Intl. J. Food. Ferment. Technol. 6(2): 233-239, December, 2016

DOI: 10.5958/2277-9396.2016.00046.5

RESEARCH PAPER

Study of Physicochemical and Microbial Quality of Spiced Fish Sauce made from *Catla Catla* Fish During Storage

A.C. Dagadkhair[1*], K.N. Pakhare[2], R.R. Andhale[1] and H.M. Syed[3]

[1]MIT CFT, MIT Art Design and Technology University, Pune, Maharashtra, India
[2]Department of Technology, Food Technology Division, Shivaji University, Kolhapur, Maharashtra, India
[3]Department of Food Chemistry and Nutrition, College of Food Technology, Vasantrao Naik Marathwada Krishi Vidyapith, Parbhani, Maharashtra, India

*Corresponding author: amoldagadkhair007@gmail.com

Paper No.: 132 Received: 13 July 2016 Accepted: 9 Dec. 2016

ABSTRACT

The present investigation was undertaken with the objective of funding out the physicochemical and microbial quality of spiced fish sauce made from the fresh water *Catla catla* fish for a period of 60 days storage. The spiced fish sauce was prepared by anaerobic fermentation for about 2 months and evaluated different physico-chemical for characteristics such as moisture, fat, protein carbohydrate, salt, total ash, pH and TSS were examined at an interval of 15 days. The microbial study of fish sauce during study showed that the TPC (Total Plate Count) and yeast and mold count were gradually decreased from that the fresh of 5.4×10^4 cfu/ml 4.3×10^3 cfu/ml and from fresh (3.1×10^3 cfu/ml) (2.0×10^2 cfu/ml), respectively during 60 days. The lactic acid bacteria count was progressively increased during storage (fresh day (2.9×10^3 cfu/ml) (4.1×10^3 cfu/ml)) during 60 days. Further, objectionable colony of *Coliform* and *Salmonella* was detected during the whole storage. The microbial counts were within the specified standards for the consumption of the fishy food products. However, the organoleptic evaluation of the fish sauce during storage showed that the highest score for overall acceptability was recorded for 60 days (8.6) and followed by 45 days (8.5) and 30 days (8.3). It can be concluded that the prepared fish sauce can be stored for 60 days with good physiochemical and sensory quality storage quality and acceptability.

Keywords: Fish, spice, fish sauce, microbial, TPC and LAB's

Fish and fishery products represent a valuable source of nutrients of fundamental importance for diversified and healthy diets. Fish provides not only high-value protein, but also a wide range of essential micronutrients, including various vitamins (D, A and B), minerals and polyunsaturated omega-3 fatty acids (docosahexaenoic acid and eicosapentaenoic acid) (FAO, 2012).

In Southeast Asia, fish sauce is made from various types of fish, from both freshwater and marine fish species by various methods. Each has its unique taste and characteristic (Ismail, 1977; Putro, 1993). Fermentation is one of the oldest techniques in food preservation as it not only extends the shelf-life but also enhances the flavour and nutritional quality of the product (Visessanguan *et al.,* 2005). Fish sauce is a translucent amber liquid with a unique aroma and flavour and is rich in amino acids". It is basically a protein hydrolysate that results from a natural fermentation of fish and salt (Saisithi, 1994). Degradation of fish protein to free amino acids is primarily responsible for the delicious taste of fish sauce. It is a rich source of essential amino acids especially lysine and vitamin B_{12} (Chayovan *et al.,* 1983).

Spices and herbs have been used for thousands of

centuries by many cultures to enhance the flavor, aroma and antimicrobial functions in foods (Omer, 2006; Reichling *et al.,* 2009). Wheat contains about 26–28% starch. Gelatinization of starch is responsible for the thickening or viscosity of foods (Vickie, 2008). Present study was undertaken with the objectives study of physico-chemical and microbial quality of spiced fish sauce made from *Catla catla* fish during storage.

