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Process Protocol for Tilapia Fish Momos and its Quality Evaluation During Chilled Storage

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Abstract

Monosex tilapia is a widely cultured fish species in India on account of its capacity to adapt to varying culture conditions. However in India, the value addition options of this potential species are less explored leading to low market value for this species. This situation has created trading difficulties to the tilapia farmers and they are in search of options for better prize realization for this species. Present study aims to investigate the potential for more effective usage of tilapia through the preparation of value-added products and the assessment of its shelf life in chilled conditions (4ºC). Momos are mince based products that are gaining more acceptance in the recent years. Dips are used as supplementary dishes along with momos which enhances its flavour. Protocols were standardized for the preparation of momos from tilapia and a dehydrated tomato-based dip was also developed. In the present study, the steamed momos had a moisture content of 53.99±1.05%, crude protein content of 31.11±0.20%, fat content of 9.38±0.37% and ash content of 0.91±0.06%. Fried momos indicated a moisture content of 43.36±0.46%, crude protein content of 29.67±1.54%, fat content of 16.09±0.69%, and ash content of 2.03±0.12%. The higher protein content in both the steamed and fried momos suggests its suitability as a healthy snack, especially for individuals who prefer seafood as a protein source. The TVBN values as well as oxidative parameters *viz*., TBARS of the samples gradually increased but were within the acceptability limit during the storage period. Storage study indicated a shelf stability of 10 days for fried momos and 13 days for steamed momos under chilled conditions (4ºC). Present study suggests fish momos to be an ideal product to capture modern market on account of their superior nutritional profile, sensory quality and easiness in preparation.

Keywords: Tilapia, momos, mince, value addition, chill storage

Introduction

Monosex tilapia is one of the species that the aquaculture sector typically chooses as it grows quickly, does well in local conditions and hence its commercial production is expanding globally (Laly et al., 2017). Tilapia production is currently estimated to be around 70,000 metric tons and future projections for India's domestic and export tilapia market, observes the tilapia market size to expand more than 0.766 million metric tons by 2027 and more than 2.155 million metric tons by 2032 (WorldFish, 2022). This fish represents a lower level in the food chain, making its cultivation inexpensive and environmentally friendly. However, despite its advantages, like high growth rate, comparatively easy culture practices, higher survival rate and short culture period, tilapia often faces a low market preference and is considered a low-valued fish. To enhance consumer acceptability and make better use of tilapia, various approaches can be adopted, including the production of value-added products. Value-added products involve transforming the raw tilapia into processed or value-enhanced forms, which can increase its appeal to consumers and potentially command a higher price (Parvathy et al., 2016). Additionally, marketing efforts that promote the nutritional benefits, sustainability, and quality of tilapia can also contribute to increasing consumer acceptability and demand for tilapia-based products.

There are a wide range of value-added and diversified marine products available for both

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export and domestic markets (Datta, 2015). These technologies can be utilized to diversify products from cultured fresh as well. Further the increasing demand of the seafood customers calls for new technologies and approaches which are simple and convenient.

Momos, a traditional dish of villages in the Himalayas, is a flat wheat dough dumpling that is typically served with chutneys, pickles, sauces, meat broth, or soup, adding to their flavor and enhancing the overall dining experience. Momos are mince based products that are well-appreciated by traditional consumers, and they are increasingly being adopted by a wider population due to their composition and the variety of sensory qualities they offer. These dumplings have a superior nutritional profile, being rich in proteins, vitamins, and minerals. Additionally, momos can be prepared using various meats or vegetarian fillings, making them suitable for different dietary preferences.

Considering their nutritional benefits, sensory appeal, and relatively simple preparation method, momos have the potential to be an ideal product to capture the modern market. However, Indian food industry has not yet widely placed such products on store shelves. This could be due to various factors such as regional variations in cuisine preferences, market trends, or limited awareness of the potential market for momos. By highlighting the nutritional benefits, sensory qualities, and convenience of momos, coupled with effective marketing strategies and collaboration with industry stakeholders, the Indian food industry can potentially tap into the market for these delicious and versatile dumplings.

