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Standardising Smoking Treatments for Improved Organoleptic Quality and Storage Stability of Carp Pickle

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Abstract

A study was under taken for developing a pickled product using meat of the carp, rohu (Labeo rohita). The meat of the fish has an intrinsic muddy flavor and presence of small bones because of which it is not popular in states like Kerala. The meat pieces were subjected to marinating for 15 min and smoking on various time and temperatures followed by frying. Pickle was prepared using the pretreated meat following a base recipe and subjected to sensory evaluation. Muddy flavour was found to decrease with increase in smoking period. The most acceptable combination of treatments was found to be marinating fish meat pieces for 15 min followed by smoking for 3 h at 60°C and frying for 30 sec at 180°C in refined vegetable oil. Vinegar- tamarind juice mixture in 1:1 proportion was found to be the most preferred acid source for preparing the pickle. The pickles was prepared using meat pieces subjected to the selected pretreatments and acid mixture, storage studies were conducted for a period of 72 days. The organoleptic scores for odour, texture, taste and overall quality significantly increasing in trend.The total plate count showed no increase in pickle during storage. This was accompanied by significant increases in total volatile base nitrogen content and pH in the latter. pH range was changed from 4 – 4.10 during storage of 72 days. The peroxide value also increased. Pickle was found more suitable as the product could be well preserved and the sourness was found to be less organoleptically.

Keywords: Rohu, pickle, smoking, pH, shelf life, sensory quality.

Introduction

Pickling is an ancient gastronomic craft of preserving food in salt, brine or vinegar. Pickling of fruits, vegetables, meat, fish and shellfish has been in practice for centuries. There are historical evidences to suggest that the ancient Indians, Egyptians and Chinese used pickling for preservation of food. The Romans made a concentrated fish pickle sauce called 'Garum', a powerful stuff with a lot of fish taste[1]. Pickle is a delicacy in many Asian countries. In India pickles made from mango and lime are very popular and are consumed at large by all sections of people. It is one of the simplest and most effective ways to preserve perishable foods for months for out of season use and for long journeys. Fish pickles are also very popular taste wise and a variety of methods are available in India from traditional processes to industrial methods. Today India exports large quantities of fish pickles to Middle East and to other parts of the world to meet the demand. Pickles are stored in sealed glass or plastic bottles. In addition to protecting the food pickling helps to retain its wholesomeness and nutritive value for a long time.

The increasing demand for fish is on account of awareness of the public about nutritional advantages of consumption of fishery products and increasing world population. In developing countries most people rely on fish for animal protein requirements. In India about two-third of the total fish caught or cultured are consumed fresh, and the remaining is preserved by various methods. All over the world food technologists are focusing much attention on the development of products based on consumer acceptance. The per capita consumption of fish varies from country to country. In recent years fish and fishery products have become very popular worldwide, as they are rich in protein, vitamins, minerals and polyunsaturated fatty acids.

Pickles are nowadays used by a number of people as an important side dish of delicacy. Fish pickles are good appetizer and highly nutritious. The technology is simple and can be easily adopted by rural people or fisher folk after a short training. No expensive equipment is required and the overall investment is low.

At present the usual route of marketing is by pursuing an export oriented approach, but a product formulated using an indigenous process like pickle, is already well accepted by the consumers and hence can be easily sold in the domestic markets. Large establishments such as malls, supermarkets, hotels and company canteens can be very effective outlets by establishing centralized production units of these products. Also, it has good export potential, particularly to those countries where a large number of Asian people resides.

Freshwater carps are among the most popular table fish of India. However, their typical muddy flavour and occurrence of fine bones have made them less acceptable in certain regions, particularly Kerala. The growth rate and yield of carps are high. Carps are comparatively much cheaper in Kerala whereas marine or brackish water fish are in greater demand and hence fetch much higher price.

Pickles are generally highly priced on account of the high price of the fish. Freshwater fishes, although low priced, are not commonly used for pickle making. This may be on account of their intrinsic problems such as odd flavour, presence of fine bones or the typical taste and texture the local people are not accustomed to.

However, there are several methods available to improve the texture, consumer acceptability as well as shelf life of fish pickle. These include pretreatments such as salting, partial drying, frying and smoking, and use of suitable food additives. Salting or drying involves removal of part of the moisture content of fish meat, making it tougher in texture. They also alter the flavours from that of fresh fish. Frying in oil can further add on to a more acceptable flavour. Smoke flavour is relished by many people.

