of stuffing

The experimental stuffing formulations were developed by incorporating minced shrimp meat at different levels in combination with potato and other ingredients. The control formulation (C) contained potato and other ingredients without the addition of minced shrimp meat, whereas treatments SM1, SM2, and SM3 were prepared with 30%, 35%, and 40% minced shrimp meat, respectively, with a

corresponding reduction in the proportion of potato and other ingredients. These formulations were utilized for the preparation and sensory evaluation of shrimp puff stuffing (Table 3.1.2 and Fig. 3.1.2). Among the treatments, the stuffing incorporated with 40% minced shrimp meat (SM3) recorded the highest overall acceptability score (8.75 ± 0.47), indicating superior sensory preference compared to the other formulations.

Table 3.1.2: Mean sensory scores of organoleptic scores of minced shrimp meat for stuffing

Characteristics	C	SM1 (30%)	SM2 (35%)	SM3 (40%)	SM4 (45%)
Appearance	6.50 $\pm$ 0.53 ^a	7.40 $\pm$ 0.52 ^b	8.20 $\pm$ 0.50 ^c	8.70 $\pm$ 0.48 ^d	8.30 $\pm$ 0.49 ^c
Taste	6.50 $\pm$ 0.53 ^a	7.50 $\pm$ 0.53 ^b	8.30 $\pm$ 0.51 ^c	8.80 $\pm$ 0.47 ^d	8.40 $\pm$ 0.50 ^c
Texture	6.30 $\pm$ 0.48 ^a	7.40 $\pm$ 0.52 ^b	8.10 $\pm$ 0.49 ^c	8.60 $\pm$ 0.46 ^d	8.20 $\pm$ 0.48 ^c
Odour	6.50 $\pm$ 0.53 ^a	7.50 $\pm$ 0.53 ^b	8.25 $\pm$ 0.50 ^c	8.70 $\pm$ 0.47 ^d	8.30 $\pm$ 0.49 ^c
Colour	6.50 $\pm$ 0.53 ^a	7.40 $\pm$ 0.52 ^b	8.15 $\pm$ 0.50 ^c	8.65 $\pm$ 0.46 ^d	8.25 $\pm$ 0.48 ^c
Overall acceptability	6.50 $\pm$ 0.53 ^a	7.50 $\pm$ 0.53 ^b	8.30 $\pm$ 0.50 ^c	8.75 $\pm$ 0.47 ^d	8.35 $\pm$ 0.49 ^c

Values are presented as mean $\pm$ 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). SM = Shrimp Meat

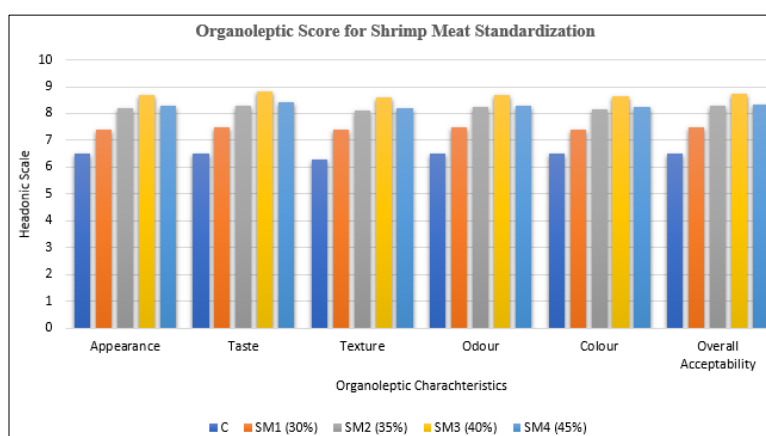


Fig 3.1.2: Mean results for appearance, colour, odour, texture, and overall acceptance minced shrimp meat for preparation of puff stuffing. Values represent mean $\pm$ SD of three determinants ($n=10$)

3.3 Standardisation of a suitable% of salt for preparation of stuffing

The experimental stuffing formulations were standardized by varying the level of salt while maintaining the proportions of the remaining ingredients accordingly. The control formulation (C) contained 1.74% salt, whereas treatments SL1, SL2, and SL3 were prepared with 2%, 3%, and 4% salt, respectively.