By utilizing tilapia in the preparation of momos, this study sought to enhance the value of this fish species and expand its market potential. The study aimed to develop a standardized protocol for the preparation of fish momos from tilapia. It likely involves determining the appropriate proportion of tilapia meat to other ingredients, such as vegetables, spices, and herbs, to achieve the desired taste and texture and also explored different cooking methods, such as steaming or frying, to optimize the sensory qualities of the fish momos. Furthermore, the study assessed the stability of fish momos under chilled conditions (4ºC). The findings could potentially support the introduction of tilapia-based momos into the market, increasing the value and marketability of tilapia both domestically and internationally.

Materials and Methods

Fresh monosex tilapia samples, having an average size of about 250g, were procured from a fish farm at Kochi, Kerala. Samples were immediately layered with flake ice (1:1 (w/w) and transported to the laboratory in high-density polyethylene boxes with polyurethane foam insulation. The ingredients for the preparation of momos and dips were purchased from the local supermarket. All the chemicals and reagents used for the study were of analytical grade.

Fish was thoroughly washed, cleaned and hot blanched (3% salt for 15 minutes). The other ingredients *viz.,* chopped onion, spring onion, crushed ginger, crushed garlic, coriander leaves, green chillies, garam masala and salt were sauted in butter for five minutes and finally mixed with cooked and shredded fish meat at 35% level. Covering of the momos was made with maida and the filling included cooked fish and sauted vegetables with a ratio of 15:10 (cover: core). Maida balls prepared were pressed to thin circular sheets of 10-12 cm and fillings containing cooked fish and ingredients were stuffed into sheets and folded manually. It was then steamed in a steamer for ten minutes for steamed momos and fried using sunflower oil in pan to attain golden brown colour for fried momos.

Further, they were equally divided into two lots; steamed momos (SM) and fried momos (FM). Samples were seal packed in HDPE trays and were chill stored at 4ºC. Samples in triplicate were drawn randomly from each lot at regular intervals and were subjected to physical, chemical, microbiological and sensory analyses.

In addition, different dips were prepared as supplement to the momos *viz.,* chilly tomato dip, coriander chilly pesto, sweet and sour chilly dip, cream cheese and celery dip, peanut chilly dip and garlic chilly dip.

For the preparation of chilly tomato dip, tomato, dry red chilly, garlic, onion were steamed and grinded along with the tomato sauce, cornflour and sugar to get a smooth paste. For tomato sauce preparation, boiled tomato, garlic, beetroot, chilly powder and sugar were blended, strained and pan cooked to get the required thick consistency.

For coriander chilly pesto, chillies, ginger, garlic, soy sauce and mayonnaise were blended smoothly to which coriander leaves, onion, sweet chilly sauce, fish sauce and water was further added and mixed to get a smooth consistent paste.

Sweet and sour chilly dip preparation involved the addition of water, vinegar, sugar and fish sauce into a pan. Further to these, crushed chilies and garlic was added and cooked. Finally, corn flour was added to get the required consistency.

Cream cheese and celery dip were prepared using ingredients *viz*., celery stick, onion, fresh cream, cheese slice and soy sauce which were blended thoroughly.

For peanut chilly dip, coconut milk, peanut butter, ginger, chili sauce, brown sugar and soy sauce were whisked to get a smooth paste.

Garlic chilly dip was prepared using boiled tomato, boiled red chillies which were blended along with garlic, pepper powder, sugar, salt and vinegar to a smooth paste.

The most preferred dip was further dehydrated to powder so as to explore the possibility of utilizing as a convenient instant dip.

Fish momos was evaluated for its nutritional aspects in terms of proximate composition as per AOAC (2019); moisture content was determined by oven drying method, fat by soxhlet technique, ash by muffle furnace method and protein by Micro kjeldahl method. Total carbohydrate was estimated from the difference in weight of other constituents (protein, fat, water, ash) to the total weight of the sample.