Pickles are acidic foods that are significantly sour to taste. This limits their extent of consumption. The commonly used acid for pickle making is vinegar that has to be added in sufficient quantities for effective preservation. However, too much use of acid limits their consumption as the pickles become too sour. It would be desirable to reduce the amount of acid by altering the treatments and by the use of appropriate food additives and organic acids in proper combinations so as to improve upon the consumer acceptability without compromising on the shelf life. Several chemical food preservatives are available in the market and some of them are being used in pickles by the manufactures. However, this practice is not to be recommended as they may affect human health.

Considering the great potential for carp as a suitable raw material for pickle and the problems associated with it, this study was undertaken. The carp, rohu (*Labeo rohita*), was used as the study material as it is commonly available in the market. In this project the effects of preprocess treatments such asMariating, frying, and smoking on the sensory quality and shelf life of fish pickle were studied in order to determine a suitable combination of treatments. Storage studies were conducted to determine the quality variations during storage of the product.

Material and Methods

Procurement of raw material and collection of meat pieces: Fresh rohu (*Labeo rohita*) of size range 400-850 g, was procured from the local fish market at Kochi. The fish was iced in an insulated box and brought to the laboratory. It was washed thoroughly to remove slime and sand, and re-iced. Fish was fully dressed by descaling, beheading and gutting using a sharp knife followed by washing with chilled potable water. The material was then deskinned and filleted. The fillets were further cut into pieces of about 1x1 cm size.

Yield of rohu fish: The non-edible portion of rohu such as head, gut, fin and intramuscular bones were removed and meat was separated. The yield of rohu meat was 42 % based on total weight of fish. The yield of meat after smoking was 35% at 60^{o}C for 3 h. Yield of smoked meat depends on smoking time and temperature.

Base recipe for pickle: A base recipe as per George with slight modification was followed for preparing pickle[2]. Fish meat pieces were marinated using a mixture of salt, chilli powder and garlic-ginger paste in the proportion 100:3:1:1 by weight. They were divided into required number of lots and subjected to different smoking time and temperature treatments as according to the stages of standardization explained below. Other ingredients were then weighed out as per (table-1). The oil was heated in a frying pan to a temperature of 180-190^{o}C and the fish pieces were deep fried for 30 sec. The pieces were taken out, drained of excess oil and kept aside. In the same oil, mustard, garlic, ginger, and green chillies were fried at the same temperature for two minutes. The pan was then removed from flame. The fried fish pieces were added to the contents of the pan and mixed well. The mixture then subjected to cooling for a few minutes followed by addition of vinegar-tamarind and rest of the spices (cardamom, clove and cinnamon). To this salt and sugar were added and mixed. Water was then added taking care to cover the pieces and stirred. The pH was checked using an electronic pH meter. The pickle was then weighed and packed according to the required net weight and transferred to clean dry glass bottles, sealed, labelled and stored.

Table-1
Ingredients of fish pickle

Sl. No.	Ingredients	Weight (g)
1.	Fish meat pieces	1000
2.	Gingili oil	200
3.	Green chilli sliced	50
4.	Garlic peeled	100
5.	Ginger peeled	100
6.	Chilli powder	50
7.	Turmeric powder	2
8.	Pepper powder	2.5
9.	Vinegar	300
10.	Table salt	60
11.	Cane sugar	10
12.	Cardamom powder	0.5
13.	Clove pieces	0.5
14.	Cinnamon pieces	0.5
15.	Water- boiled and cooled	200

Standardisation of smoking treatments: The fish pieces were subjected to marinating then smoking treatments at different time and temperature before preparing pickle. In order to select the most suitable time and temperature combination the study was conducted in various stages. Pickles were prepared by adopting a base recipe as given Sec. 2.3 using smoked fish meat. The pH was adjusted to 4 using 1:1 mixture of vinegar and tamarind juice. Prepared pickles were subjected to sensory evaluation. The most acceptable combination of treatments obtained at one stage was used as the control for the next stage of study. The best combination obtained at this was used as the control for further study, and so on.