These formulations were utilized for the preparation and sensory evaluation of the shrimp puff stuffing (Table 3.3.1 and Fig. 3.3.1). Among the treatments, the formulation containing 3% salt (SL2) attained the highest overall acceptability score (8.70 ± 0.48), indicating optimum sensory quality and consumer preference.

Table 3.3.1 Mean sensory scores of a suitable% of salt for preparation of puff Patti

Characteristics	C (1.74)	SL1 (2%)	SL2 (3%)	SL3 (4%)
Appearance	6.50 ± 0.53^a	7.50 ± 0.53^b	8.50 ± 0.53^c	6.50 ± 0.53^a
Taste	6.50 ± 0.53^b	7.40 ± 0.52^c	8.70 ± 0.48^d	4.50 ± 0.53^a
Texture	6.50 ± 0.53^a	7.40 ± 0.52^b	8.50 ± 0.53^c	6.50 ± 0.53^a
Oduor	6.50 ± 0.53^b	7.50 ± 0.53^c	8.50 ± 0.53^d	5.50 ± 0.53^a
Color	6.50 ± 0.53^b	7.50 ± 0.53^c	8.50 ± 0.53^d	5.50 ± 0.53^a
Overall acceptability	6.50 ± 0.53^b	7.40 ± 0.52^c	8.70 ± 0.48^d	4.50 ± 0.53^a

Values are presented as mean $\pm$ 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). SL= Salt

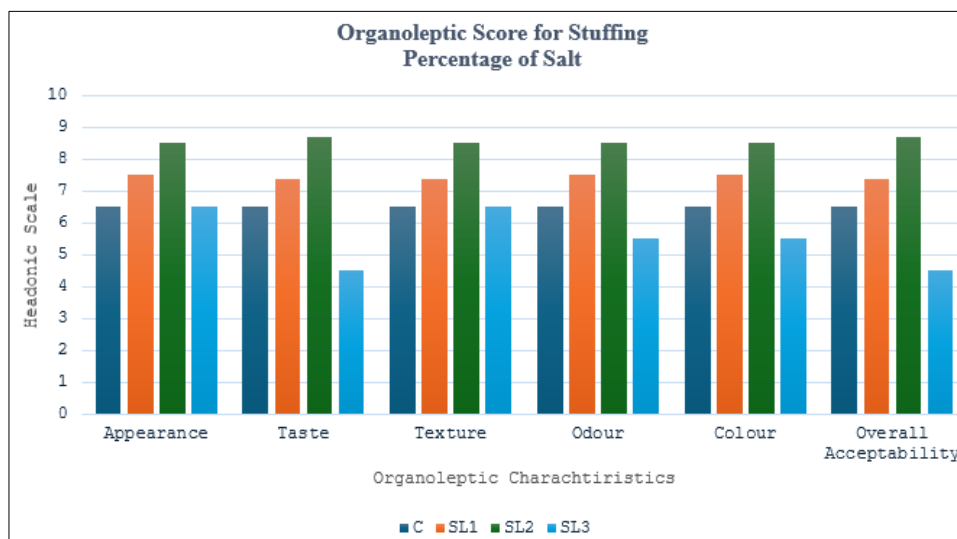


Fig 3.3.1: Mean results for appearance, taste, texture, odour, colour and overall acceptance of salt for preparation of puff stuffing. Values represent mean $\pm$ SD of three determinants ($n=10$)

3.4 Standardisation of a suitable% of red chilli powder for preparation of puff stuffing

The experimental stuffing formulations were prepared by varying the level of red chilli powder while proportionately adjusting the other ingredients. The control formulation (C) contained 0.87% red chilli powder, whereas treatments RC1, RC2, and RC3 were formulated with 10%, 12%, and 15% red chilli powder, respectively.

