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Effect of egg albumen (protein additive) on surimi prepared from lizardfish (*Saurida tumbil*) during frozen storage

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Abstract. Lizardfish (*Saurida tumbil* (Bloch, 1795)) is a relatively abundant, low value fish that has wide distribution in India due to its adaptability to different environments. This study is an attempt to explore the possibilities of better utilization of this species by development of minced-based value added products and the evaluation of shelf life during frozen storage. Lizardfish were mince for the preparation of value added products viz., surimi and surimi with 3% egg albumen. The biochemical, gel strength and sensory parameters were analyzed to study the quality changes and shelf life of these products in frozen storage at -20°C. The addition of 3% egg albumen exhibited gel enhancing effect by increase in gel stregth 113.56 g.cm, where as same treatment after 120th days of storage, % of total protein was higher 12.69 with comapare to without egg albumen surimi.
Keywords: lizardfish, *Saurida tumbil,* surimi, egg albumen, frozen storage.

Introduction. Lizardfish (*Saurida tumbil* (Bloch, 1795)) is not preferred as a table fish in fresh condition due to its unfamiliar appearance. They are caught in large quantities by the shrimp trawlers and are low priced compared to other commercial varieties. Lizardfish is a lean fish with high flesh content, delicate and susceptible for spoilage (Sharma 1989). Surimi is a wet, frozen concentrate of the myofibrillar proteins of fish muscle (Lanier 1986). The presence of endogenous proteolytic enzymes in fish mince or surimi results in a decrease in gel strength with a brittle and non elastic gel (Alvarez et al 1995). To alleviate the problems associated with protein degradation caused by the endogenous proteinases, inhibitors and other additives have been used in surimi gels (Benjakul & Visessanguan 2000; Lee et al 2000; Benjakul et al 2001). Many compounds of protein nature have been used in best to improve the gel physical properties of surimi and control proteolysis. These compounds are called protease inhibitors (Kuhn et al 2004). Egg white is the most common available food grade inhibitor. Egg white contains of at least two protease inhibitors, Cystatin and Ovomucoid (Patricio 2002).

Benjakul et al (2003) found that both endogenous sarcoplasmic and myofibril-associated proteinases play an important role in degradation of myofibrillar proteins in lizardfish muscle, particularly at 60–65°C. This may lead to the lower gel quality of this species during gelation process. Therefore, the addition of some protein additives possessing the protease inhibitory activity should pave the way for gel improvement of lizardfish surimi. The objective of this study is to study the effect of egg albumen on proteolysis and gelling properties of lizardfish.

Materials and Methods

Raw Material. Fresh sized lizardfish (*S. tumbil*) with average size of average length 26.99 cm and weight 150.08 g were purchased from Veraval harbour (Gujarat). Samples

were kept in ice using the fish/ice ratio 1:1 (w/w) and transported to the Department of Fish Processing Laboratory a College of Fisheries, Junagadh Agricultural University, Veraval. Upon arrival, the fishes were washed, cleaned and processed immediately.

Chemicals. Most of the chemicals were purchased from Central Drug House (CDH) limited - New Delhi, Ranbaxy laboratories limited – SAS Nagar, Astron chemical (INDIA), Rankem – New Delhi, Chemdyes Corporation, Baroda chemical industries limited (Baroda). Agars were purchased from Hi-Media laboratories private limited (Mumbai, India). Egg albumen was obtained from Ovabel food limited (Bangalore, India).

Preparation of surimi. Surimi was prepared according to the method of Benjakul et al (2003). Fresh lizardfish were washed with tap water. The flesh was removed manually and minced into the uniformity. The mince was then washed with chilled water (5^{o}C) at a mince/water ratio of 1:3. The mixture was stirred gently for 3 min and washed mince was filtered with layer of nylon screen. The washing process was repeated twice. The washed mince referred to as 'surimi' was mixed with cryoproctants like Sucrose 4% (w/w), Sorbitol 4% (w/w), Sodium tri-poly phosphate 0.3% (w/w). In the treatment, egg albumen 3% (v/w) [Ovabel food limited, Banglore] was added to a portion of surimi with cryoproctants. The samples were mixed in Silent Cutter for 5 minutes. All samples of unwashed meat, surimi and surimi with 3% egg albumen were packed separately into polyethylene bags and subjected to freezing.

Freezing and storage. The fish meat and surimi packed in polyethylene bags were frozen in plate freezer at -40^{o}C. The total time for freezing was 90 to 100 minutes. The frozen samples were stored in Cold Storage at -20^{o}C ± 2^{o}C. Frozen sample were analyzed at periodic intervals to assess the quality with the period of storage.

