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Effect of different packages on storage characteristics of Pangasius fish soup powder

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Abstract

The aim of this study was to find out suitable packaging material for the fish soup powder prepared from Pangasius fish. For this purpose the storage study of fish soup powder in four different packages namely metalized film, trend pouch, HDPE and LDPE pouch was conducted. It revealed that the metalized film pouch was the best packaging material for storing the fish soup powder, since the biochemical, microbiological and organoleptic changes were least in the soup powder stored in the metalized film pouches.

Keywords: Fish soup powder, packaging, Pangasius fish, organoleptic evaluation, value added fish products, storage studies

Introduction

The utilization of Pangasius fish (*Pangasianodon hypophthalmus*) for the development of different processed has gained importance because of having small bone, absence of fishy odour, delicate flavour and firm texture after cooking , which allow a wide range of culinary preparation (Orban *et al*.,2006).

Soup is a delicacy enjoyed by people of all classes in East and the West. Fish soup powder and soup tablets have become an accepted instant food item (Gopakumar, 1973). Fish soup powder has become a commercial success and there are several agencies in India currently manufacturing and marketing it (Gopakumar, 1973). Miscellaneous underutilized fish is an ideal raw material for the preparation of fish soup powder.

Gopakumar *et al*. (1974) prepared fish soup powder and soup powder tablets from pink perch, croaker, eel etc. Shenoy *et al.* (1987) published a feasibility report on the production of fish soup powder. Warang *et al.* (2005) prepared fish soup powder from croaker fish. Wartha (2012) prepared fish soup powder from Tilapia fish. Yadav (2008) utilized brown seaweed (*Sargassum tenerrimum)* for the preparation of edible soup. Gopal *et al.* (1988) worked on development of flexible packaging for fish soup powder. Gopakumar (1996) also worked out the suitable packaging material for fish soup powder and other fishery products.

In the present work, an attempt was made to prepare fish soup powder from Pangasius fish and studying storage characteristics of this fish soup powder in four different

packages namely metalized film, trend pouch, HDPE and LDPE pouch to find out the most suitable packaging material for the product.

Materials and methods

Standardized method for preparation of fish soup powder:

The different ingredients used in the fish soup powder were standardized after preparing the soup powder several times and organoleptic evaluation at each stage. The quantity of ingredients used in the fish soup powder is given in Table 1. For preparation of fish soup powder 1000 g of cooked fish meat was mixed and homogenized with other ingredients namely fried onion, garlic pieces, ginger, carrot, tomato powder, pepper powder, cinnamon powder, coriander, salt, additives such as mono sodium glutamate and ascorbic acid as a preservative. This homogenized paste was then made into slurry form and dried in hot air oven at 55^{o}C to 60^{o}C for 6 to 7 hours. The dried material was then powdered, sieved and packed in packaging material.

Storage studies:

The storage study of fish soup powder was undertaken. The fish soup powder was packed in metalized films, trend pouches, HDPE pouches and LDPE pouches; sealed and kept at room temperature for shelf life studies. The studies included organoleptic, biochemical and microbiological evaluation of fish soup powder at 15 days of intervals for 90 days.

Moisture was estimated by the method of AOAC (2005), Fat by soxhlet extraction, crude protein by kjeldhal's method and the ash was determined as per AOAC (2005). The Carbohydrate was estimated by Anthrone method. pH of homogenate recorded by using the pH meter (Sentex, USA) (AOAC, 2005). The TVB-N values were estimated by convey micro diffusion method (Beatty and Gibbons, 1936) and expressed as mg % N/100 g fish meat. Peroxide value of fish soup powder was estimated by titrimetric method of AOAC (2005). The TPC was estimated using Plate count agar media and pour plate technique. Mycological agar was used for determination of mould count. For Staphylococcus counts**,** egg-yolk free Baired-parker agar plates medium (Lachica, 1984) and incubated at 37°C for 48 hours. For Salmonella counts the method of APHA (1976) was adopted. *E. coli* was estimated as per Collins and Lyne (1984) using Tergitol-7 agar plate medium. For organoleptic evaluation**,** various sensory characteristics such as appearance, colour, taste, consistency, odour and overall acceptability were evaluated during the standardization by a group of ten trained panelists using a ten point hedonic scale.