Caloric value of the sample was calculated as per Souci et al. (2000) as:

Total calories ((kCal/100g) = (4 x protein weight % + (9 x fat weight %) + (4 x carbohydrate weight %)

The biochemical parameters *viz*., pH (pH meter - Cyberscan 510, Eutech Instruments, Singapore), Total Volatile Base Nitrogen (TVB-N) (Conway, 1947), Thiobarbituric Acid Reactive Substance (TBARS) (Tarladgis et al., 1960) and Free Fatty Acid (FFA) (AOAC, 2019) were analysed.

Total plate count was enumerated following the methodology prescribed by USFDA (2001) adopting serial dilution of blended sample using pour plate technique. Microbiological counts were performed in triplicate and expressed as cfu g^{-1}.

A group of 10 trained panelists, evaluated various attributes of the samples using a 9-point hedonic scale. The attributes assessed were appearance, odor, flavor, color and texture. The scale used was based on Meilgaard et al. (2006) with a score of 1 indicating extreme dislike and a score of 9 indicating highest acceptability. The limit of acceptability for the attributes was set at 4. To determine the overall acceptability of the product, the scores for all the attributes were summed, and the total was divided by the number of attributes evaluated.

Data obtained in triplicates were analysed by analysis of variance (ANOVA) using the statistical software SPSS 16 (SPSS Inc. Chicago) for interpretation of the results.

Results and Discussion

Value addition is a significant approach in the fish and seafood industry that offers numerous benefits, including market value enhancement, employment opportunities, and foreign exchange earnings through export of value-added products (Ikbal et al., 2021). By implementing value addition techniques, the industry can effectively utilize low-valued fish and meet consumer demands for convenient foods with assured quality and extended shelf life. Ready-to-eat or ready-to-cook products have a higher market value compared to raw fish, making them attractive commodities for international trade.

Evaluating the nutritional content of value-added seafood products is crucial for promoting consumer awareness, assisting dietary needs and preferences, supporting health and wellness goals, enabling comparisons and substitutions, and ensuring compliance with labeling regulations. It empowers consumers to make informed choices about the products they consume and contribute to their overall well-being. In the present study, the steamed momos had a moisture content of 53.99±1.0%, crude protein content of 31.11±0.20%, fat content of 9.38±0.37%, ash content of 0.91±0.06% and carbohydrate of 4.61±1.43%. On the other hand, the fried momos had a moisture content of 43.36±0.4%, crude protein content of 29.67±1.54%, fat content of 16.09±0.69%, ash content of 2.03±0.12% and carbohydrate of 8.85±1.12%. The higher fat content in the fried momos can be attributed to the frying process, as frying in oil adds additional fat to the food compared to steaming. The higher protein content in both the steamed and fried momos suggests that they are suitable as a healthy snack, especially for individuals who prefer seafood as a protein source. Earlier reports by Pathak et al. (2014) indicated a moisture content of 65.70±0.43%, 17.2±0.13% protein, 3.75±0.08% fat and ash of 0.98±0.004% in steamed fish momos from Rohu and this variations in comparison to the present study may be on account of the difference in the product composition and preparational procedures.

Moisture content is economically important for both the food processor and the consumer, as it is inversely related to the amount of dry matter present in the food. During storage, the moisture content of fried momos ranged from about 42% to 44%, while for steamed momos, it ranged from 48% to 54% (Fig. 1a). Fried momos exhibited lower moisture content compared to steamed momos. Additionally, a gradual decrease in moisture content was observed for steamed momos during storage. The presence of a harder wrap/covering in fried momos, resulting from the frying process, likely acted as a barrier and prevented further moisture escape compared to steamed momos. Reports by Vanitha et al. (2015) indicated a decrease in moisture content in fish burgers prepared from Catla ranging from 55.08% to 52.42% during refrigerated storage.