Chemical, microbiological and texture analyses. The proximate composition was determined according to AOAC (2006) methods. Crude protein content was determined using the Kjeldahl method (AOAC, 2006). Crude lipid was determined by the soxhlet method (AOAC, 2006). Ash content was determined by ashing samples overnight at 550^{o}C. Moisture content was determined by drying samples overnight at 100^{o}C until constant weight was achieved. Total Volatile Base Nitrogen (TVB-N) and Trimethylamine Nitrogen (TMA-N) were determined by the Convey micro diffusion method of Beatty & Gibbons (1937). Peroxide Value (PV) and Free Fatty Acid (FFA) were determined according to Jacobs (1958) and Takagi et al (1984), respectively. Microbiological examinations were carried out as per AOAC (2006) methods. The gel strength of the prepared gel was measured using Electronic Rheometer (Rheotex, SD-700, Japan) by the puncture test method as described by Park (2000). For sensory evaluation a panel of three members was constituted. Sensory characteristic were evaluated for texture (Ashi) using Biting Test (Park 2000). Bite a 5 mm thick slice piece of the gel sample and evaluate its resilience upon touch to teeth and cohesiveness upon bite by 3 panelists on 10-stage merit marks.

Statistical analysis. All experiments were analyzed with three replicates. Data analyzed statistically were carried out as per factorial complete randomized design. Analysis of variance was worked out using standard statistical procedures as described by Snedecor & Cochran (1967).

Results and Discussion

Raw material characteristics. Analysis of fresh lizardfish is shown in Table 1. The yield of mince was 42.22% from the whole lizard fish. TVB value of lizardfish was 12.13 mg 100g^{-1}. Generally, TVB of fresh fish is less than 20 mg 100g^{-1} (Connell 1990). The test values for oxidative rancidity, Peroxide Value (PV) and Free Fatty Acid value (FFA) were also found to be within the limit of fresh fish with no sign of rancidity. The fat content of this fish was 1.89. It could be concluded that lizardfish was a lean fish because its fat content was less than 4% (Spinelli & Dassow 1982). This result was different from experiments on lizardfish in Japan reported by Suwansakornkul et al (1993) whose fat content of *Saurida undosquamis* (Richardson, 1848), *Saurida wanieso* Shindo & Yamada, 1972 and *Saurida elongata* (Temminck & Schlegel, 1846) were less than 1%.

Table 1

Raw material characteristics

Physical characteristics	*Mean ± S.D.*
Total lenght (cm)	26.99 ± 4.01*
Standard lenght (cm)	23.02 ± 3.49*
Weight of fish (g)	150.08 ± 87.47*
Yield of picked meat (from whole fish)(%)	42.22 ± 3.03
Chemical characteristics	
TVB-N (mg %)	12.13 ± 1.62
TMA-N (mg %)	2.80 ± 0.00
PV (milliequivalent of O2 / Kg of fat)	3.80 ± 0.10
FFA value (% of oleic acid)	0.11 ± 0.00
Microbiological characteristics	
(TPC) per gm of sample (log colony-forming units/g)	4.75 ± 0.18
Sensory characteristics	
Appearance	7.76 ± 0.67
Odour	8.51 ± 0.75
Texture	7.88 ± 0.27
Over all acceptability	8.05 ± 0.56
Proximate composition (%)	
Moisture	78.43 ± 0.03
Total Protein	17.15 ± 0.09
Total Lipid	1.89 ± 0.01
Total Ash	1.59 ± 0.01