Stage I: In stage I meat pieces were marinated with salt, chilli powder and ginger-garlic paste in the proportion 3:1:1 for 15 min and divided into seven lots. They were then subjected to the following treatments. i. Smoking for a period of 1 h at a temperature 70^{o}C, followed by frying for 30 sec at 180^{o}C. ii. Smoking for 2 h at 70^{o}C, followed by frying for 30 sec at 180^{o}C. iii. Smoking for 3 h at 70^{o}C, followed by frying for 30 sec at 180^{o}C. iv. Smoking for 1 h at 60^{o}C, followed by frying for 30 sec at 180^{o}C. v. Smoking for 2 h at 60^{o}C, followed by frying for 30 sec at180^{o}C. vi. Smoking for 3 h at 60^{o}C followed by frying for 30 sec at 180^{o}C. vii. Drying for 2 h at 50^{o}C, followed by frying for 30 sec at 180^{o}C (as a control).

Stage II: i. Smoking for a period of 3 h at a temperature of 60^{o}C, followed by frying for 30 sec at 180^{o}C (selected from stage I as control). ii. Smoking for 5 h at 60^{o}C, followed by frying for 30 sec at 180^{o}C. iii. Smoking for 3 h at 50^{o}C, followed by frying for 30 sec at 180^{o}C. iv. Smoking for 5 h at 50^{o}C followed by frying for 30 sec at 180^{o}C.

Stage III: Two most suitable combinations were selected from stage II. Pickles were prepared adopting the two treatment combinations but varying the source of acid. The commonly used acid source vinegar and tamarind were added in sufficient quantities for effective preservation. The combinations studied were as follows. i. Smoking for a period of 3 h at a temperature of 60^{o}C, followed by frying for 30 sec at 180^{o}C, followed by adding vinegar. ii. Smoking for 3 h at 60^{o}C, followed by frying for 30 sec at 180^{o}C, followed by adding tamarind juice. iii. Smoking for 3 h at 60^{o}C, followed by frying for 30 sec at 180^{o}C, followed by adding 1:1 mixture of vinegar and tamarind juice. iv. Smoking for 5 h at 60^{o}C, followed by frying for 30 sec at 180^{o}C, followed by adding vinegar. v. Smoking for 5 h at 60^{o}C, followed by frying for 30 sec at 180^{o}C, followed by adding tamarind juice. vi. Smoking for 5 h at 60^{o}C, followed by frying for 30 sec at 180^{o}C, followed by adding 1:1 mixture of vinegar and tamarind juice.

Stage VII: The most acceptable combination of acid source was finally selected for making pickle for storage study. Fish pieces subjected to the pretreatments were marinated using salt, chilli powder and ginger-garlic paste in the proportion 3:1:1 for a period of 15 min, followed by smoking for 3 h at a temperature of 60^{o}C, followed by frying for 30 sec at 180^{o}C. The pieces were then pickled using 1:1 vinegar-tamarind juice mixture as a source of acid for storage study.

Storage study: Prepared pickles was packed in clean glass containers and stored at ambient temperature. Storage study was done for a period of 72 days. Sampling was done every 12th day and subjected to various tests.

Proximate composition of raw meat *viz.* moisture content was determined by the oven drying method of AOAC (1984)[3]. Crude protein content was estimated by the micro Kjeldahl method[3]. The Soxhlet method of AOAC (1990) was followed for fat estimation[4]. The method of AOAC (1984) was followed for ash content estimation[3]. Carbohydrate content was indirectly calculated using the formula: % of carbohydrate = 100 - (%moisture + %protein + % fat + % ash).

TVBN content was determined by Conway's microdiffusion method of Beatty and Gibbons[5]. The method of Connell (1975) was followed for peroxide value determination[6]. pH was determined as per the method of Lanier *et al.*[7]. Total plate count and total fungal count were determined according to the method of APHA 1992[8].

Sensory evaluation: The organoleptic quality parameters, *viz.,* odour, taste, texture and overall acceptability, of the product on storage were evaluated periodically by an expert panel of 6-9 judges. A seven point hedonic scale was used for this purpose. Sensory evaluation sheet was provided to the judges for recording their judgments.

Statistical analysis: Data obtained were analyzed using Friedman's Two-way Analysis of Variance by ranks for related samples. The analysis was carried out using SPSS package ver. 20. In cases where treatment showed significant differences pairwise comparison was performed. For total plate count (TPC) and total fungal count (TFC), chemical parameters pH, TVBN, PV variations showed in (table-2).

