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Packaging of *Shidal*: The Present Need for the Markets in North East India

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ABSTRACT

Shidal is a popular and widely consumed fermented fish product especially in North-Eastern part of India. Fermented fish products are liable to get contaminated with various human health hazards, biological as well as chemical during handling and marketing. Use of improper packaging material could cause unintentional adulteration of *shidal* which can lead to deterioration of *shidal* quality. Therefore, this study was aimed at identification of appropriate packaging material which is significant for food safety and hygienic marketing of *shidal*. The study was conducted at ambient conditions with three packaging materials such as retort pouch, polyester-polyethylene laminate and polyethylene pouch, respectively against a control. Quality indices such as pH, water activity (a_w), Free fatty acids (FFA), Peroxide value (PV), Total volatile base nitrogen (TVBN) and Thiobarbituric acid reactive substances (TBARS) were analyzed. On 90th day of study, pH, a_w and microbial load in *shidal* packed with retort pouch was recorded as 6.05, 0.85 and 6.08 log cfu/g, respectively. The results demonstrated that retort pouch could be considered as the appropriate packaging material for *shidal* due to its ability to preserve desirable biochemical and microbial qualities of *shidal* to a better extend as compared to other two packaging materials.

Key Words: Fermented fish, health hazard, North-East India, *shidal* packaging.

INTRODUCTION

Fermented fish is a healthy fish product with numerous health benefits. It is rich in essential fatty acids, amino acids, vitamins, minerals and reported to possess bioactive compounds, antioxidant properties and various other physiological benefits (Tamang and Kailasapathy, 2010). In North-Eastern India, fermented fish products serve as a regular source of animal protein in the diet of people. Some of the common fermented fish products are *ngari* and *hentak* in Manipur, *tungtap* in Meghalaya, *puthi shidal*, *phasa shidal* & *lona ilish* in Tripura, *nghaum*, *nghathu* & *dan pui thu* in Mizoram, *ngyii papi* inm Arunachal Pradesh, *seedal* in Assam etc. (Thapa *et al*, 2004, 2006, 2007). The demand for good quality s*hidal* is very high in this region of India. However, due to diverse nature of raw material, fermentation techniques, storage environment and retailing behaviour, there exists significant difference in quality and microbial loads among fermented fish products of North-East India. Unhygienic handling, cross contamination and unfavorable storage condition are found to be the key factors responsible for inferior quality of *shidal*. Nevertheless, these issues could be overcome by implementing suitable packaging system. But use of improper packing material could leads to oxidation of nutrients and cross contamination with human health hazards. Several local vendors are observed selling *shidal* by wrapping them with old newspaper, which is a harmful practice. This could implicate significant health hazards as the inks used for printing newspaper are reported to contain multiple bioactive compounds such as naphthylamin, benzidine and 4-aminobiphenyl, which are carcinogens (Chemical Today Magazine,

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FSSAI, 2017). These compounds could migrate into *shidal* when comes in contact and could affect the health of the consumers. Understanding the negative effect of newspaper's ink on human health, Food Safety and Standards Authority of India (FSSAI) has even released a restriction note to discourage use of newspapers for packing and storage of all forms of foods (FSSAI, December 2016).

Therefore, it is a high time to replace the inappropriate packaging material of *shidal* with suitable ones so that the consumers could obtain the maximum health benefits from *shidal*. Hence, there is an urgent need to popularize packaging of *shidal* with suitable packaging material to prevent quality deterioration, cross contamination and food loss.

MATERIALS AND METHODS

The samples were procured from fermented fish manufacturer nearby Agartala, Tripura. The control sample (Fig. 1) was kept in petridish covered with lid and the remaining samples were packed in different packaging materials such as polyester-polyethylene laminate (Fig. 2), polyethylene pouch (Fig. 3) and retort pouch (Fig. 4) in order to assess their suitability as *shidal* packaging material. These samples were stored at ambient condition and studied for a period of 90 days.

pH was determined using digital pH meter (Eutech tutor pH/ ºC meter, Singapore). A ratio of 1:10 (w: v) sample to distilled water was taken for preparing homogeneous mixture using homogenizer (Polytron system PT 2100, Kinematica, AG, Germany). Water activity of the samples was measured directly using water activity meter (AquaLab Series 3, Decagon Devices, USA).