These formulations were used for the preparation and sensory evaluation of shrimp puff stuffing (Table 3.4.1 and Fig. 3.4.1). Among the treatments, the formulation containing 12% red chilli powder (RC2) achieved the highest overall acceptability score (8.70 ± 0.48), indicating optimum flavour and overall sensory quality.

Table 3.4.1: Mean sensory scores of a suitable% of red chilli powder for preparation of puff stuffing

Characteristics	C (0.87)	RC1 (10%)	RC2 (12%)	RC3 (15%)
Appearance	6.50 ± 0.53^a	7.30 ± 0.48^b	8.40 ± 0.52^c	6.50 ± 0.53^a
Taste	6.50 ± 0.53^b	6.70 ± 0.48^b	8.50 ± 0.53^c	5.50 ± 0.53^a
Texture	6.50 ± 0.53^a	7.30 ± 0.48^b	8.50 ± 0.53^c	6.50 ± 0.53^a
Odour	6.50 ± 0.53^a	7.40 ± 0.52^b	8.50 ± 0.53^c	6.50 ± 0.53^a
Colour	6.50 ± 0.53^a	7.30 ± 0.48^b	8.50 ± 0.53^c	6.50 ± 0.53^a
Overall acceptability	6.50 ± 0.53^b	6.70 ± 0.48^b	8.70 ± 0.48^c	5.50 ± 0.53^a

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). RC= Red chilli Powder

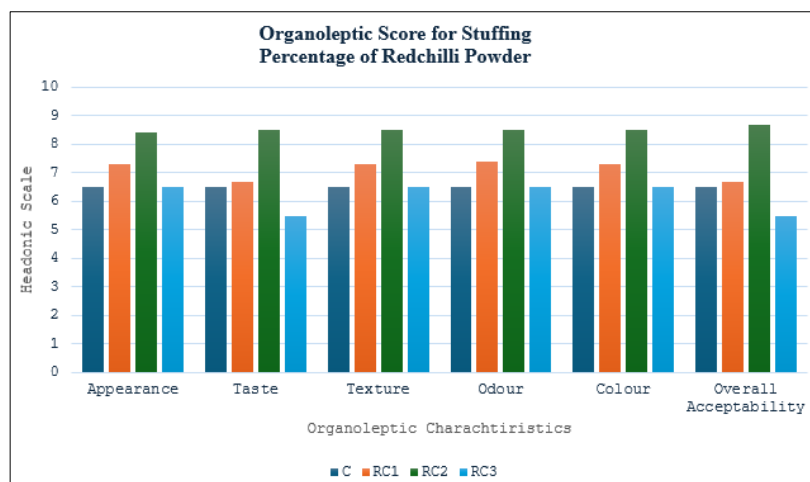


Fig 3.4.1: Mean results for appearance, colour, odour, texture, and overall acceptance of red chilli powder for preparation of puff stuffing. Values represent mean± SD of three determinants (n=10)

3.5 Standardisation of a suitable% of garam masala for preparation of puff stuffing

The experimental stuffing formulations were standardized by varying the level of garam masala while proportionately adjusting the other ingredients. The control formulation (C) contained 5% garam masala, whereas treatments G1, G2, and G3 were prepared with 10%, 12%, and 14% garam

masala, respectively. These formulations were utilized for the preparation and sensory evaluation of shrimp puff stuffing (Table 3.5.1 and Fig. 3.5.1). Among the treatments, the formulation containing 12% garam masala (G2) recorded the highest overall acceptability score (8.70 ± 0.48), indicating superior flavour and overall sensory acceptability.