Flow sheet for Preparation of plain Fish sauce

Fresh Fish
↓
Sensory evaluation
↓
Dressing
↓
Cut it into required size pieces
↓
Washed
↓
Mixed with salt
(3:1 proportion fish: salt)
↓
Kept in a glass jar and light the lid was tight
(To maintain anaerobic condition)
↓
Kept for Fermentation
(for 2 month)
↓
Shape the jar occasionally during fermentation
Amber colored of liquid was drained off
↓
Transfered to well sterile bottle
↓
Plain fish sauce
↓
Spices
↓
Roasting
↓
Grinding
↓
Mix into plain fish sauce
↓
Pasteurization
↓
Pouring into required size bottle
↓
Capping
↓
Cooling and storage

Fig. 1: Flow chart for preparation of plain and spiced fish sauce

MATERIALS AND METHODS

Raw materials

The raw materials such as fresh fish, salt, wheat flour, spices and other material were procured from the local market.

Preparation of plain and spiced fish sauce

Spiced fish sauce was prepared as per the methodology given by (Al-Jedah *et al.*, 2000). The flow chart and recipe used for the preparation of the spiced fish sauce is presented in the fig. 1 and table 1, respectively.

Table 1: Recipe for the preparation of the spiced fish sauce

Name of ingredient	Quantity
Plain (Concentrated) fish sauce (kg)	1
Wheat	1.5
Coriander	1
Mustard	1
Cumin seeds	500
Fennel seeds	750
Black pepper	100
Water (lit)	8

Physicochemical analysis of spiced fish sauce

Chemical constituents like moisture, fat, protein, carbohydrate, total ash, salt, TSS, TS Total organic content and pH were determined as per the methodology given by AOAC, (2005).

Microbial Quality of fish Sauce

Microbial quality parameter such as Total plate count (TPC), Yeast and Moulds (YM), LAB's, *Coliforms* and *Salmonella* count, were examined as per the methods given by APHA, (1992). The effects of storage on microbial quality of spiced fish sauce was studied for 60 days at specific interval of 15 days.

Sensory evaluation

The sensory evaluation of prepared fish sauce was carried out as per the method given by the Sung and Stone (2004).

Table 2: Effect of storage (ambient temperature) on chemical composition of spiced fish sauce

Characteristics	Storage (Days)					SE±	CD at 5 %
	Fresh	15	30	45	60		
Moisture(g/100g)	65.81	65.85	65.89	65.95	66.20	0.0191	0.0590
Fat(g/100g)	06.20	06.16	06.15	06.12	06.08	0.0103	0.0318
Protein(g/100g)	05.72	05.79	05.84	05.97	06.25	0.0129	0.0397
Carbohydrates (g/100g)	16.15	15.87	15.70	15.57	15.10	0.0214	0.0662
Salt(g/100g)	03.20	03.20	03.19	03.18	03.18	0.0115	0.0355
Total Ash(g/100g)	02.90	02.90	02.89	02.88	02.88	0.0096	0.0297
pH	5.62	5.45	5.32	5.10	4.87	0.0187	0.0579
Total soluble solids	21	22	22	23	23	1.0645	3.2805

*Each value represents the average of three determinations

Statistical analysis

The data obtained from various parameters were recorded and statistically analysed as per method of Panse and Sukhatme (1987).

RESULTS AND DISCUSSION

The results pertaining to the present study effect of storage on physicochemical and microbial properties of spiced fish sauce were studied and presented under suitable headings and sub headings.

Effect of storage (ambient temperature) on physicochemical

The effect of storage (ambient temperature) on physicochemical quality of spiced sauce were studied and results obtained are depicted in table 2 for 60 days storage at an interval of 15 days.

