Fishery Technology 58 (2021) : 214 - 218

Quality changes in Ready-to-eat fish spread prepared from low-cost Croaker fish (*Otolithus Sp.*) and Natural Ingredients

A. U. Pagarkar[1]*, S. B. Satam[1], N. D. Chogale[1], K. M. Shinde[1], V. R. Bhatkar[2], P. E. Shingare[1], S. A. Mohite[2], S. D. Naik[2], S. Y. Metar[1], V. R. Sadaverte[1], B. P. Bhosale[2], N. B. Rathod[3] and P. M. Haldankar[4]

[1] *Marine Biological Research Station, (DBSKKV, Dapoli), Ratnagiri - 415 612, India*

[2] *College of Fisheries, (DBSKKV, Dapoli), Ratnagiri, Shirgaon - 415 639, India*

[3] *PG Institute of Post-Harvest Technology, (DBSKKV, Dapoli), Roha, Raigad - 415 712, India*

[4] *Dr. B.S. Konkan Krushi Vidyapeeth, Dapoli, Ratnagiri, 415713, Maharashtra, India*

Abstract

Food spreads have became a vital part of breakfast menu these days, which has led to their steady growth in the food market. The continuous use of artificial additives gradually results in long-term adverse health effects on consumers. Of late the demand for foods products without any artificial additives or preservatives has increased. Therefore, in the present study, a ready-to-eat fish meat spread was developed from a low-cost Croaker fish along with other natural ingredients and its quality changes during refrigerated storage were studied. The sensory analysis showed that the fish spread made from Croaker fish meat retained its quality upto 21 days when refrigerated, making it a liable alternative to currently available meat spreads.

Keywords: Fish product, fish spread, biochemical changes, shelf life, quality changes

Introduction

Fish and fishery products are regarded as highly nutritious foods and are one of the most valuable sources of good quality protein available to humans. Fat in several fish is rich in n-3 polyunsaturated fatty acids (PUFAs) and also contain several macro and micronutrients, thus impacting health promotion. The catches of croaker was 1.96 lakh tonnes during 2019-20, contributing to 5.2% of the total marine fish production in India (Anon, 2020). During the same period, the production from Maharashtra was 0.05 lakh tonnes accounting for about 0.13 % of the total croaker landings of India. Croaker, locally known as "*Dhoma*" in Maharashtra is generally sold at very low prices, though they are rich in proteins (Bal & Rao, 1984). Efforts are continuously being made to utilize the uneconomic varieties of fishes through appropriate technological processes by converting them into different kinds of value-added products (Pagarkar et al., 2011). With today's busy lifestyle, present market trends reflect a rapidly growing demand for processed foods that are more convenient to handle, store and ready-to-eat (Pagarkar et al., 2011). Spreadable products are a kind of convenience products meant to be spread on or sandwiched on a base like bread. Low-calorie food spreads are gaining more attention owing to the rise in health consciousness among consumers. Children and young adults are the main consumers of food spreads. The continuous use of artificial additives in food gradually leads to long-term adverse health effects on consumers. Therefore, demand for foods products without any artificial additives or preservatives is increasing. The present study was thus carried out to develop a meat spread from Croaker fish and other natural ingredients as a healthier alternative to already existing meat spreads in the market, with an aim to utilize the undervalued fish meat for making value added products.

Received 11 August 2021; Revised 22 September 2021; Accepted 12 October 2021

*E-mail: pagarkarau@gmail.com

Materials and Methods

Croaker (*Otolithus sp*.), locally known as Dhoma, was brought to laboratory in ice (1:1) from Mirkarwada landing center, Ratnagiri in insulated boxes. The dressed, washed and gut opened fishes were cooked for 10-12 min in boiling water and meat was separated. The cooked meat was further packed in polythene bag and stored in deep freezer at $^{-}18^{o}C$ until further use (Pagarkar et al., 2006). Average percentage yield of *Dhoma* from whole to meat (without skin) was calculated. Spices were procured from the local market and dried at 50±1°C for 4 h in a hot air oven. The spices were then finely ground and sieved. All the ingredients including spice mix and fish meat were added in a fixed proportion as shown in Table 1. The fish meat and other ingredients were weighed and mixed. This was then braised at a temperature of 85±2°C. After cooking, the mix was grinded in a grinder for 3-4 min to get a fine paste like consistency (Kumar et al., 2015). Immediately after grinding, the product was packed in food grade PET jar and stored under refrigeration (0-4°C). During storage, the biochemical, microbiological and sensory quality attributes of the fish spread were studied.