Table 1: Standardized ingredients for the preparation of fish soup powder.

Sr. No.	Ingredients	Quantity (g.)
1	Fish meat	1000
2	Corn flour	250
3	Black Pepper powder	25
4	Tomato powder	120
5	Milk powder	80
6	Salt	67
7	Sugar	16
8	Chopped onion	399
9	Garlic	8
10	Ginger	19
11	Coriander	13
12	Carrot	53
13	Butter	133
14	Ascorbic acid	1

Results and discussion

Changes in biochemical characteristics of fish soup powder:

Changes in moisture content of fish soup powder:

In the present study, moisture content of fish soup powder was found to increase along with the storage period of three months. The values ranged from 10.77% to 11.05%, 10.77% to 11.35%, 10.77% to 11.58% and 10.77% to 12.00% in metalized film, trend pouch, HDPE pouch and LDPE pouch respectively. This may be due to water-vapour transmission through packaging materials. Gopal *et al*., (1988) reported that the Low Density Polythene (LDPE) has high gas and moisture transmission rates. Hence increase in moisture content is higher in this pack. Increase in moisture content during storage has been reported by several workers. Gopal *et al*. (1988) reported that the moisture content of prawn soup powder was increasing from initial value of 5.63% to 9.15% after six months, when packed in Low Density Polythene -High Density Polythene (LDPE-HDPE) co-extruded film packaging. The moisture content of dried fish-cereal mixture was also found to increase from 9.14% to 11.92% upto 240 days of storage (Basu, 1990).

Warang *et al*., (2005) reported that the moisture content of soup powder made by using Croaker fish was increased after 120 days of storage from 7% to 8.19%, 7% to 8.23% and 7% to 8.31% in trend pouch, HDPE pouch and LDPE pouch respectively.

Yadav (2008) reported that the moisture content of seaweed soup powder prepared from dried powder of *Sargassum tenerrimum* was increased after 90 days from 9.01% to 10.46% in trend pouch.

Wartha (2012) reported that the moisture content of soup powder made by using Tilapia fish was increased after 90 days of storage from 1.74% to 2.19%, 1.74% to 2.85%, 1.74% to 2.93% and 1.74% to 2.99% in metalized film, trend pouch, HDPE pouch and LDPE pouch respectively.

Changes in pH of fish soup powder:

In the present study, the pH showed slight increasing trend from the initial value of 6.70 in all the four packs i.e. metalized film pouch, trend pouch, HDPE pouch and LDPE pouch. The increase in pH content may be due to increase in moisture and bacterial activity.

Cobb and Hyder (1972) discussed the effect of pH on protein recovery from fish muscle during the production of fish protein concentrate. The protein recovery was 54% at pH 2 and at pH 7 the protein recovery was 48%.

Warang *et al*., (2005) reported increasing trend of pH in the stored material during the storage period of 4 months and attributed the increase to increase in moisture and bacterial activity. Yadav (2008) reported that the pH of seaweed soup powder was increased from the initial value 5.53 to 6.0 after 3 month of storage.

Wartha (2012) reported that soup powder stored in metalized film, trend pack, HDPE pouch and LDPE pouch also showed increasing trend of pH during the storage period of 3 months.