It is clear from the result in that the moisture content of spiced sauce was found to be increased linearly from fresh 65.81g/100g to to that 60 days was 66.20g/100g. Whereas, the fat content was slightly decreased during storage period fresh (6.20g/100g) to 60 days (6.08g/100g). The increase in moisture content and decrease in fat content of spiced sauce may be due to degradation and hydrolysis of nutrients by fermentation of lactic acid bacteria. The results obtained are in accordance with the Magdi, (2010) for moisture and fat content of spiced fish sauce. The protein content of the spiced fish sauce increased during the storage, the increase in protein concentration of spiced fish sauce may be due to increase in bulk of microbes in the sauce.

Further, it was noted from the table 2 that carbohydrates content decreased from fresh 16.15g/100g, 15 days 15.87g/100g, 30 days 15.70g/100g, 45 days 15.57g/100g to 60 days 15.10g/100g. Ultimate results showed that the carbohydrate content decreased during storage and it could be due to utilization of carbohydrate by microbes in the sauce. Negligible changes were however observed for the salt and ash content during the period of 60 days storage. The pH of any food product has direct impact on the storage of spiced fish sauce. The pH of spiced sauce however gradually decreased during storage. The pH of sauce during in noted from fresh 5.62 in 15 days 5.45, 30 days 5.32 in 45 days 5.10 and 60 days 4.87. However, slight decrease in the total soluble solids took place during the storage. Results obtained are comparable with the results reported by Nicole *et al.* (2011).

Effect of storage (ambient temperature) on viscosity of spiced fish sauce

The viscosity of the spiced fish sauce was measured during the 60 days storage at an interval of 15 days by using the Brookfield viscometer and results recorded are summarized in the table 3 and Fig. 1.

Table 3: Effect of storage (ambient temperature) on viscosity of spiced fish sauce

Days	Viscosity in Centipoise (cP)
Fresh	282.0
15	278.2
30	275.3
45	268.6
60	260.4

*Each value represents the average of three determinations

From the table 3, Fig 1 it could be revealed that the viscosity gradually decreased from the fresh value 282.0 cP to that of 15 days 278.2 cP to 30 days 275.3 cP to 45 days 268.6 cP to 60 days 260.4 cP. Decrease in the viscosity during storage might be due to fermentation activity and hydrolysis of food components. Similar results and concerning viscosity changes during storage were expressed by Beal *et al.* (1999) and Fengxia *et al.* (2014).

Microbial quality of spiced fish sauce

In fish sauce production, microorganisms were associated with the fermentation process, the different microbial quality parameters such as TPC, Yeast and Mold, LAB's, coliform and Salmonella were examined during the storage of 60 days at an interval of 15 days. The results recorded are tabulated in the table 3.

The results (table 4) show that the TPC of fish sauce drastically decreased during storage, It was found that the TPC and Yeast and mold count decreased from fresh fish sauce (5.4×10^4cfu/ml) to 60 days (4.3×10^3cfu/ml) and fresh (3.1×10^3 cfu/ml) to 60 days (2.0×10^2cfu/ml) respectively. The constituents in spices such as sulphur compounds, terpenes and terpene derivatives, phenols, esters, aldehydes, alcohols and glycosides have shown antimicrobial functions and may results in decrease in the TPC. The results of TPC are comparable with the results narrated by Berna *et al.* (2005) and Syed *et al.* (2010).

Further, it could be revealed that the LAB count was progressively increased during storage right from the fresh (2.9×10^3 cfu/ml) to 15 days (3.1×10^3cfu/ml), 30 days (3.4×10^3 cfu/ml), 45 days (3.6×10^3cfu/ml) and 60 days (4.1×10^3cfu/ml). Addition of spices could act as stimulants for the growth of Lactic acid bacteria (Al Jedah *et al.*, 2000) Results of the LAB are in accordance with the findings of Rollan *et al.*, (2010). However, during the whole study right from the preparation of plain fish sauce to the final microbial