*n = 100

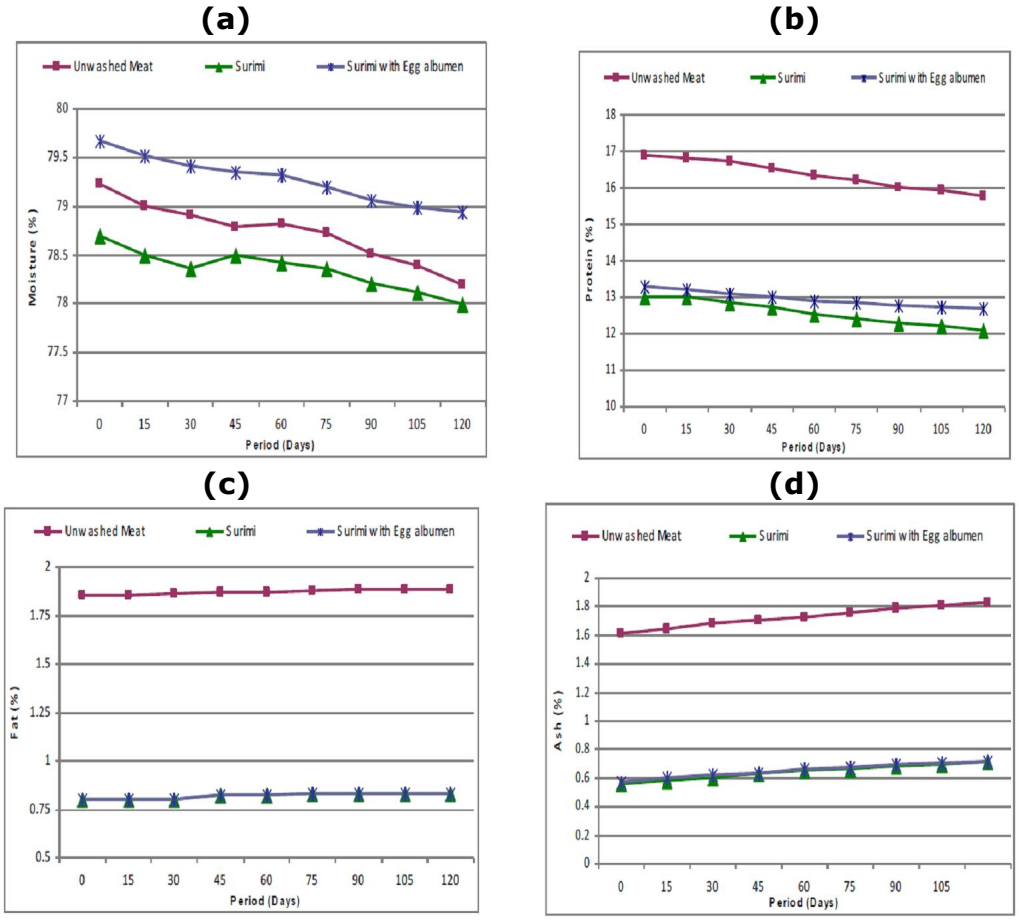

Figure 1. Changes in proximate composition during frozen storage: (a) moisture, (b) protein, (c) fat, (d) ash.

Frozen storage characteristics. Proximate compositions of each sample are shown in Figure 1. During frozen storage the moisture content of all the samples decreased gradually. It is usual to find reduction in moisture content of fish and fishery products during frozen storage because of dehydration (Joseph & Perigreen 1988). A significant decrease in the protein content was observed as a result of frozen storage. This could be connected with denaturation of fish protein that is associated with frozen fish (Reay 1933). Moisture and protein decreasing results have been reported with bigeye snapper (*Priacanthus hamrur* (Forsskal, 1775)) surimi (Singh et al 2004). The total lipid content of all the three samples remained more or less stable during 120 days of frozen storage. No significant change was noted in the fat content. The similar trend of fat content obtained in mackerel increased during frozen storage (Lakshmisha et al 2008). The ash content, which is a measure of total mineral in the fish meat, has shown slight increase of no significant importance.

TMA-N a breakdown product of TMAO (Trimethylamine N-oxide), which serves as a good index of textural changes during storage (Regenstein 1984). In present study TMA-N of all samples increased slightly during storage period. The increasing of TMA-N content during the storage of meat and surimi may be due to enzymatic degradation of TMAO to TMA. A marked increased in tri methylamine-N-oxide demethylase (TMAOase) activities was observed in minced of *Saurida micropectoralis* Shindo & Yamada, 1972 during frozen storage (Leelapongwattana et al 2005).

Concerning the TVB-N value (Figure 2) increase during frozen storage, same increasing trend found in frozen minced fish (Vareltzis et al 1997, Suvanich et al 2000). This increase can be explained as a result of the breakdown of endogenous compounds into non-protein N-compound. It was recommended that the total volatile base (TVB-N), which is the most significant criteria for defining the fish quality, should not be over 30-35 mg $100g^{-1}$ in fish meat (Huss 1988). TVB-N value increased during the storage, but stayed within the quality limits. However, according to the present results, previous studies account for a TVB-N content increase during the frozen storage of minced muscle (Vereltzis et al 1997; Siddaiah et al 2001).