Storage (in days)	**Metalized film (%)**	**Trend pack (%)**	**HDPE pouch (%)**	**LDPE pouch (%)**
0	10.77	10.77	10.77	10.77
15	10.78	10.80	10.87	10.90
30	10.81	10.85	10.92	11.10
45	10.85	10.94	11.15	11.30
60	10.90	11.12	11.28	11.48
75	11.00	11.22	11.40	11.65
90	11.05	11.35	11.58	12.00

Storage (in days)	Metalized film	Trend pack	HDPE pouch	LDPE pouch
0	6.70	6.70	6.70	6.70
15	6.71	6.71	6.72	6.74
30	6.72	6.73	6.75	6.77
45	6.74	6.77	6.80	6.83
60	6.80	6.83	6.85	6.88
75	6.84	6.88	6.90	6.95
90	6.90	6.92	6.97	7.0

Changes in TVB-N values of fish soup powder:

In the present study, TVB-N values showed an increasing trend. Total Volatile Base-Nitrogen (TVB-N) value is the index of spoilage. The spoilage is accompanied by release of several volatile compounds like Trimethyl amine, ammonia etc. The recommended upper acceptable limits vary from 30-60 mg % (Balachandran, 2001).

In the present work though the value showed increasing trend, after three months of storage period, TVB-N values were found to be 23.5 mg %, 23.5 mg %, 26.4 mg % and 22.7 mg % in metalized film, trend pouch, HDPE pouch and LDPE pouch respectively, which were below the acceptable limits.

Katadi (2000) working on similar line reported an increase in TVB-N values of prawn wafers along with extended storage.

Warang *et al*., (2005) reported that the TVB-N values of soup powder made by using Croaker fish was increased after 120 days of storage from 23.2 mg % to 23.4 mg %, 23.2 mg % to 23.4 mg % and 23.2 mg % to 23.7 mg % in trend pouch, HDPE pouch and LDPE pouch respectively.

Wartha (2012) reported that the TVB-N values of soup powder made by using Croaker fish was increased after 90 days of storage from 22.3 mg %, 22.4 mg %, 22.4 mg % and 22.6 mg % in metalized film, trend pouch, HDPE pouch and LDPE pouch respectively.

Changes in peroxide value (PV) of fish soup powder:

PV is a measure of degree of oxidation of fat hence termed as index of spoilage due to oxidative rancidity. The upper acceptable limit for peroxide value is between 10-20 milimoles of oxygen per kg of fat (Balachandran, 2001).

Storage (in days)	Metalized film (mg %)	Trend pack (mg %)	HDPE pouch (mg %)	LDPE pouch (mg%)
0	23.2	23.2	23.2	23.2
15	23.2	23.2	23.2	23.2
30	23.2	23.2	23.2	23.3
45	23.2	23.2	23.3	23.4
60	23.2	23.3	23.4	23.5
75	23.4	23.4	23.5	23.6
90	23.5	23.5	23.6	23.7

In the present work, the initial peroxide value was 1 and after 3 months of storage period, it increased to 1.2, 1.3, 1.5 and 2.4 in metalized film, trend pouch, HDPE pouch and LDPE pouch respectively, which were below the acceptable limits.

Gopal *et al.*, (1988) reported that the increase in peroxide value is due to high oxygen transmission rate of LDPE pack. The values ranged from 1.0 to 2.2 milimoles of oxygen per kg of fat in LDPE pouch sample. The values increased but within the level of acceptance (10-20 milimoles of oxygen per kg of fat).

Venugopalan and James (1969) reported the increasing trend of PV of fish soup mix during shelf life studies. Katadi (2000) determined the PV content of prawn wafers and also found an increase in peroxide value along with extended storage.

Warang *et al*., (2005) reported that the peroxide values of soup powder made by using Croaker fish was increased after 120 days of storage from 0 to 0.1 milimoles of oxygen per kg of fat and 0 to 1.75 milimoles of oxygen per kg of fat in HDPE pouch and LDPE pouch respectively. In trend pouch it remained 0 milimoles of oxygen per kg of fat throughout the storage period.

Wartha (2012) reported that the peroxide values of Tilapia soup powder was 1 and after 3 months of storage period, it increased to 1.1, 1.2, 1.3 and 2.2 in metalized film, trend pouch, HDPE pouch and LDPE pouch respectively.