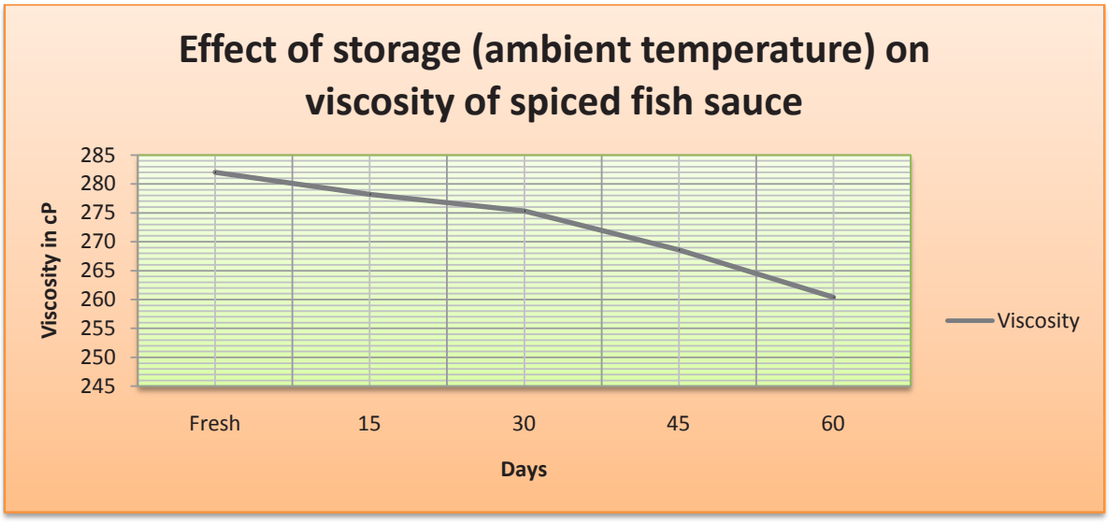

Fig. 1. Effect of storage (ambient temperature) on viscosity of spiced fish sauce

Table 3: Effect of Storage (Ambient temperature) on microbial quality of Spiced fish Sauce

Microbial Quality	Colony count (cfu/ml)				
	Days				
	Fresh	15	30	45	60
TPC	5.4×10^4	4.7×10^4	1.4×10^4	5.7×10^3	4.3×10^3
Yeast and mold	3.1×10^3	1.3×10^3	4.5×10^2	3.4×10^2	2.0×10^2
Lactic Acid Bacteria (LAB)	2.9×10^3	3.1×10^3	3.4×10^3	3.6×10^3	4.1×10^3
Coliform	Absent	Absent	Absent	Absent	Absent
Salmonella	Absent	Absent	Absent	Absent	Absent

*Each value represents the average of three determinations

examination of spiced sauce showed absence of any Coliform and Salmonella count in the sample.

Sensory Evaluation of the of Spiced fish Sauce during the storage

The different organoleptic parameters such as color, taste, flavor and overall acceptability were evaluated from the 10 semi-trained panelist and the sensory score obtained are presented in the table 5 and Fig. 2.

Table 4: Sensory evaluation of the of Spiced fish Sauce during the storage

Days	Sensory attributes			
	Colour	Taste	Flavour	Overall acceptability
Fresh	8.5	7.5	7.5	8.0
15	8.4	8.3	7.5	8.2
30	8.3	8.3	8.0	8.3
45	7.7	8.5	8.3	8.5
60	7.5	8.5	8.5	8.6
Mean	8.10	8.22	7.96	8.32
SE±	0.1064	0.0869	0.1011	0.0966
CD at 5 %	0.3280	0.2678	0.3115	0.2977

*Each value represents the average of ten determinations

It is clear from the table 4 that colour of spiced fish sauce was drastically affected during storage. The sensory score for colour of fish sauce was found to be linearly decreased from the fresh to (8.5) to 60 days (7.5) with a mean value of 8.10. The decrease in the color sensory score during storage may be due to changes in the chemical composition of sauce by action of LAB. The taste of product was progressively increased during storage, the best taste was observed on 45 days (8.5) and 60 days (8.5) storage and which was at par with 15 days (8.3) and 30 days (8.3) followed by fresh day (7.5).