Monitoring the pH values of fish muscle can be a reliable indicator of its quality, as changes in pH can provide insights into the spoilage process and the presence of potentially harmful bacterial activity. In the present study, the initial pH values of the momos samples were 5.79±0.02 for fried momos and 5.83±0.02 for steamed momos. During the storage period under chilled conditions, a gradual increase in pH values was observed for both fried and steamed momos (Fig. 1b). The pH values reached a value of 6.24±0.02 and 6.35±0.02 for fried momos and steamed momos, respectively towards the end of storage period. The findings of the study was similar to that reported by Benjakul et al. (2002), which suggests that an increase in pH values is indicative of product spoilage and the formation of alkaline compounds due to autolysis and bacterial metabolites. However, biochemical parameters shall also be taken into account before arriving at a conclusion.

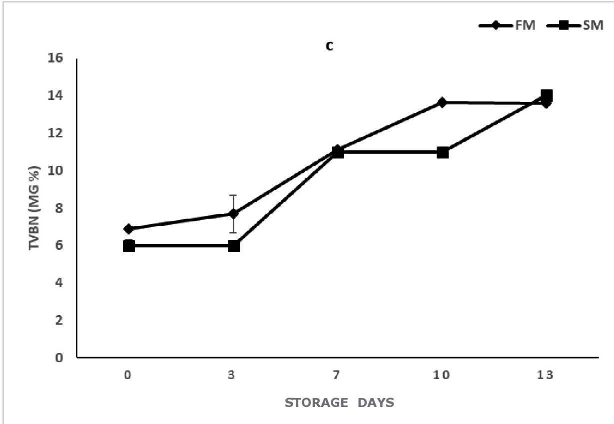
Total Volatile Base Nitrogen (TVB-N) is a measure of the decomposition of proteins in fish muscle, resulting in the production of compounds such as ammonia, trimethylamine, creatine, purine bases, and free amino acids. In the current study, the TVB-N values gradually increased over the storage period for both fried and steamed momos (Fig. 1c). On the initial day of storage, the fried momos had a TVB-N value of 6.89±0.00 mg%, which increased to 13.59±0.00 mg% by 13th day. Similarly, the steamed momos exhibited similar initial values (6.00±0.23) and reached a value of 14.00±0.00 mg% towards the end of the storage period. These findings align with previous research by Chomnawang et al. (2007), which suggests that an increasing TVB-N value is associated with bacterial deterioration and endogenous enzyme activity in the fish samples. The commonly accepted limit of acceptability for fish and fishery products is TVB-N level of 30-35 mg% (Lakshmanan, 2000). The results obtained in the current study fall well below this limit, indicating that the momos samples remained within acceptable quality levels.

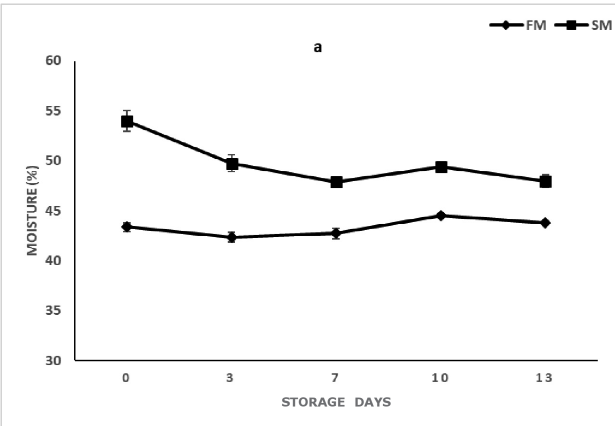
Thiobarbituric Acid Reactive Substance (TBARS), indicative of oxidative rancidity, showed an increase in their values during the storage study for momos under chilled conditions (Fig. 1d). Fried momos had an initial value of 0.446±0.002 mg Malonaldehyde/kg on 0th day, which finally reached a value of 1.009±0.019 mg Malonaldehyde/kg towards the end of the storage period. Steamed momos exhibited a value of 0.289±0.002 mg Malonaldehyde/kg on 0th day, which reached a value of 0.807±0.001 mg Malonaldehyde/kg on 13th day under chilled conditions. The concentration of malonaldehyde is used as a marker for the development of objectionable odor/taste in fish and a level of 2 mg malonaldehyde per kg of fish is considered as the acceptability limit (Connell, 1990; Goulas & Kontominas, 2007). TBARS was within this limit for both the samples throughout the storage period. The reference to Simeonidou et al. (1998) study on ice storage of fish underscores the potential utility of TBARS as a biochemical index for tracking quality changes in fish during storage.