Table 1. Standardized formulation for the preparation of fish spread

Sl. No.	Ingredients	Composition (%)
1.	Dhoma fish meat	47.30
2.	Salt	02.23
3.	Spice mix	02.47
4.	Skimmed milk powder	01.86
5.	Condiments	05.95
6.	Corn starch	03.97
7.	Natural colour annatto	10.00
8.	Water	27.17

The trimethylamine (TMA-N) and total volatile base nitrogen (TVB-N) contents of fish spread was determined as per the procedure suggested by Beatty & Gibbons (1937) using Conway micro-diffusion units. Peroxide value (PV), the indicator of lipid rancidity, was measured by titrimetric method (AOAC, 2005). pH of the homogenized sample with distilled water (1:4) was measured using pH meter (AOAC, 2005). Fish spread (10 g) was aseptically homogenized with 90 ml of physiological saline (0.85% NaCl). The obtained homogenized sample was then serially diluted using physiological saline. Total plate count (TPC) was enumerated by spreading 1 ml of homogenate on plate count agar and incubating at 35°C for 48 h (APHA, 1992). For *Escherichia coli*, Tergitol-7 agar was used and incubation was at 35°C for 24 h. *Staphylococcus aureus* and *Salmonella* sp. were estimated using Baird Parker and Bismuth Sulphate agar, respectively followed by incubation at 35°C for 48 h. After incubation, plates showing typical colonies were counted and calculated by multiplying the number of counted colonies with reciprocal of dilution factor and depicted as log cfu g^{-1} (AOAC, 2005). Sensory analysis of fish spread based on appearance, flavour, colour, spreadability, taste, texture, adhesiveability and overall acceptability were evaluated by a trained panel on 9-point hedonic scale from 9 (Like extremely) to 1 (dislike extremely). Fish spread was considered unfit for consumption when average overall acceptability was below 5 (Pagarkar et al., 2006). The results were statistically analysed by applying analysis of variance (ANOVA). The significant differences were tested at 5% level (Snedecor & Cochran, 1967).

Results and Discussion

Whole fresh fish weighing from 35 to 75 g recorded a dressed yield of 54.48% and cooked fish meat yield of 36.74%. Gopakumar, 2002; Pagarkar et al. (2006) reported that yield of deboned meat varied from 35-50% based on the types of fish used. Moisture content in the fish spread showed a slight decrease from 24.43 to 22.04% during the period of storage (Fig. 1). Loss of moisture can be due to dehydration of fish spread during refrigerated storage (Rathod & Pagarkar, 2013). There was an increase in the pH values of fish spread during refrigerated storage as shown in Fig. 2. The pH of live fish muscle is around neutral while post-mortem pH varies from 6.0 to 7.1 as influenced by several factors. The initial pH of fish spread was 6.85, which increased to 7.30 during 21 days of storage. The increase in the pH value may be a result of volatile compounds liberated due to enzymatic degradation and microbial decay (Chaijan et al., 2005; Pawar et al., 2019). Trimethylamineoxide (TMAO) is the compound, which occurs naturally in most of the marine fishes and is responsible for the characteristic fishy odour and flavour. Trimethylamine (TMA) is the bacteriologically degraded product of TMA-O (Huss, 1995). TMA-N is a very useful quality index for assessing freshness and the acceptable limit is 15 to 20 mg 100 g^{-1} in marine fish

(Mahakal et al., 2017). Fish spread stored at refrigerated temperature showed an increase in TMA-N content from 7.00 to 14.00 mg 100 g^{-1} during the storage of period 21 days (Fig. 3). Presence of total volatile base-nitrogen (TVB-N) content less than 35–40 mg100 g^{-1} in fish muscle is normally regarded as fit for consumption. TVB-N value of fish spread increased from 10.50 to 28.00 mg N 100 g^{-1} during 21 days of refrigerated storage (Fig. 4). Microbial catabolic activity and enzymatic action leads to protein disintegration resulting in accumulation of ammonia and other volatile bases during storage, which could be the reason for increase in TVB-N (Tokur et al., 2004; Pawar et al., 2019).