Results and Discussion

The organoleptic scores of the pickle in relation to storage period are shown in figure-1. Total volatile base nitrogen (TVBN), pH, peroxide value (PV), total plate count and total fungal count shown in table-2.

Proximate composition of rohu meat: The moisture, crude protein, fat, ash and carbohydrate content were 76.10, 17.25, 0.81, 3.75% and 2.09%, respectively. The results for proximate composition of rohu meat was similar with slight variation to that reported by Sagar he observed moisture 78.80%, crude protein 18.43%, fat 0.80 %, ash 1.02 % and carbohydrate 0.95% in rohu meat[9]. Gopal *et al*. reported that on an average meat of Indian major carps contains 70-80% moisture, 15-19% protein, 3-9% fat and 1-1.4% ash[10]. Variation in proximate composition is due to size, sex, type of feed and culture environment.

Table-2
Changes in chemical and bacteriological parameters of fish pickles during storage

Parameters / Storage period (days)	pH	TVBN (mg%)	PV (meq of O2/kg)	TPC (cfu/g)	TFC (cfu/g)
0	4	0	0.3	2.67×10^4	6.55×10^3
12	4.28	14	1.2	2.46×10^4	6.43×10^3
24	4.25	16.8	1.6	2.08×10^4	5.53×10^3
36	4.12	18.2	2	2.12×10^4	5.56×10^3
48	4.13	19.6	2.4	2.04×10^4	4.53×10^3
60	4.12	21	2.8	1.93×10^4	4.50×10^3
72	4.10	22.4	3.2	1.99×10^4	4.36×10^3

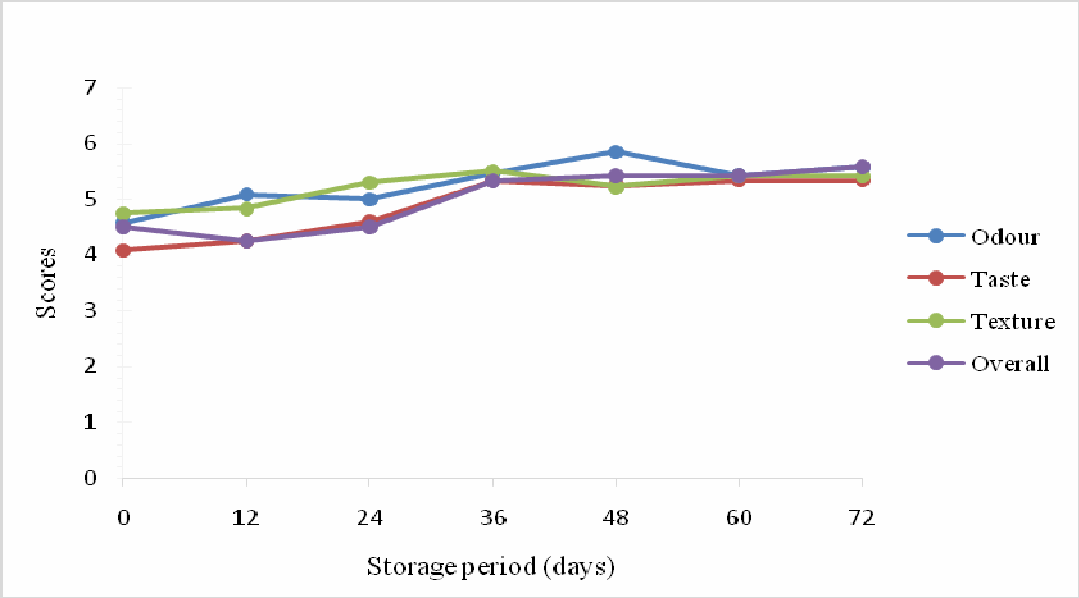

Figure-1
Sensory variations of pickle during storage

Dressed yield of rohu: The non-edible portion of rohu such as head, gut, fin and intramuscular bones were removed and meat was separated. The yield of rohu meat was 42 % based on total weight of fish. Similar result with slight variation in yield of rohu meat 37.50 % was obtained by Sagar(2005)[9].

Selection of recipe for preparation of rohu pickle: Rohu pickle was prepared as per the recipe and method of George (2012)[2].

Standardization of smoking treatments: Pickles were prepared on different smoking time and temperature smoking for 3 h at a temperature of 60°C, followed by frying for 30 sec at 180°C was superior. The pieces were then pickled using 1:1 vinegar-tamarind juice mixture as a source of acid for storage study.