Fig 1. *Shidal* in petriplate (Control)

Fig 2. *Shidal* in Polyester-polyethylene laminate (PES-PE) pouch

Fig 3. *Shidal* in Polyethylene (PE) pouch

Fig 4. *Shidal* in Retort pouch (transparent)

Aerobic plate count (APC), Free fatty acids (FFA) and peroxide value (PV) were estimated according to AOAC (2016). APC was expressed as log cfu/g. FFA was expressed as percentage oleic acid while PV was expressed as meq. O_2kg^{-1} of lipid, respectively. Total volatile base nitrogen (TVBN) was estimated according to Conway's method (1947). Thiobarbituric acid reactive substances (TBARS) was estimated according to method described by Tarladgis *et al* (1960) and expressed as mg of malonaldehyde (MDA) kg^{-1} of lipid. The wavelength of the samples was measured at 538 nm.

RESULTS AND DISCUSSION

The results demonstrated significant variation in quality attributes of *shidal* with respect to packaging

Table 1. Changes in biochemical quality of packaged *shidal* at different storage period.

Days	Quality Parameter	Control	PES-PE	PE	RP
Day 1	pH	5.41±0.00	5.41±0.00	5.41±0.00	5.41±0.00
	Water activity (a_w)	0.75±0.00	0.75±0.00	0.75±0.00	0.75±0.00
	FFA (% oleic acid)	26.24±1.19	25.22±0.64	26.20±0.97	25.11±0.13
	PV (meq O_2/100g)	20.46±1.63	20.25±0.54	20.33±0.62	20.47±0.69
	TVBN (% mg/100g)	50.18±2.36	49.88±2.72	50.45±1.51	49.75±2.83
	TBARS (mg malonaldehyde/kg)	2.04±0.00	2.07±0.10	2.08±0.03	2.05±0.07
Day 5	pH	5.78±0.03	5.72±0.02	5.72±0.08	5.70±0.03
	Water activity (a_w)	0.77±0.00	0.76±0.00	0.77±0.00	0.76±0.00
	FFA (% oleic acid)	30.3±1.00	28.36±0.28	29.10±0.34	28.25±0.31
	PV (meq O2/100g)	23.73±0.60	22.32±0.85	23.08±0.72	21.07±0.75
	TVBN (% mg/100g)	62.47±1.17	57.85±0.52	60.87±0.27	55.36±0.60
	TBARS (mg malonaldehyde/kg)	3.18±0.16	3.87±0.37	3.70±0.22	2.31±0.29
Day 20	pH	6.10±0.00	5.82±0.01	5.94±0.00	5.78±0.02
	Water activity (a_w)	0.82±0.00	0.81±0.00	0.84±0.00	0.77±0.00
	FFA (% oleic acid)	45.2±0.83	35.55±1.17	39.45±0.52	30.10±0.75
	PV (meq O_2/100g)	30.23±1.23	27.16±1.27	28.20±0.37	25.14±0.30
	TVBN (% mg/100g)	70.13±1.01	63.45±0.45	65.98±0.68	60.11±0.13
	TBARS (mg malonaldehyde/kg)	3.95±0.33	3.64±0.33	3.08±0.26	2.44±0.26
Day 40	pH	6.37±0.01	6.08±0.03	6.12±0.02	5.72±0.01
	Water activity (a_w)	0.90±0.00	0.86±0.00	0.88±0.00	0.80±0.00
	FFA (% oleic acid)	58.76±1.29	46.99±0.72	51.15±0.37	43.58±0.43
	PV (meq O_2/100g)	40.24±0.32	34.45±0.23	37.62±0.49	30.35±0.68
	TVBN (% mg/100g)	85.19±0.86	70.12±0.20	78.61±0.54	67.85±0.24
	TBARS (mg malonaldehyde/kg)	4.16±0.30	3.61±0.25	4.75±0.34	2.52±0.26
Day 60	pH	6.52±0.07	6.08±0.02	6.33±0.03	5.85±0.02
	Water activity (a_w)	0.92±0.00	0.85±0.00	0.90±0.00	0.83±0.00
	FFA (% oleic acid)	65.14±0.31	50.62±0.73	58.36±0.67	48.95±0.69
	PV (meq O_2/100g)	45.92±1.45	34.73±0.52	41.16±0.60	33.25±0.54
	TVBN (% mg/100g)	102.49±0.32	80.35±0.71	90.05±0.70	71.33±0.61
	TBARS (mg malonaldehyde/kg)	5.50±0.32	4.55±0.30	5.04±0.17	3.83±0.26
Day 90	pH	6.67±0.03	6.28±0.06	6.43±0.09	6.05±0.04
	Water activity (a_w)	0.94±0.00	0.88±0.00	0.92±0.00	0.85±0.00
	FFA (% oleic acid)	68.21±0.29	59.46±0.29	62.33±0.12	55.14±0.13
	PV (meq O_2/100g)	50.25±0.58	39.91±0.38	45.27±0.60	30.12±0.20
	TVBN (% mg/100g)	150.92±0.32	96.49±0.35	120.94±0.54	75.05±0.45
	TBARS (mg malonaldehyde/kg)	5.26±0.39	4.15±0.25	5.07±0.34	3.34±0.11