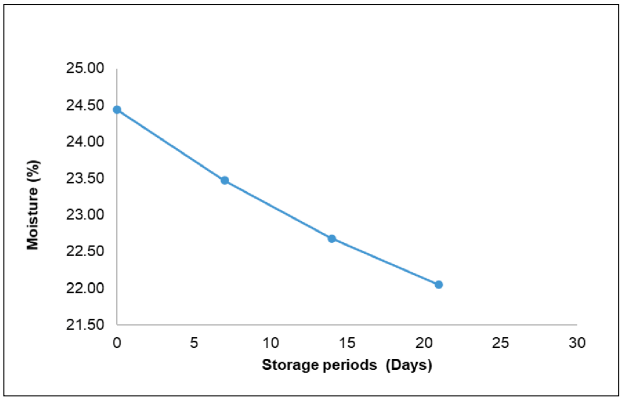

Fig. 1. Moisture content of chilled stored fish spread

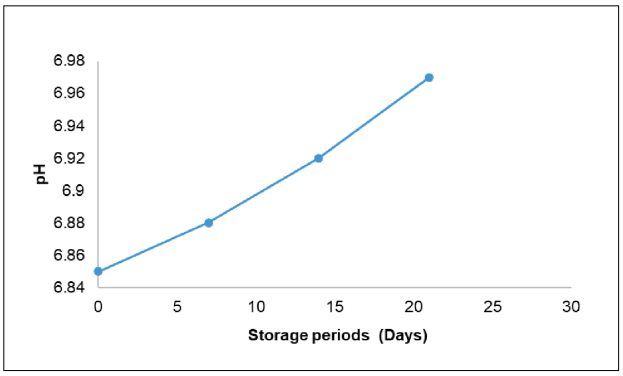

Fig. 2. pH of chilled stored fish spread

Peroxide value is a quality parameter measuring liberation of lipid hydroperoxides as products of primary lipid oxidation (Durmus et al., 2014; O¨zyurt et al., 2011). Products start to taste and smell rancid once the PV value increases over 10 as suggested by Srikar et al. (1993). On the contrary, Lajolina et al. (1983) suggested that PV values up to 30 meq of O_2 kg^{-1} of fat could be acceptable for