Further, it could be noted that the flavour character was successively increased during storage of sauce, the highest score for the flavour was noted on 60 days (8.5) followed by 45 days (8.3). It was seen from the results that variation do exists in overall acceptability score. The overall acceptability was found to be highest on 60 days storage (8.6). The overall acceptability of spiced sauce on storage of 45 days (8.5) and 30 days (8.3) was also good as compared to 15 days (8.2) and fresh (8.0). The overall acceptability of sauce was attributed to the different characters of colour, taste and flavour of the product. It was revealed from the scores of the overall acceptability that the overall acceptability of sauce was gradually increased on storage. This effect on sensorial quality of spiced fish may be due to changes in the chemical composition of sauce and increase in the acidity results into increasing the palatability of the product.

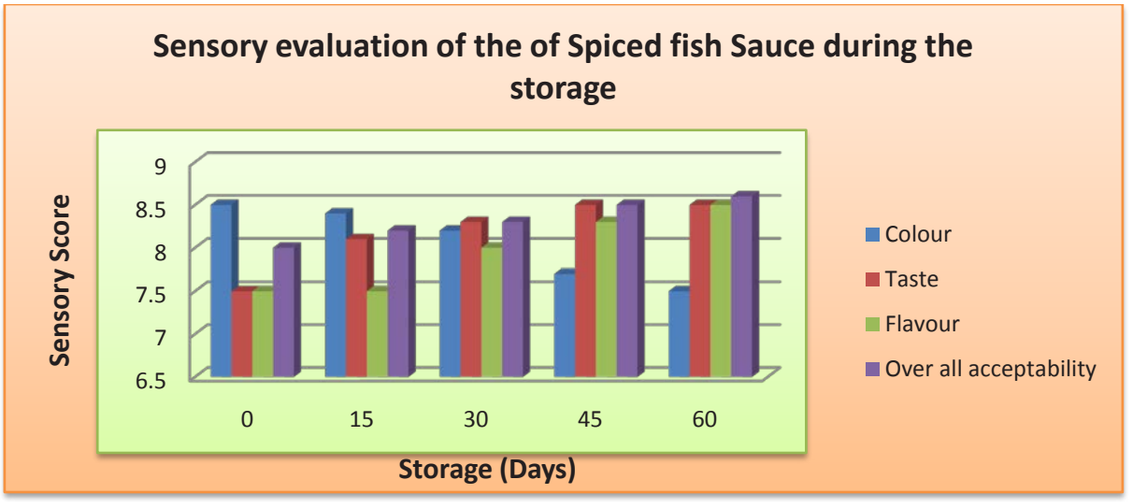

Fig. 2: Sensory evaluation of the of Spiced fish Sauce during the storage

CONCLUSION

Form the present investigation, it could be concluded that the *Catla* fish sauce can be stored for 60 days at room temperature. During the storage physicochemical and microbial changes were observed. The microbial count during the storage was found to be within the given limit and hence prepared sauce was fit for consumption and commercial exploitation.

REFERENCES

A.O.A.C. 2005. Official Methods of Analysis of the AOAC International, 18th ed. Association of Official Analytical Chemists, Gaithersburg, MD, pp -320-380.

Al-Jedah, J.H., Alib, M.Z. and Robinson, R.K. 2000. The inhibitory action of spices against pathogens that might be capable of growth in a fish sauce (mehiawah) from the Middle East. *International Journal of Food Microbiology.* **57:** 129–133.

APHA. Compendium of methods for the microbiological examination of foods 1992. American Public Health Association (APHA), Vanderzant C and Splittstoesser DF, (eds), Washingthon DC, pp. 233-310.

Beal, J., Skokanova, E., Latrille, N., Martin, G. and Corrieu, P. 1999. Combined Effects of culture conditions and storage time on acidification and viscosity of stirred yogurt. *Journal of Dairy Science,* **42**: 673:681.