Table 3.5.1: Mean sensory scores of a suitable% of garam masala for preparation of puff stuffing

Characteristics	C (5%)	G1 (10%)	G2 (12%)	G3 (14%)
Appearance	6.50±0.53 ^a	7.50±0.53 ^b	8.50±0.53 ^c	6.50±0.53 ^a
Taste	6.50±0.53 ^b	7.10±0.74 ^b	8.70±0.48 ^c	4.70±0.48 ^a
Texture	6.50±0.53 ^a	7.40±0.52 ^b	8.50±0.53 ^c	6.50±0.53 ^a
Odour	6.50±0.53 ^b	7.50±0.53 ^c	8.60±0.52 ^d	5.70±0.67 ^a
Colour	6.50±0.53 ^b	7.50±0.53 ^c	8.70±0.48 ^d	5.50±0.53 ^a
Overall acceptability	6.50±0.53 ^b	7.50±0.53 ^c	8.70±0.48 ^d	4.60±0.52 ^a

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). G= Garam masala

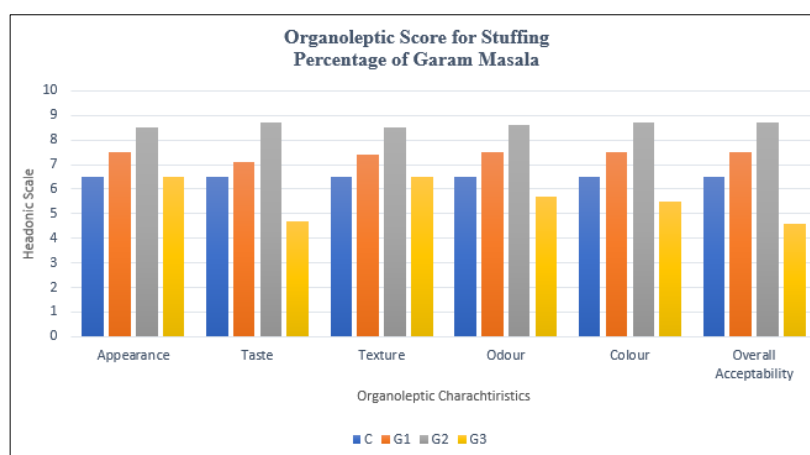


Fig 3.5.1: Mean results for appearance, colour, odour, texture, and overall acceptance of garam masala for preparation of puff stuffing. Values represent mean± SD of three determinants (n=10)

3.6 Final Standardized Recipes of Puff Patti and Stuffing

3.6.1 Standardisation of a suitable % of ingredients for preparation of puff Patti

Standardized quantity for of all ingredients for preparation of Patti was included in table 3.6.1.1 which was further used to prepare puff.

Table 3.6.1.1: Final Standardized Recipe for Puff Patti Incorporated with Finger Millet Flour

Sr. no.	Ingredient	Quantity in gm.
1.	Bread flour	900
2.	Finger millet flour	100
3.	Water	500
4.	Salt	17
6.	Dalda shortening	300
	Total	1,817

3.6.2 Final recipe for storage study

After standardisation of all ingredients and shrimp meat the final recipe was included in table 4.10 using which the puff was prepared and storage study was carried on.

Table 3.6.2.1: Final Standardized Recipe for Storage Study

Sr. No.	Ingredients	Quantity (g)
1	Shrimp Chopped Meat	340
2	Boiled Potato	510
3	Chopped Vegetable (Onion, Coriander, Green Chilli Paste)	100
4	Garam Masala	12
5	Turmeric Powder	3
6	Red Chilli Powder	12
7	Mustard Seeds	5
8	Cumin Seeds	5
9	Salt	3
10	Oil	10
11	Citric Acid	5
Total (g)		1003