Changes in microbial characteristics of fish soup powder:

Changes in Total Plate Count:

The TPC showed an increasing trend in all the packs. The limits for TPC are $5x10^5$ cfu/g. for fresh/chilled/frozen fishery products and for cooked/boiled fishery products it is $1x10^5$ cfu/g. (EIA, 1995).

In the present study though the trend is increasing till storage period of 90 days, the values remained within the limits i.e. $2.0x10^3$ cfu/g., $2.2x10^3$ cfu/g., $2.5x10^3$ cfu/g. and $4.5x10^3$ cfu/g. in metalized film, trend pouch, HDPE pouch and LDPE pouch respectively. The reason for slight increase in content may be presence of moisture in product itself. In LDPE pouch the increasing moisture due to high vapour moisture transmission rate of pack may contribute the increasing TPC.

Venugopalan and James (1969) while working on identical lines reported that on storage at 37^0 C, the TPC decreased from initial value of $6.1x10^4$ cfu/g. to $7.5x10^3$ cfu/g. after eight weeks of storage. Basu (1990) while studying the storage characteristics of dried fish-cereal mixture reported that the TPC was increasing from initial value of $1.5x10^2$ cfu/g. to $1.9x10^7$ cfu/g. after 240 days of storage.

Storage (in days)	**Metalized film**	**Trend pack**	**HDPE pouch**	**LDPE pouch**
	(Milimoles of oxygen/ kg of lipid)			
0	1	1	1	1
15	1	1	1	1.2
30	1	1	1	1.4
45	1	1	1.1	1.6
60	1	1.1	1.2	1.8
75	1.1	1.2	1.3	2
90	1.2	1.3	1.5	2.4

Warang *et al*., (2005) reported that the TPC of soup powder made by using Croaker fish was increased after 120 days of storage from the initial value $2.0x10^3$ cfu/g. to $2.2x10^3$ cfu/g, $2.5x10^3$ cfu/g and $7.0x10^3$ cfu/g in trend pouch, HDPE pouch and LDPE pouch respectively.

Yadav (2008) reported that the TPC of seaweed soup powder prepared from dried powder of *Sargassum tenerrimum* was increased after 90 days from the initial value $2.0x10^3$ cfu/g. to $2.2x10^3$ cfu/g, in trend pouch.

Wartha (2012) reported that the TPC of soup powder made by using Tilapia fish was increased after 120 days of storage from the initial value $2.0x10^3$ cfu/g., $2.2x10^3$ cfu/g., $2.5x10^3$ cfu/g. and $4.5x10^3$ cfu/g. in metalized film, trend pouch, HDPE pouch and LDPE pouch respectively.

Changes in mould count:

Absolutely no mould growth was observed till the end of storage period (i.e. 90 days) in soup powders packed in metalized film, trend pouch, HDPE pouch and LDPE pouch in present storage study. The present observation of total absence of mould in fish soup powder during storage is in agreement with Basu (1990) in case of dried fish-cereal mixture wherein there was no mould growth at the end of 175 days of storage.

Changes in other pathogenic organisms:

The pathogenic organisms such as *E.coli, Salmonella* and *Staphylococci* were found to be absent during entire course of storage study. This may owe to the perfect hygiene maintained during the entire process of soup powder preparation.

Storage (in days)	**TPC (cfu/g.)**			
	Metalized film	**Trend pack**	**HDPE pouch**	**LDPE pouch**
0	$2.0 x10^3$	$2.0 x10^3$	$2.0 x10^3$	$2.0 x10^3$
15	$2.0 x10^3$	$2.0 x10^3$	$2.0 x10^3$	$2.0 x10^3$
30	$2.0 x10^3$	$2.0 x10^3$	$2.0 x10^3$	$3.0 x10^3$
45	$2.0 x10^3$	$2.0 x10^3$	$2.0 x10^3$	$3.4 x10^3$
60	$2.0 x10^3$	$2.0 x10^3$	$2.1 x10^3$	$3.7 x10^3$
75	$2.0 x10^3$	$2.1 x10^3$	$2.3 x10^3$	$4.0 x10^3$
90	$2.0 x10^3$	$2.2 x10^3$	$2.5 x10^3$	$4.5 x10^3$