Berna, K., Sukran, C., Sebnem, T. and Tolga, D. 2005. Chemical, microbiological and sensory changes associated with fishsauce processing. *Springer-Verlag,* pp. 155-160.

Chayovan, S., Rao R.M., Liuzzo, J.A. and Khan, M.A. 1983. Chemical characterization and sensory evaluation of a dietary sodium-potassium fish sauce. *Journal of Agriculture Food Chemistry,* **31**: 859–63.

FAO. *State of World Fisheries and Aquaculture* 2012. Food and Agricultural Organization of the United Nations, Rome, pp. 184-190.

Fengxia, L., Tara, G., Biniam, K., Ann Van, L., Xiaojun, L. and Marc, H. 2014. Comparing the effects of high hydrostatic pressure and thermal processing on blanched and unblanched mango (*Mangifera indica l.*) nectar using headspace fingerprinting as an untargeted approach. *Food Bioprocess Technology,* DOI: 10.1007/s11947-014-1280-3.

Ismail, M.S. 1977. Accelerated fermentation of fish soy paste and fish soy-sauce by using *Aspergillus oryzae* NRRL 1989. *Symposium on Indigenous Fermented Foods*, Bangkok, Thailand, **62**: 115—118 .

Magdi A. Osman. 2010. Effect of traditional fermentation process on the nutrient and antinutrient contents of pearl millet during preparation of Lohoh. *Journal of the Saudi Society of Agricultural Sciences,* pp. 112-116.

Nicole, M., Yufei, H., Xiangzhen, K. and Caimeng, Z. 2012. Effects of Fermentation on Nutritional and Functional Properties of Soybean, Maize, and Germinated Sorghum Composite Flour. *Journal of Food Science*, DOI:10.1111 j.1750-3841.2010.01920.

Omer, Erturk. 2006. Antibacterial and antifungal activity of ethanolic extracts from eleven spice plants. *Section Cellular and Molecular Biology* DOI: 10.2478/s11756-006-0050-8, Biologia, Bratislava, 61/3: 275—278.

Panse, V.G. and Sukhatme, P.V. 1987. Statistical methods for agricultural workers *ICAR Pub*. Edn. New Delhi.

Putro, S. 1993. Fish Fermentation Technology in Indonesia. In fish fermentation technology. Lee, C H, Steinkraus, K H and Alan Reilly, P J (Eds). United Nations University Press, Tokyo, Japan, pp. 107-128.

Reichling, J., Schnitzler, P., Suschke, U. and Saller, R. 2009. Essential oils of aromatic plants with antibacterial, antifungal, antiviral, and cytotoxic properties - an overview. *Forsch. Komplement. Med.*, **16**(2): 79-90.

Rollan, G., Gerez, C.L., Dallagno, A.M., Torino, M.I. and Font, G. 2010. Update in bread fermentation by lactic acid bacteria. *A Mendez Vilas*, (ed), **45**: 122-125.

Saisithi, P. 1994. Traditional fermented fish: Fish sauce production. In: A.M. Martin, editor. Fisheries processing biotechnological application. London: Chapman & Hall, pp. 111–31.

Sung, W.C. and Stone, M. 2004. Characterization of legume starches and their noodle quality. *J. of Marine Sci and Tech.*, **12**: 25-32.

Syed, M.A., Thangaraj, S., Mohamed, S.S., Feroz, K.K. and Esath, S.N. 2010. Antimicrobial and Biochemical Analysis of Some Spices Extract against Food Spoilage Pathogens. *Internet Journal of Food Safety*, **12**: 71-75.

Vickie, A. Vaclavik 2008. Essentials of Food Science Third Edition. The University of Texas Southwestern Medical Center at Dallas, Texas, pp. 230-232.

Visessanguan, W., Benjakul, S., Riebroy, S. and Thepkasikul, P. 2004. Changes in composition and functional properties of proteins and their contributions to Nham characteristics. *Food Chemistry*, **66**: 579–588.