4. Discussion

4.1 Standardization of Finger Millet (Ragi Flour)

The puff Patti incorporated with 10% finger millet flour (F2) recorded the highest overall acceptability score (8.60 ± 0.52) compared to the control, F1 (5%), and F3 (15%) treatments. The improved sensory quality observed at the 10% incorporation level may be attributed to the starch and dietary fibre present in finger millet, which contribute to better binding properties and desirable textural characteristics. In addition, finger millet enhances the nutritional profile of the product through its rich mineral and fibre content. However, a decline in sensory scores was observed at the 15% incorporation level. This reduction may be associated with the higher fibre content of finger millet, resulting in a denser texture and darker appearance. Furthermore, the presence of phenolic compounds may impart slight flavour changes when incorporated at higher levels. Similar findings were reported by Devi *et al.* (2014) and Kumar *et al.* (2021) [2, 16], who observed that moderate incorporation levels improved product quality, whereas excessive addition reduced consumer acceptability.

4.2 Standardization of Shrimp Chopped Meat in Stuffing

The stuffing formulation containing 40% shrimp meat (SM3) achieved the highest overall acceptability score (8.75 ± 0.47) compared to the control, SM1 (30%), SM2 (35%), and SM4 (45%) treatments. The enhanced sensory quality at this level may be attributed to the contribution of shrimp proteins, natural flavour compounds, and improved juiciness, which positively influenced the taste and texture of the product. Shrimp muscle is known to contain free amino acids and nucleotides that enhance umami flavour, thereby increasing overall consumer preference. However, a

slight decline in acceptability was observed at the 45% incorporation level. This may be due to the higher shrimp content affecting the binding characteristics of the stuffing and producing a comparatively stronger seafood flavour. Similar observations have been reported in fish-based products, where optimum meat incorporation improved sensory quality, while excessive levels adversely affected texture and overall balance (Pawar *et al.*, 2012; Rathod *et al.*, 2014). Chandra *et al.* (2020) [1, 18, 19] also emphasized that maintaining an appropriate proportion of fish or shrimp meat is essential for achieving desirable sensory attributes and structural stability in value-added seafood products.

4.3 Standardization of Salt Level

Among the different salt concentrations evaluated, the formulation containing 3% salt (SL2) obtained the highest overall acceptability score (8.70 ± 0.48) compared to the control, SL1 (2%), and SL3 (4%) treatments. Salt plays a crucial role in enhancing flavour and improving the overall palatability of food products. The higher sensory score obtained for the 3% salt formulation may be attributed to its ability to enhance flavour without masking the characteristic taste of shrimp. Lower salt levels resulted in a comparatively bland product, whereas higher levels led to excessive saltiness, negatively affecting acceptability. Similar findings were reported by Pawar *et al.* (2012) [18], who observed that optimum salt incorporation improved sensory quality, while excessive salt levels adversely influenced product flavour.

4.4 Standardization of Red Chilli Powder

The formulation containing 12% red chilli powder (RC2) recorded the highest overall acceptability score (8.70 ± 0.48)

when compared with the control, RC1 (10%), and RC3 (14%) treatments. Red chilli powder contributes significantly to the colour, flavour, and pungency of the product. The superior sensory performance of RC2 may be attributed to the balanced level of spiciness and enhanced visual appeal imparted by the chilli powder. Lower incorporation levels resulted in reduced flavour intensity, whereas higher levels produced excessive pungency, which negatively affected consumer acceptance. Similar observations were reported by Rathod *et al.* (2014)^[19], who found that optimum spice incorporation improved the sensory quality of value-added fish products.

4.5 Standardization of Garam Masala

The formulation containing 12% garam masala (G2) achieved the highest overall acceptability score (8.70±0.48) compared to the control, G1 (10%), and G3 (14%) treatments. Garam masala plays an important role in enhancing the flavour and aroma profile of the product. The improved acceptability observed at this level may be attributed to the balanced blend of spices, which complemented the natural flavour of the shrimp stuffing and enhanced overall sensory quality. Lower levels produced a less pronounced flavour profile, while higher levels resulted in an overpowering spice taste that reduced consumer preference. The traditional local recipe for puff stuffing contained 5% garam masala; however, sensory evaluation indicated that a higher incorporation level of 12% was more acceptable. Similar findings were reported by Chandra *et al.* (2020)^[1], who noted that balanced spice incorporation significantly improves the sensory characteristics of fish-based products.