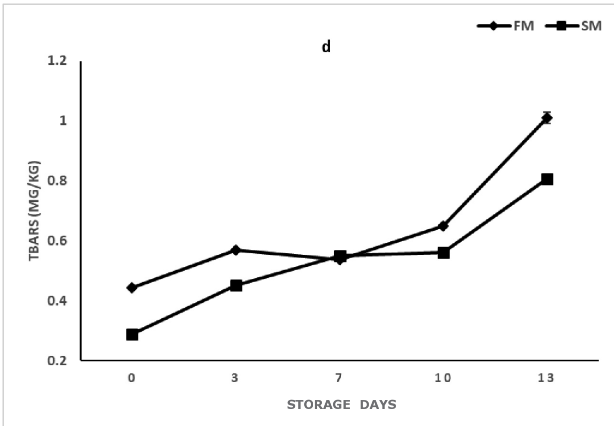
The Free Fatty Acid (FFA) values exhibited an increasing trend during the storage period for both fried and steamed momos (Fig. 1e). For fried momos, the FFA values increased from 0.069±0.002% to 0.554±0.002%, while for steamed momos, the values increased from 0.123±0.002% to 0.647±0.002%. These findings are consistent with the results reported by Jeyakumari et al. (2017) for fish fingers during chilled storage. In their study, the FFA values increased from 0.14% to 0.43% over the storage period. A similar trend was observed by Ucak et al. (2011) during the refrigerated studies of fish burgers from Atlantic mackerel. Vanitha et al. (2015) reported an increase in FFA from 0.22% to 0.94% of oleic acid during the storage period of 17 days for Catla burgers during refrigerated storage. The increase in FFA values is an indication of the hydrolysis of triglycerides (fats) present in the momos samples, resulting in the release of free fatty acids. This hydrolysis process can be attributed to the action of lipolytic enzymes present in the fish tissue or microbial activity. The increase in FFA values beyond a certain threshold may indicate the onset of rancidity and deterioration of the product.

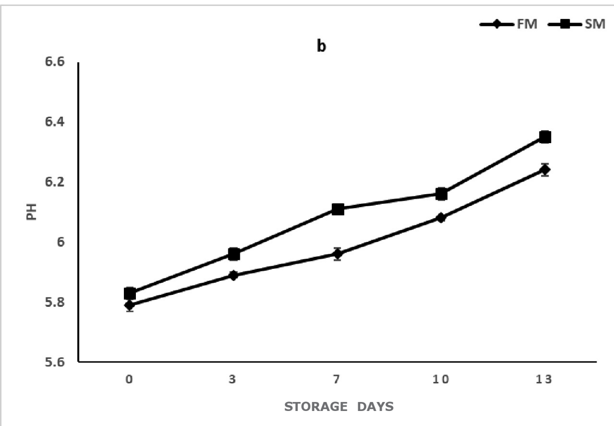
The sensory parameters of the momos samples exhibited a decreasing trend during the chilled storage period. The decreasing trend was particularly notable for taste and odour attributes (Fig. 1f). For fried momos, the sensory scores reached the acceptability limit (3.5±0.5) on the 10th day of storage from an initial score of 8.7±0.5 and for steamed momos, the sensory scores reached the acceptability limit (3.0±0.6) on the 13th day from 8.8±0.4. The decreasing trend in sensory scores suggests a decline in the overall quality and sensory attributes of the momos samples as the storage period progressed. The deterioration in taste and odour could be attributed to several factors such as lipid oxidation, protein degradation, and microbial spoilage (Tavares et al., 2021).