PES-PE: Polyester polyethylene; PE: Polyethylene; RP: Retort pouch ;FFA- free fatty acid; PV- peroxide value; TVBN- total volatile base nitrogen; TBARS- Thiobarbituric acid reactive substances.

materials used for storage. This signifies the need for use of suitable *shidal* packaging material in order to preserve the nutritive quality and prevent unwanted cross contamination with human health hazards.

pH

pH plays an important role in food safety and quality which is also true for fish and fishery products. pH is considered as an important determinant and hurdle of microbial growth and the high pH aquatic food has a higher spoilage potential and a shorter shelf life (Newton and Gell, 1981). The highest pH recorded was 6.67 in control sample followed by 6.43 packed in PE pouch and the lowest pH was recorded 6.05in retort pouch at 90th day of storage. A higher pH of *shidal* may be attributed to the higher content of volatile nitrogen compounds (Muzaddadi, 2013). Similar results were reported by Majumdar *et al*., (2004 & 2016) in market samples of Tripura puthi *shidal*, phasa *shidal* and *lona ilish* with pH value of 5.86±0.11, 6.62±0.07 and 5.66±0.06 respectively.

Water activity (a_w)

Water activity (a_w) is an important hurdle for the growth of microbes in the food systems. In fermented fish products also water activity can have significant role which aids in its preservation and shelf life. The results of a_w are presented in Table 1. Initial a_w of *shidal* had a value of 0.75 and was recorded to maximum value of 0.94 in control and lowest value of 0.85 in retort pouch packed sample at 90th day of storage. The results demonstrated that the packed *shidal* sample had minimal changes in a_w unlike in the control sample which might be due to high moisture barrier property of the packaging material. Water activity is observed to be more reliable indicator of food stability than moisture content (Kumar *et al*., 2017).

Changes in Biochemical quality

The results of biochemical changes are presented in Table 1. The control *shidal* was found to have highest quality deterioration and the *shidal* packed in RP showed lowest quality deterioration followed by PES-PE and PE, respectively.

Biochemical parameters such as TVBN, PV, FFA and TBARS were analyzed. TVBN values correspond to the nitrogen fraction present in the samples while PV, FFA and TBARS correspond to lipid degradation products. During fermentation, proteins are hydrolysed to amino acids, peptides and ammonia. Proteins being the major constituent of fish, their degradation results major changes during fish fermentation.

TVBN is used as an indicator of fish spoilage since its increase is related to the activity of spoilage bacteria (Ozogul *et al*, 2004). Generally, fermented fish products posses high volatile nitrogen compounds due to prolong process of protein degradation; and does not indicate spoilage. Highest TVBN (mg/100g) content was recorded in control *shidal* with a value of 150.92 and lowest in retort pouch packed *shidal* (75.05) on 90th day of storage. The high concentration of these volatile compounds however does not manifest any off-odour in *shidal*. Kakati and Goswami (2013) had reported higher TVBN content in *ngari* and *hentak*, fermented fish products of Manipur. Roy *et al* (2014), observed high level of TVBN (210.92 mg/100g) in Telesech-fermented fish product of Tripura. So, presence of volatile nitrogenous compounds in desirable quantity does not make the products unacceptable rather they were necessary constituents in the fermented fish products.