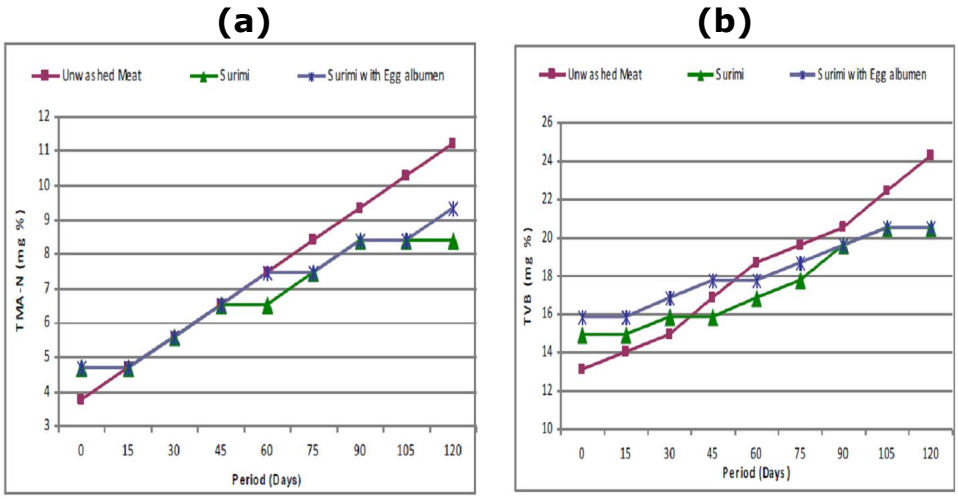

Figure 2. Changes in chemical characteristics during frozen storage: (a) TMA-N, (b) TVB.

Gel-forming ability defined by gel strength (g/cm^2) of unwashed and surimi of lizardfish meat is shown in Table 2. The highest gel strength was obtained in gel prepared from surimi with 3% egg albumen than other samples. Egg white contains several proteinase inhibitors, namely ovoinhibitor, ovamacroglobulin, which has inhibitory activity against serine proteinase (Nakamura & Doi 2000). Egg white at various concentrations (0-3%) was used by Eakpetch et al (2008) in Pacific white shrimp (*Litopenaeus vannamei* (Boone, 1931)) meat. All sample of *L. vannamei* showed increased in breaking force of gel.

The decreasing gel forming ability with increasing frozen storage is the manifestation of the changes in protein structure and extent of denaturation. A similar report of reduction in gel strength of frozen surimi made from *Oreochromis mossambicus* has been reported by Murthy et al (2011).

Table 2

Changes in gel strength (g x cm) in frozen samples during storage

Storage period (days)	*Unwashed meat*	*Surimi*	*Surimi with 3% egg albumen*
0	40.03 ± 0.25	94.68 ± 4.94	113.56 ± 1.72
30	31.47 ± 0.65	81.37 ± 2.22	102.07 ± 3.69
60	24.23 ± 0.46	69.48 ± 1.60	90.72 ± 0.57
90	19.11 ± 0.53	60.64 ± 0.81	80.40 ± 0.57
120	13.05 ± 0.63	50.64 ± 0.16	69.67 ± 1.82
	S.Em. ±	*C.D. at 5%*	*CV*
Treatment (T)	0.492	1.420	-
Days (D)	0.635	1.834	3.04
T x D	1.100	3.176	-

S.Em. - Standard error of mean, C.D. - Critical difference, CV - Coefficient of variance

Mean score of sensory evaluation of kamaboko prepared from unwashed meat, surimi and surimi with egg albumen were assessed using biting test described by Park (2000). The results (Figure 3) show that surimi with egg albumen registered higher score of Ashi than other samples. All unwashed meat and surimi samples showed decreasing score, similar to gel strength during frozen storage. This data further substantiate the findings of decrease in gel strength with period of storage. During storage period, decreasing in organoleptic score of surimi prepare from *P. hamrur* with increasing period was reported by Singh et al (2004). Lakshmisha et al (2008) have also reported similar decreasing score in sensory quality of *Rastrelliger kanagurta* (Cuvier, 1816).

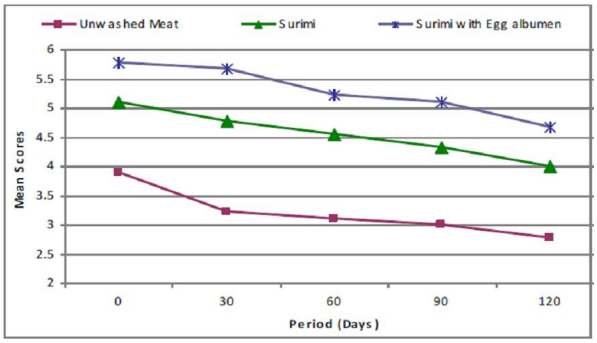

Figure 3. Changes in sensory mean scores during frozen storage.

Conclusions. Lizardfish was found to be suitable for surimi production. It possess all physical and chemical characteristics like white meat, low fat, good gelling property to fulfill the requirements of raw material for surimi production. At the same time it is cheaper than other surimi raw material and abundantly available. The weakness in gel strength if improved can enhance its potential as raw material for surimi production. Improvement in gel strength was noted in the addition of 3% egg albumen. This shows the potential of lizardfish as an alternative resource for surimi production with egg albumen as an additive to enhance its gel strength. Egg albumen has also shown inhibitory effect on proteolysis during frozen storage. Lizard fish is suitable to make surimi of low grade value unless its gel strength is further improved by food additives.

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