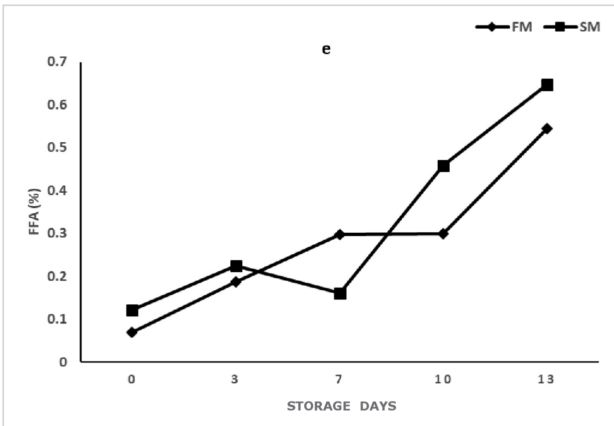
The variations in the total microbial count (TPC) of tilapia mince momos stored under chilled conditions are depicted in Fig. 1g. On the 10th day of storage, the fried momos exhibited a microbial load











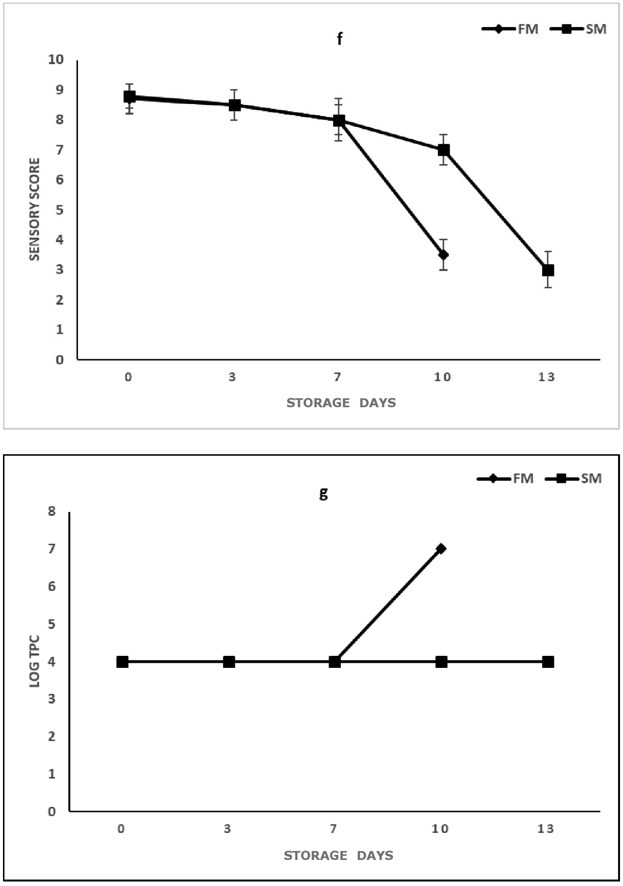


Fig. 1. Variations in parameters: a. Moisture, b. pH, c. TVBN, d. TBARS, e. FFA, f. Sensory scores, g. Log TPC of momos during chilled storage (4°C)

with a TPC of 7 log cfu g^{-1}, whereas the steamed momos had a TPC of 4 log cfu g^{-1}. According to the International Commission on Microbiological Specifications for Foods (ICMSF, 1998), a microbial count of 7 log cfu g^{-1} is considered as the limit beyond which a food product is deemed unsafe for consumption. Therefore, based on the microbial load, the shelf period for fried momos was determined to be 10 days. This finding is consistent with the sensory acceptance results, as on the 10^{th} day, the sensory acceptability of the fried momos declined. On the other hand, although the steamed momos did not exceed the microbiological limit on the 13^{th} day, the sensory acceptance declined. Hence, a shelf life of 13 days was considered as the limit for steamed momos under chilled storage conditions. These findings highlighted that even if the microbial load was within acceptable limits, sensory deterioration may occur on account of other parameters, influencing the shelf life of the product.