Muraleedharan*et al.* (1982) were also developed various methods of preparing different types of ready-to-serve pickled products from green mussel (*Pernaviridis)* and studied their storage characteristics. Out of three types of products, *viz.,* dried and pickled, fried and pickled and light smoked and pickled, the latter was found to have the longest shelf life[11].

Changes in organoleptic quality characteristics: The result of organoleptic evaluation of rohu pickle stored at ambient temperature showed gradual increase in overall acceptability from 0 to 72 days. Similarly, Abraham *et al.* reported gradual increase in overall acceptability score of prawn pickle up to 60 days of storage. Then the score decreased till the end of the storage study[12]. Kumar and Basu noticed increasing trend of overall acceptability of prawn pickle up to 90 days of shelf life study[13].

Changes in pH: The pH of pickle was initially 4.0 after 12th days of sampling showed increased to pH 4.28. After 12th day of sampling pickle showed decreasing trend 4.28- 4.10 throughout the storage period. Similar result was observed by Chandrashekar*et al.* They reported decrease in pH from 5.1 to 4.9 for pickle from *Nemipterus japonicus*[14]. Gupta and Basu

reported decrease in pH from 4.50 to 4.36 in blood clam (*Anadaragranosa*) pickle[15].

Changes in total volatile base nitrogen (TVBN): The TVBN values pickle showed an increasing trend. The TVBN values ranged from 0-22.4. The TVBN values appear to be well around the acceptable limits set for fish products (30mg/100g)[14]. Gradual increase in TMA-N and TVBN values from 2.38 to 6.72 mg/100g and from 9.80 to 32.20 mg/100g in fish pickle of *Nemipterus japonicus* respectively was reported by Chandreshekar*et al.*[14].

Changes in peroxide value (PV): Peroxide value of pickle was observed increasing trend throughout the storage study from 0.3-3.2 meq. of O_2/Kg. Increase in the peroxide value might be due to the oxidation of fat during storage period. Behanan*et al.* (1992) recorded increasing trend of peroxide value from 2.07 to 10.54 meq. of O_2/Kg in pickled fish[16]. Kumar and Basu (2001) found increase in peroxide value from 1.37 to 10.25 meq. of O_2/Kg in prawn pickle[13].

Microbial changes in rohu pickle: Initially at 0^{th} day sampling TPC count of pickle was 2.67×10^4. The total plate count of pickle showed microbial count decreasing in trend to 1.99×10^4 cfu/g at 72^{th} day of sampling. Vijayan*et al.* observed decreasing trend of total plate count in clam meat pickle from 6.2×10^3 to 3.20×10^2cfu/g throughout the storage study[17]. Dhanapal*et al.* reported decrease in total plate count from 3.1×10^3 to 1.2×10^1cfu/g in chank meat pickle[18]. Total fungal count of pickle initially at 0^{th} day was 6.55×10^3, pickle showed decreasing in trend till the 72^{th} day found 4.36×10^3. Acidic condition is suitable to grow fungus. The longer shelf life may be due to the presence of higher amount of oil on the top layer of the pickle or due to proper sealing of the cap[19]. It was observed that the meat pickles containing low percentage of oil at the top layer showed mold growth. Muraleedharan*et al*. have reported that stray patches of fungus were observed on the top layer of the mussel pickled in vinegar after 6 months of storage[11].

Conclusion

It is evident from the present study that the pickle products of good quality can be prepared by using fresh water fish (*Labeo rohita)* rohu by smoked and preserved by using edible organic acid like acetic acid and tamarind juice (1:1) ratio and preserved in acceptable condition for a reasonable period at ambient temperature. The packaging of pickles in glass bottles has long shelf life because of its inertness and impermeability to moisture and gases. In the present study, the rohu meat pickles were packed in glass bottles and their shelf life extends up to 72 days of storage. The longer shelf life may due to the presence of acetic acid and tamarind mixture as preservative and higher amount of oil on the top layer of the pickle or due to proper sealing of the cap. Also, higher amount of spices and ingredients were added for the pickle preparation in the present study, and it may be the reason for the longer shelf-life period. This study has proved that the pickling is one of the best methods for effective ways to preserve perishable foods for months for out of season use and for long journeys.

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