Storage (in days)	**Mould count (cfu/g.)**			
	Metalized film	**Trend pack**	**HDPE pouch**	**LDPE pouch**
0	Nil	Nil	Nil	Nil
15	Nil	Nil	Nil	Nil
30	Nil	Nil	Nil	Nil
45	Nil	Nil	Nil	Nil
60	Nil	Nil	Nil	Nil
75	Nil	Nil	Nil	Nil
90	Nil	Nil	Nil	Nil

*ND = Not detected

The bacteriological characteristics of fish soup powder (Gopakumar *et al*., 1974) and fish soup mix (Venugopalan and James., 1969) revealed that there was total absence of pathogenic micro-organisms such as *E.coli, Salmonella, Vibrio, Staphylococci* and *Streptococci* etc.

Storage (in days)	**Staphylococci, Salmonella, E.coli**			
	A	**B**	**C**	**D**
0	ND	ND	ND	ND
15	ND	ND	ND	ND
30	ND	ND	ND	ND
45	ND	ND	ND	ND
60	ND	ND	ND	ND
75	ND	ND	ND	ND
90	ND	ND	ND	ND

A: Metalized film, B: Trend pack, C: HDPE pouch, D: LDPE pouch

Changes in organoleptic quality characteristics:

The organoleptic analysis during the storage of soup powder at room temperature indicated that there was decline in overall quality characteristics namely appearance, colour, odour, taste and overall acceptability etc. during storage. The appearance, colour and consistency of soup remained almost same and there were slight differences in scores throughout the storage period. The other characteristics such as odour and taste decreased with extended storage. Compared to metalized film, trend pouch and HDPE pouch, the decline in quality was faster in LDPE pouch. After three months of storage, the colour of LDPE sample became dark (score 5.1) and there was slight off odour (score 5.3). According to panelists organoleptic evaluation, the soup powder packed in LDPE pouch appeared to be slightly poor after storage of three months on overall acceptability criteria. The decline in quality was slowest in sample packed in metalized film and organoleptic evaluation showed that it scored highest points in all four types of packaging material used.

Gopakumar *et al.* (1974) also carried out the organoleptic evaluation of fish soup powder depending on overall acceptability criteria during storage at room temperature. The results of which revealed that the product, fish soup powder was acceptable up to four months when stored at ambient conditions.

Warang *et al*., (2005) carried out the organoleptic evaluation of fish soup powder made by using Croaker fish depending on overall acceptability criteria during storage at room temperature. The results of which revealed that the product, fish soup powder was acceptable upto four months when stored at ambient conditions in trend pouch, HDPE pouch and LDPE pouch.

Yadav (2008) carried out the organoleptic evaluation of seaweed soup powder prepared from dried powder of *Sargassum tenerrimum* during storage at room temperature proved that the soup powder was acceptable upto three months when stored at ambient conditions in trend pouch.

Wartha (2012) carried out the organoleptic evaluation of Tilapia fish soup powder packed in metalized film, trend pack, HDPE pouch and LDPE pouch depending on overall acceptability criteria during storage at room temperature. He found that the decline in quality was slowest in sample packed in metalized film and organoleptic evaluation showed that it scored highest points in all four types of packaging material used whereas the soup powder packed in LDPE pouch appeared to be slightly poor after storage of three months on overall acceptability criteria.

Conclusion

The use of four different types of packages namely Metalized film, Trend pouch, HDPE pouch and LDPE pouch for storing the soup powder revealed that the metalized film pouch was the best packaging material for storing the fish soup powder. The biochemical, microbiological and organoleptic changes were minimum in the

metalized film pouches stored fish soup powder.

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