In the study, six different kinds of dip were prepared to be combined with the momos: coriander chilly pesto, cream cheese dip, chilly tomato dip, peanut butter dip, sweet and sour dip, and garlic chilly dip. Among these, freshly prepared coriander chilly pesto and chilly tomato dip received higher sensory acceptance according to the hedonic scale rating (Fig. 2). Both coriander chilly pesto (8.65±0.40) and

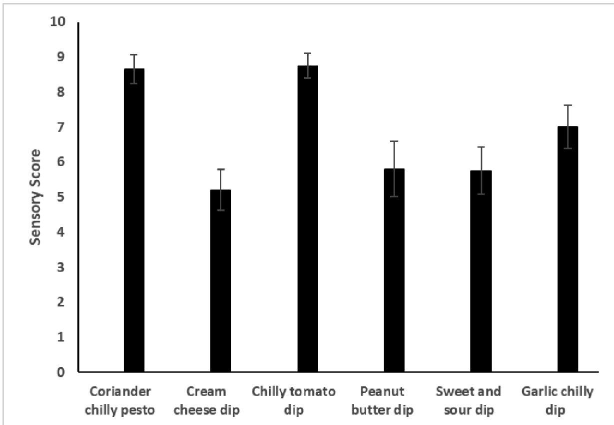


Fig. 2. Sensory scores of different supplementary dips for fish momos

Table 1. Proximate composition of fish momos and dip

	Fried Momos	Steamed Momos	Dehydrated tomato dip
Moisture (%)	43.36±0.46	53.99±1.05	3.59±0.07
Protein (%)	29.67±1.54	31.11±0.20	34.31±0.70
Fat (%)	16.09±0.69	9.38±0.37	5.41±0.13
Ash (%)	2.03±0.12	0.91±0.06	3.35±0.05
Carbohydrate (%)	8.85±1.22	4.61±1.43	53.34±0.76
Energy (kCal/100g)	298.89	227.30	399.29

Values are expressed as Mean ± SD; n = 3 chilly tomato dip (8.75±0.35) had almost similar levels of sensory acceptance, but coriander chilly pesto included mayonnaise as an ingredient and hence from a safety perspective, the chilly tomato dip was selected for further study. For convenience to use, chilly tomato dip was initially dried as a powder in an electrical drier (Kraftwork MARS) and then reconstituted with hot water for the study. The proximate composition analysis of the dehydrated tomato dip indicated 3.59±0.07% moisture content, 5.41±0.13% fat, 3.35±0.05% ash, 34.310.70% protein content and 53.34±0.76% carbohydrate. The low moisture content was a result of the drying process adopted to achieve ambient storage stability for the dip. Furthermore, the reconstituted dip was tested for its microbial stability after 24 hours and 48 hours of storage. The results indicated a microbial load of 5 log cfu g^{-1} in both cases, suggesting that the dip remained safe for consumption even after reconstitution and storage for up to 48 hours under ambient conditions. This microbial stability could be attributed to factors such as the reduced pH contributed by ingredients like tomato in the dip.

Present study suggests the opportunities to enhance the utilization of valuable aquaculture resources *viz*., Monosex Tilapia, which can lead to increased profitability for farmers and cater to the growing demand from consumers. Exploring the various value-added options beyond the traditional whole fish market by diversifying the product range, farmers can tap into different market segments and potentially command higher prices, thus improving their profitability. In addition to increased profitability, the study highlights the potential for generating foreign exchange through the aquaculture sector. By focusing on improving the quality and value of Tilapia products, farmers can enhance their competitiveness in domestic as well as international markets.

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