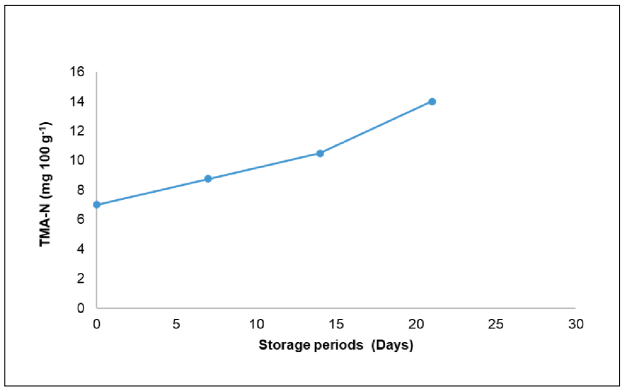

Fig. 3. TMA-N of chilled stored fish spread

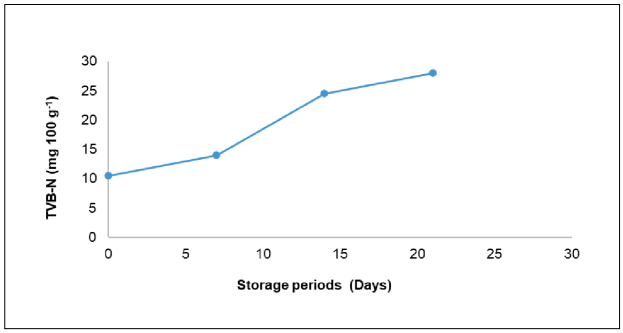

Fig. 4. TVB-N of chilled stored fish spread

fishery products. PV of fish spread increased from 5.0 to 10 meq of O_2 kg^{-1} during 21 days storage as presented in Fig. 5, which were well within the maximum limits. The high initial PV may be due to the reaction of oxygen present in the sample with frying medium leading to oxidation. The lower increase in PV during storage may be due to the antioxidant property of spices used in making fish spread. Al-Bulushi et al. (2005) found an increase in PV from 14 to 23.7 meqO_2 kg^{-1} of fat during storage of fish burgers. PV increased to 12.88 meqO_2 kg^{-1} at the end of 12 weeks in case of frozen fish cutlet (Ninan et al., 2010). The changes in the microbiological quality of fish spread are depicted in Table 3. Total plate count showed a significant increase during storage from an initial value of 3.1×10^2 cfu g^{-1} (2.49 log cfu g^{-1}) to 3.2×10^3 cfu g^{-1} (3.51 log cfu g^{-1}) during 21 days storage period (Table 2). The values were within the permissible limit of 7 log cfu g^{-1} of meat as approved by ICMSF (1978). Similar observations were done for fish cutlet prepared from *Catla catla* (Pawar et al., 2019). *Escherichia coli*, *Staphylococcus aureus* and *Salmonella* were not detected in the fish spread during 21 days of refrigerated storage period. This may be attributed

Table 2. Microbiological quality of refrigerated stored fish spread

Days	TPC (cfu g^{-1})	Spore count (cfu g^{-1})	*Staphylococcus* (cfu g^{-1})	*E. coli* (cfu g^{-1})	*Salmonella sp.* (cfu g^{-1})
00	3.1×102	ND	ND	ND	ND
07	3.6×102	ND	ND	ND	ND
14	4.2×102	ND	ND	ND	ND
21	3.2×103	ND	ND	ND	ND

*ND= Not detected

to the high temperature during preparation, which kills most of the bacteria and spores. Simillarly, Vanitha et al. (2013) reported that mince-based products were free from *E. coli, Staphylococci aureus, Faecal streptococci, Salmonella* and *Vibrio cholera*. Fish spread was evaluated for appearance, colour, taste, texture, odour and overall acceptability during the storage period (Fig. 6). The sensory values showed a decrease during the storage period, which corresponded to the increase in TMA-N, TVB-N, PV and TPC. The results also indicated that the fish spread had a shelf life of 21 days. The shelf life of fish cutlet made from *Wallago attu* was found to be 10 days (Gupta et al., 2015) whereas shelf life for fish cutlet prepared from catla was 12 days (Pawar et al. 2019).

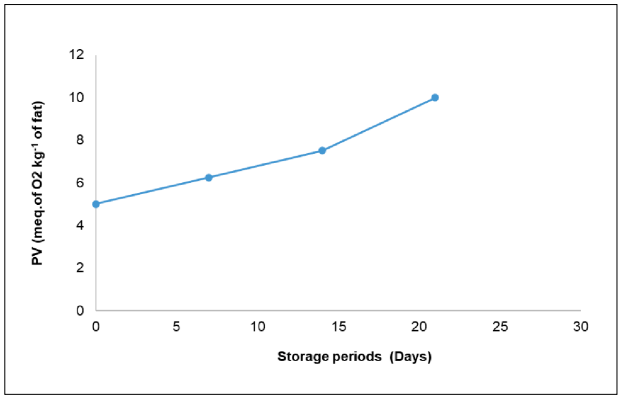

Fig. 5. PV of chilled stored fish spread

The food spread market across the globe has grown considerably owing to the rising demand. Low-cost fishes like croaker can be efficiently utilized for preparing nutritious and healthy fish spreads. Results of storage trial in the present work reveal that biochemical and microbiological quality parameters of the fish spread prepared from croaker fish were within the maximum permissible limit during the storage period. The organoleptic quality analysis revealed that the fish spread was acceptable up to 21 days in refrigerated storage.

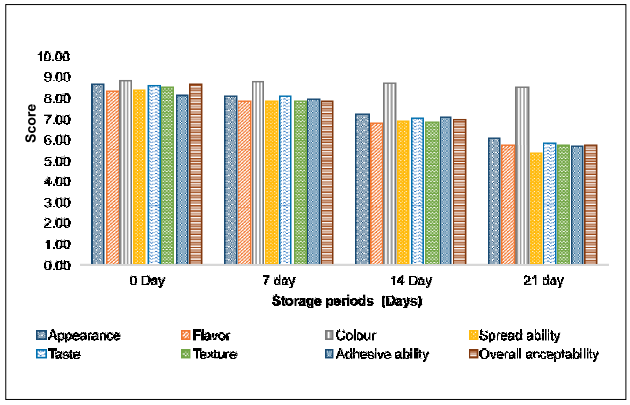

Fig. 6. Organoleptic quality of chilled stored fish spread

Acknowledgments

The authors are thankful to Dr. B.S. Konkan Krushi Vidyapeeth, Maharashtra, authorities for providing necessary facilities to carry out the research work.

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