Fish used for manufacture of *shidal* viz, *Puntius* sp., contains good amount of PUFA due to which they undergo rancid very quickly by the process of oxidation. In the present study, highest FFA, PV and TBARS content were recorded in control *shidal* with a value of 68.21(% oleic acid), 50.25 (meqO_2/Kg lipid) and 5.26 (mg MDA/kg), respectively. While lowest was recorded in RP packed *shidal* with a value of 55.14 (% oleic acid), 30.12 (meqO_2/Kg lipid) and 3.34 (mg MDA/kg), respectively. Higher PV and FFA values in control *shidal* indicated higher degradation of lipid by oxidative free radicals and enzymatic hydrolysis due to direct exposer to atmospheric condition unlike the packed samples. High levels of unsaturated fatty acids may be responsible for deterioration in quality of *shidal* on exposure to air (Majumdar *et al*, 2009).

In the present work, lower TBARS content was observed which is an indication of limited secondary lipid oxidation in the product. Similar TBARS value were also reported by other authors in related fermented fish products (Sarojnalini and Suchitra, 2009). The lower levels of TBARS in the products could be due to the unstable nature of carbonyls which react easily with other compounds (Auborg *et al*, 1997). TBARS also react and breakdown thus may not necessarily accumulate.

Changes in microbial load

The bacterial load in *shidal* may be attributed from various sources such as soil, containers used for fermentation, fish handlers, insects, flies and the original bacterial load of the dried fish used as raw material for *shidal* production. The microbial load of control and packaged *shidal* at different storage period is presented in Fig 5. Highest bacterial load was observed in control sample with a value of 9.45 log cfu/gand the lowest was recorded in *shidal* packed with RP with a value of 6.08 log cfu/g followed by PES-PE and PE, respectively. However, not much difference in microbial counts was observed between PES-PE, PE and RP.

Aerobic plate counts (APC) generally do not relate to food safety hazards, but indicates quality, shelf life and post processing contamination. These bacteria degrade fish protein leading to the production of various volatile compounds from amino acids as well as small peptides (Lopetcharat and Park, 2002). Study conducted by Muzaddadi (2002) also showed a higher bacterial count of 6.5 to 8.0 log cfu/g in *shidal* prepared with 2% and 5% salt. The BIS and ICMSF standard specifies bacterial load of 5 x10^5 cfu/g as acceptable limit for fresh fish but this limit may not be applicable for fermented products as higher count are expected in case of fermented fish product, particularly in the salt-free fermented fish like *shidal*. Therefore, though these bacteria are observed at higher count, they are not harmful being the fermentative flora.

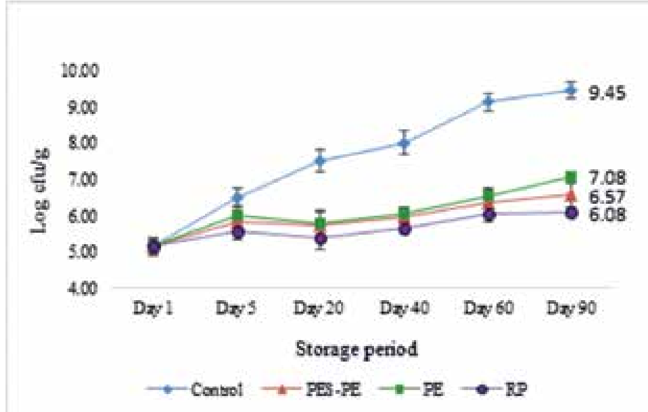

Fig 5. Microbial load (APC) of packaged *shidal* at different storage period

CONCLUSION

The present study had demonstrated that packaging plays an important role in preservation of *shidal* quality by delaying nutrients degradation and preventing cross contamination. Transparent retort pouch (RP)and polyester-polyethylene (PES-PE) laminate showed least nutrients degradation during the storage period of 90 days and also maintained lower microbial load comparatively. Thus, these two potential packaging material could be used as an appropriate packaging materials for *shidal* which could improve quality, safety and economic value of the product.

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