5. Conclusion

The findings of the present study demonstrated that bakery puff prepared from Kiddi shrimp (*Parapenaeopsis styliifera*) fortified with finger millet (ragi) flour and selected seasoning ingredients exhibited superior organoleptic qualities compared to the control product. The standardized formulation comprised puff patti incorporated with 10% finger millet flour (F2) and stuffing containing 40% shrimp meat (SM3), 3% salt (SL2), 12% red chilli powder (RC2), and 12% garam masala (G2). This combination resulted in desirable sensory attributes and the highest overall acceptability among the formulations evaluated. The incorporation of finger millet enhanced the nutritional quality of the product by contributing dietary fibre, minerals, and other health-promoting components, while maintaining acceptable sensory characteristics. Similarly, the addition of shrimp meat improved the flavour, texture, and protein content of the bakery puff, thereby increasing its nutritional and sensory value. The optimized levels of salt, red chilli powder, and garam masala further enhanced the taste, aroma, and overall palatability of the product. The study highlights the potential of utilizing Kiddi shrimp (*Parapenaeopsis styliifera*), an underutilized marine resource, for the development of innovative value-added seafood products. The conversion of such low-value shrimp into a convenient and consumer-acceptable bakery product can contribute to better resource utilization and product diversification in the seafood processing sector. Furthermore, the developed bakery puff represents a nutritious alternative snack product owing to its high-quality protein from shrimp and the nutritional benefits of finger

millet. The successful standardization of the formulation demonstrates that *Parapenaeopsis styliifera* can be effectively incorporated into bakery-based products to produce a value-added food with enhanced nutritional characteristics and high consumer acceptability. Therefore, the developed shrimp bakery puff has promising potential for commercial production and wider consumer acceptance.

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Doi:10.1080/02626667.2014.896996.

Affiliation Address

AS Sharangdhar

Department of Fish Processing Technology and Microbiology,
College of Fisheries, Shirgaon, Ratnagiri, Maharashtra, India

JM Koli

Department of Fish Processing Technology and Microbiology,
College of Fisheries, Shirgaon, Ratnagiri, Maharashtra, India

AS Desai

Department of Fish Processing Technology and Microbiology,
College of Fisheries, Shirgaon, Ratnagiri, Maharashtra, India

SS Sawant

Department of Fish Processing Technology and Microbiology,
College of Fisheries, Shirgaon, Ratnagiri, Maharashtra, India

MT Sharangdhar

Department of Fisheries Engineering, College of Fisheries, Shirgaon,
Ratnagiri, Maharashtra, India

DI Pathan

Department of Fish Processing Technology and Microbiology,
College of Fisheries, Shirgaon, Ratnagiri, Maharashtra, India

Shalu

Central Institute of Fisheries Education, Versova, Andheri (West),
Mumbai, Maharashtra, India

Panchkarla Sedyaw

Department of Fish Processing Technology and Microbiology,
College of Fisheries, Shirgaon, Ratnagiri, Maharashtra, India

SB Bhor

Department of Fish Processing Technology and Microbiology,
College of Fisheries, Shirgaon, Ratnagiri, Maharashtra, India

RS Apte

Department of Fish Processing Technology and Microbiology,
College of Fisheries, Shirgaon, Ratnagiri, Maharashtra, India

DR Murkute

Department of Fish Processing Technology and Microbiology,
College of Fisheries, Shirgaon, Ratnagiri, Maharashtra, India

Anupam Das

Department of Fish Processing Technology and Microbiology,
College of Fisheries, Shirgaon, Ratnagiri, Maharashtra, India

TM Sawant

Department of Fisheries Resources Economics, Statistics and
Extension Education, College of Fisheries, Ratnagiri, Maharashtra,
India